Analysis of a participatory approach for collection of economic data in aquaculture systems at farm level in Brazil

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Abstract

Economic assessment at the farm level requires a robust methodology in order to assure reliability. This paper describes an innovative methodology and analyzes its ability to fill a gap regarding economic methodology for farm level aquaculture in Brazil. This methodology consists of collection of technical parameters, production costs and other economic information by expert panels with value chain agents. Variables are obtained through consensus among panel participants considering the typical farm approach (TFA). All collected data are presented to producers in order to improve comprehension about their performance. A benefit of this methodology includes highly reliable data because information is provided by a representative sample of producers that confirm it in a consensus process. Moreover, data collection costs are low in comparison to individual interviews or survey methods. Continuous updating of inputs prices and the high level of participation of producers are other assets of this method. Despite its effectiveness the method presents some challenges including: (a) the heterogeneity of producer profiles and consequent difficulty in standardizing data, (b) the logistic requirements related to organization of meetings, and (c) mobilization of producers and other panel participants in order to assure their representative presence in the meeting.

Keywords: typical farmer, fish farms, production costs, panel method.

1. Introduction

Aquaculture stands out as one of the possible solutions to meet the growing global demand for human protein consumption. This is because the commercial fishing sector, though it is still approximately 59% of total fish production, has only shown stable production in recent years with around 90 million tons annually (Table 1).

Table 1: World fisheries and aquaculture production (million tonnes, 2007 to 2014)

Production/year	2007	2008	2009	2010	2011	2012	2013	2014
Capture	90,8	90,1	90,1	89,1	93,7	91,3	92,4	92,0
Aquaculture	49,9	52,9	55,7	59,0	62,0	66,6	70,5	73,9
Total world fisheries	140,7	143,1	145,8	148,1	155,7	158,0	162,9	165,9

Source: FAO, 2016.

This trend of growth in aquaculture is also occurring in Brazil (Table 2).Sector production grew by 94% between 2008 and 2014, when it reached about 562.000 tons. This increase in activity has been supported by various government actions including public policy and research.

Table 2:- Brazilian aquaculture production (thousand tonnes, 2008 to 2012)

Aquaculture production	2008	2010	2012	2014
Inland	282	394	611	474
Marine	83	85	96	88
Total	365	479	707	562

Source: FAO, 2016.

Besides the growth in recent years and government actions for the promotion of activity in Brazil, there is considerable potential to increase aquaculture production in Brazil, due to the large quantity of water resources in the country. In this context, it is important to note that much of this potential lies in hydroelectric reservoirs where aquaculture parks are being created by the Brazilian government. The 219 hydroelectric reservoirs located in 22 states cover a total area of 3.14 million hectares of surface water. According to estimates of Embrapa Fisheries and Aquaculture, considering the 37 largest reservoirs of Brazil, domestic aquaculture production could reach approximately 5 million tons (Table 3), i.e. more than 10 times the value observed for Brazilian aquaculture in 2010, which was about 479,000 tons.

Table 3: Annual aquaculture production potential in the 37 largest Brazilian reservoirs (2016)

Region	Production (tons)
Northeast	1,934,100
Southeast	1,569,660
North	872,025
Midwest	429,435
South	173,750
Total	4,978,970

Source: Own elaboration (2016).

Even considering the recent growth in production and its potential, the Brazilian aquaculture industry still has many structural problems. International trade of fish, for example, has shown increasing deficits in recent years, reaching a negative trade balance of more than US$ 1 billion in 2015, mainly due to an increase in imports (Figure 1). This fact indicates that an increase in domestic consumption of fish, which is estimated at around 14.5 kg per capita/year (Scorvo Filho, 2014), is not being absorbed only by the growth of domestic aquiculture production , but mainly by imports from Chile, China and Norway (Flores and Pedroza Filho, 2014).

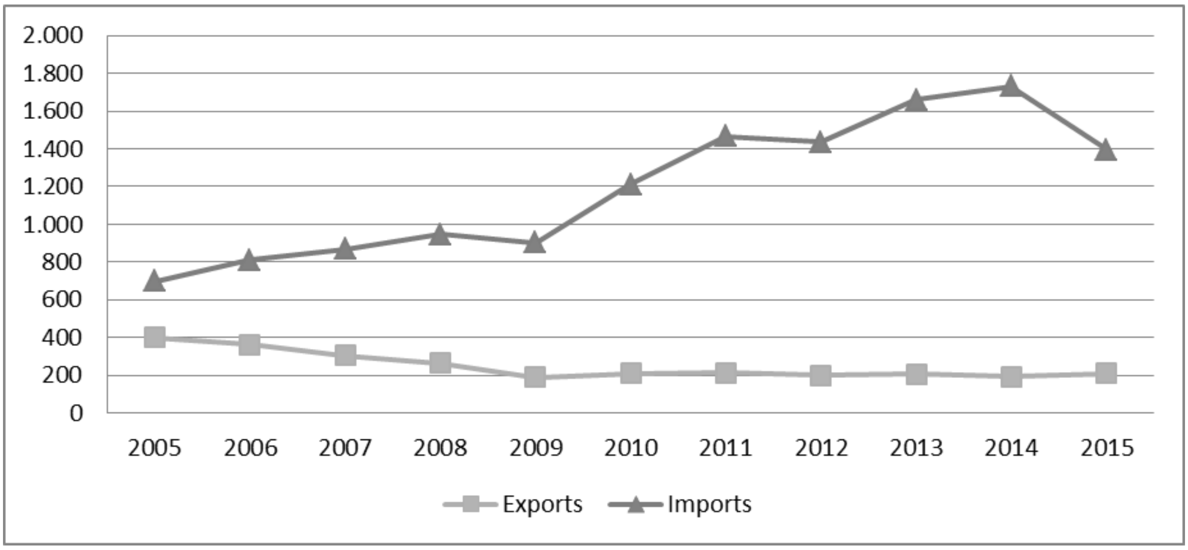

Figure 1: Brazilian fisheries trade (US$ millions, 2005 to 2015)

Source: ALICEWEB/MIDIC (2016).

There are several bottlenecks to overcome in order to achieve increases in the quantity of aquaculture farms and improvements in the quality of the national aquaculture industry. Bureaucracy to obtain licences to start an aquaculture operation, low yields, scarcity of research projects linked to the demands of the productive sector and extension programs, and inadequate commercial feeds for certain species are some of the barriers to get throught (Ostrensky et al., 2008; Rabobank, 2013; Scorvo Filho, 2013).

Another important problem to be solved in the aquaculture sector in Brazil is the difficult in generating economic data at producer level. A lack of economic information at the farm level is often one of the most important bottlenecks in the aquaculture sector, especially in developing and emerging countries (Flores and Pedroza Filho, 2014). This kind of information is crucial for decision making processes at the producer level and also to public institutions in relation to issues like insurance, credit, support policies, research, technology transfer, and extension actions. However, gathering economic data in agricultural systems at the farm level requires a sturdy methodology in order to ensure reliability of results.

To solve this problem, Embrapa (Brazilian Agricultural Research Corporation), in partnership with CNA (Brazilian Confederation of Agriculture and Livestock), have carried out, from 2014 to 2016, a research project that collected data of production costs for the main aquaculture species in Brazil. In the next sections, we will describe in detail the methodology application and discuss advantages and disadvantages of this approach.

This paper aims to describe this innovative methodology and fill a gap regarding economic data at the farm level in aquaculture using a participatory approach.

2. Theoretical Framework

According to Feuz and Skold (1990), when conducting farm level research, some difficult decisions emerge concerning the type of data on which to base the analysis. Frequently there are only few options available: 1) collect individual data from a farm or a sample of farms to be analyzed; 2) use aggregate state or regionally reported data; or 3) use synthetic farms, often referred to as the economic-engineering approach. Each of these options has its advantages and disadvantages. The advantage of collecting individual farm data is that the subsequent analyses should adequately describe the farm(s) being studied. One should be confident in the results and recommendations for that specific farm or group of farms. On the other hand, the major disadvantages of this method are the time required and the high cost for gathering individual farm data. Additionally, unless the farms were selected from a carefully designed random sample, the potential to make general statistical inferences to a broader group of farms is limited.

An advantage to using secondary published data at the state, or other aggregated level, is the data are relatively inexpensive to obtain. Nevertheless, farming in many regions is quite diverse, and average aggregate data may not be representative of any actual farming area or any particular farm (FAO, 2016).

Synthetic farms are often constructed from economic-engineering machinery budgets, agronomic crop response functions, and livestock production coefficients (FAO, 2016). According to Feuz and Skold (1990), as advantages, data collection is relatively inexpensive and results should not be biased. While these synthetic farms may represent what could or should be, they often overstate what actually is and therefore this can be a limitation in evaluating farm level data.

The creation and maintenance of a set of typical farms, as a data base, can alleviate some of the data problems associated with the other sources of data mentioned. Data can be collected, or synthesized, for a set of typical farms and be quite representative of farms in an actual area. The costs of doing this are generally less than those associated with collecting data from a large number of individual farmers (Berg and Kaiser, 2017; Feuz and Skold, 1990).

According to Feuz and Skold (1990), the analyses of typical farms can be useful to measure the effects of government policies and to compare different farm types. It can be instrumental to evaluate technological changes across farm types and to predict variables as: land values, government program participation, technology adoption, and profitability on various types of farms.

The typical farm approach (TFA) is being used by several institutions in Brazil and other countries for collecting and analyzing economic data at farm level in many different sectors such as dairy, poultry, pork, cattle, soybean, cotton, and sugarcane (Hemme *et al*, 2014; Deblitz, 2005; Pedroza *et al*, 2015, Cepea, sem data; FAO, 2016).

The inception of using typical farms in economic analysis occurred in 1928 when Elliot defined a typical farm as being a modal farm in a frequency distribution of farms of the same universe; in other words, it is representative of what a group of farmers are doing very similar things (Hemme 2014 apud Dillon and Skold 1992, AFPC 2010). By this definition, a typical farm is one that is representative of the group of farms.

In the late 1950's, Thompson carried out research using the idea of typical farms. He stated that typical farm studies allow for detailed examination and insights into the individual farm, while saving on the resources required for the study. Like Elliott, Thompson emphasized the point that typical farms should represent a modal concept and not be based on averages. He also suggested that developing a synthetic typical farm may be more appropriate than using any actual farm to represent a group of farms. (Feuz and Skold, 1990).

In 1963, Plaxico and Tweeten replaced the idea of representative farms constituting a typical or modal concept by the idea of being an average of all the farms of a group. They emphasized emphasized that representative farms should be closely tied to representative resource situations. While much of their research was at an aggregated policy level, they recognized the usefulness of representative farms as providing a framework for analyzing public policy effects on different types of farms.

TFA is applied in various regions and therefore it is possible to compare the economic performance of a same species in different geographical areas. This procedure is used in international network projects like *Agribenchmark* and IFCN (International Farm Comparison Network), aiming to compare indicators among different agricultural sectors internationally (FAO, 2016; Hemme *et al*, 2014; Deblitz, 2005).

Since TFA is based on the typical producer characterization, the quantitative and qualitative selection of the participants is essential to the success of the process. The selection of a large and very heterogeneous group of producers can hinder the efficacy of the panel by a lack of consensus among participants about the local typical farm. On the other hand, a small and homogeneous group can lead to data collection of a very particular subset – one that may not be representative of the entire region. In addition, the methodology is very dependent on the skills and viewpoints of people who carry it out (Townsley, 1996). Thus it is critical to combine a multidisciplinary team prepared with previous planning meetings as well as subsequent evaluation meetings in order to adjust and guarantee a satisfactory application of the methodology (Silva *et al.*, 2013).

Another challenger of the TFA is to assure reliable data. The panel methodology is often chosen because it offers the possibility of solving this problem by using a triangulation process. Indeed, the consistency of collected data is assured by this triangulation process in which information must be confirmed by the majority of participants in a consensus process (Townsley, 1996; Silva *et al.*, 2013). Furthermore, the presence of agents from different segments of the production chain (i.e. feed and fingerling suppliers, fish farmers, processors, wholesalers, policy makers) enhances the discussion around data collected, reinforcing the validation of the information and reducing bias (Palerud et al., 2008 apud Berg & Kaiser, 2017). These professionals play the role of advisors, since they are familiar with the reality of the producers of the region.

3. Materials and Methods

The methodology of this article consists of an analytical description of the process of data collection and analyses based on TFA, aiming the economic performance assessment of aquaculture at farm level. This method has been used, in Brazil and abroad, for economic evaluation at farm level of several other agricultural sectors such as grains, livestock, cotton, coffee and forestry (CNA, 2016; Agribenchmark, 2017).

All information is based on the research project "*Campo Futuro da Aquicultura*", carried out in the main aquaculture regions in Brazil by a partnership between Embrapa (Brazilian Agricultural Research Corporation) and CNA (National Agriculture Confederation). Since this project was based on a participatory approach, the expert panel was the method chosen to collect data from aquaculture agents (i.e. producer, input suppliers and technicians). The project aimed to develop a technical and economic characterization of the most typical aquaculture farmer of a given region, which was selected among the most representative producing areas of the country.

From a participatory perspective, the expert panel is reputed to be one of the better methods to provide economic data at farm level. This method provides a realistic and up-to-date dataset from individuals directly related to the studied sector (Coulter *et al*, 2016; Pinheiro *et al*, 2013; Leiss, 2010, Taylor *et al* 1987). One of the main aims of expert panels is to generating relevant information amongst a group of recognised experts and/or stakeholders around a set of issues (JRC-EU, 2007).

The expert panel method relies on the principle of eliciting expert knowledge from groups of individuals who deliberate upon a given topic area. This method is often used when specialized input and opinion is required for an evaluation. Generally, a variety of experts is engaged from various fields of expertise to debate and discuss subjects until they reach consensus. In the case of the mentioned project, subjects of concern include economic and technical parameters such as productivity indices, production costs, input prices, and other related information.

In the *Campo Futuro da Aquicultura* project the panel method was composed by four main steps, which were carried out in a logical sequence (Figure 2).

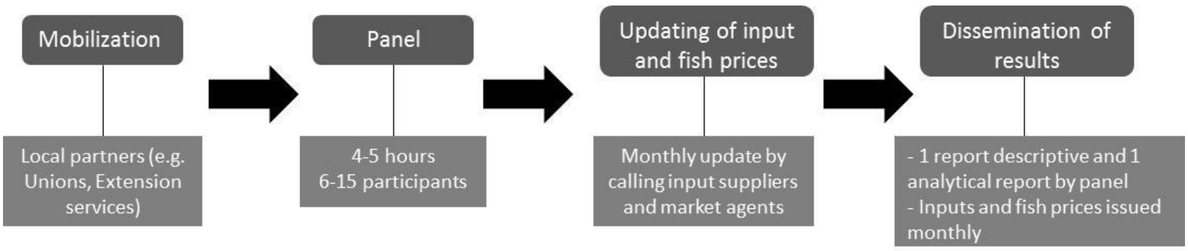

Figure 2: Four main steps of the panel method employed in the Project Campo Futuro da Aquicultura

The main steps of the expert panel method used in the mentioned research are discussed below:

a) Mobilization and panel planning

One of the first steps of the panel process concerns the choice and mobilization of experts. In the present research, the selection of the experts was focused in the main aquaculture value chain agents as fish farmers, input suppliers, consultants and extension service technicians. This phase was support by local partners as extension service agencies and farmers unions. The collaboration of local organizations was very important because of their proximity and confidence with fish famers.

The choice of panel moderator also deserved special attention in the planning. According to Snippe (2016), though the focus of a panel concerns a defined subject, this can quickly get completely off track and out of control if moderator does not keep the focus. Therefore, the main moderator role is to assure panel participants to connect with the major subject. However, the moderator should not dominate the discussion, but explore the best of the panel participants, so that their information and ideas are expressed efficiently. Moreover, moderator must to assure a homogeneous participation from all experts in order to avoid the dominance of the discussion by some more orally active ones.

Finally, the panel planning includes the development of spreadsheets for collection of the technical and economic data concerning aquaculture production. This is particularly important since each species and their respective production systems can present significant differences in terms of economic parameters. Therefore, specific spreadsheets should be prepared for different panels (e.g. tilapia farming in net cage; tambaqui in earthen ponds).

b) Panel conduction

The expert panel method was carried out by meetings which brings together fish farmers, technicians and suppliers (6 and 15 people average) (Figure 3). It is moderated by professionals with backgrounds in economics and aquaculture. During the meeting, through debate and consensus, moderators questioned the participants on technical and economic data of the prevailing production system by using the criteria of the most frequent features of the fish farms (or "typical producer") (Hoffmann, 2006; Deblitz, 2005).

The data concerns variables like farm structure and investments, technical parameters of the production system, performance indexes, spending on inputs, transaction costs, feed conversion ratio (FCR), market prices, among others, recording such information in spreadsheet specifically developed for this purpose.

Because the panel is composed of people with a wide range of experience and technical viewpoints, the discussion produces a large number of information. As consequence, divergences among participants are very often. Then, in order to reach a consensus about the best information provided by participants, moderator employs some techniques. As proposed by Spreckelmeyer (1987), one of these techniques concerns gaming or simulation that are used to sensitize the participants to the complexity of the issue and then to create the process of consensus building.

Figure 3: Panels with fish farmers in Brazil
Source: Embrapa/CNA - Campo Futuro da Aquicultura

Properties participating in the panels should be approximately the same size as the typical farm size selected. However, none of the farmers is obliged to disclose his individual farm data. Moderator asks the participants about the prevailing production system by using the criteria of the most frequent features of the typical farmer. Each statistic is determined by discussing the most frequent farm and not the farmer's own farms.

The moderator's main role is to iron out any biases which individual farmers may show. He is able to do this by knowing more farms and farmers than those participating in the panel and thus having a greater overview of the situation. Hence, the data obtained reflects an agreement among the panel participants and gives a far more accurate picture of reality and the origin of data in comparison to statistical averages derived from existing or original surveys (Deblitz, 2005).

Although the panels are focused mainly on economic data, the use of a participatory approach provides an overview of the local aquaculture production chain, which enables better comprehension of the economic analysis based on an other aspects of the activity (e.g. input supplies, marketing strategies, public policy, technological level of the farmers, transportation logistics etc.). Additionally, the panel methodology presents a low cost method when compared to individual interviews with farmers or to survey methods.

At the end of the panel, all collected data are analyzed and presented to producers in order to correct errors and to improve participants' comprehension about their economic performance in the aquaculture business. As a result, yield rates, production costs and all indicators resulting from the panel tend to be fairly close to the regional reality and provide an overview of the performance and profitability of the activity in the region.

It is important to emphasize that indexes and costs declared by each participant are not necessarily related to their properties, because these information rely on the model producer determined at the beginning of the panel. Therefore, the description of the model producer is crucial in order to fairly represent the size and the system of production of most local fish farms. However, the result does not draw statistical inferences, due to the small sample size.

One panel is promoted in each selected production zone and later data is updated on a regular basis by calling input suppliers, fish farmers and wholesalers to monitor prices and input cost variation.

c) Reporting and dissemination of panel findings

According to JRC-EU (2007), the main objetive for reporting is to disseminate analyses and findings and to present priorities and recommendations for further action. Therefore, reports should be adapted to their focused audiences.

In the present project the panel reports were peer reviewed by Embrapa team before being published. This peer revision aimed to check for factual or analytical errors and overall readability of the report. Often the draft reports were also sent to the local partners for review.

The findings generated three types of information: (a) descriptive report with the main technical and economic data collected; (b) analytical report with deeper interpretation of results (Figure 4) and (c) monthly uptade of prices concerning fish and the main inputs (i.e. fingerlings, fish feed, energy).

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Ativos AQUICULTURA

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Impactos da mancha branca nos custos de produção do camarão no Nordeste

Por Fabrício Pereira Rezende, Marcelo Matavelli

OS SISTEMAS DE PRODUÇÃO

Os sistemas de produção nos três polos de carcinicultura – Aracati/CE, Acaraú/CE e Natal/RN – monitorados pelo Projeto Campo Futuro de Aquicultura, uma parceria entre CNA/Embrapa, contam com realidades distintas nos sistemas de cultivo, as quais se encontram sumarizadas a seguir (Tabela 1).

Tabela 1. Características zootécnicas dos cultivos de camarão Litopenaeus vannamei nos polos de Aracati, Acaraú e Natal.

Sistema de produção:	Polos		
	Aracati/CE	Acaraú/CE	Natal/RN
Fase	PL12 - 10g	PL12 - 10g	PL12 - 15g
Sobrevivência (%)	70%	80%	30%
Produtividade (kg/m2/ciclo)	0,04	0,20	0,05
Ciclo (dias)	90	105	100
Área alagada (ha)	4,5	20,0	18,0
Conversão alimentar (kg Ração/ kg camarão)	1,4	1,3	1,6
Produção (kg/ha)	11.025	40.000	8.100
Mão de obra (número de empregados fixos)	4	7	4
Produtividade por empregado (kg/dia/homem)	6,04	13,70	4,44
Quantidade ração (t/ciclo)	15,43	52,00	12,96

Fonte: Projeto Campo Futuro, 2016.

ANÁLISE ADMINISTRATIVA – RECEITA E CUSTO OPERACIONAL

Os custos de produção verificados nos polos de Aracati/CE e Acaraú/CE em agosto de 2015 tiveram os valores de insumos atualizados mensalmente. Os valores atualizados para dezembro de 2016 podem ser percebidos em duas condições, a primeira considerando a propriedade típica da região onde ainda não ocorreu incidência da síndrome da mancha branca (Figura 1), doença viral aguda e por vezes letal que acomete os camarões, e a segunda em uma simulação, considerando a infestação por mancha branca com alto nível de severidade e 30% de sobrevivência, semelhante ao observado no polo de Natal/RN em agosto de 2015 (Figura 2). Ressaltamos que o grau de severidade e as taxas de sobrevivências com a mancha branca podem variar entre 10% e 80%, conforme o manejo adotado em cada empreendimento.

Figure 4: Example of analytical report of the Project Campo Futuro da Aquicultura

Usually the panel reports were announced in a press release disseminated via CNA and Embrapa websites. Participants also receive the filled in panel spreadsheet for their own use on the farm as feedback. Data released consists of: costs of production, analysis of economic viability (e.g. net margins, net present value, effective operating cost), inputs and fish price index (Matsunaga *et al.*, 1976).

4. Results and Discussion

Results presented bellow concern a large range of information gathered through expert panels carried out in 27 aquaculture production zones and related to 6 species and different production systems, from 2014 to 2016 (Figure 5).

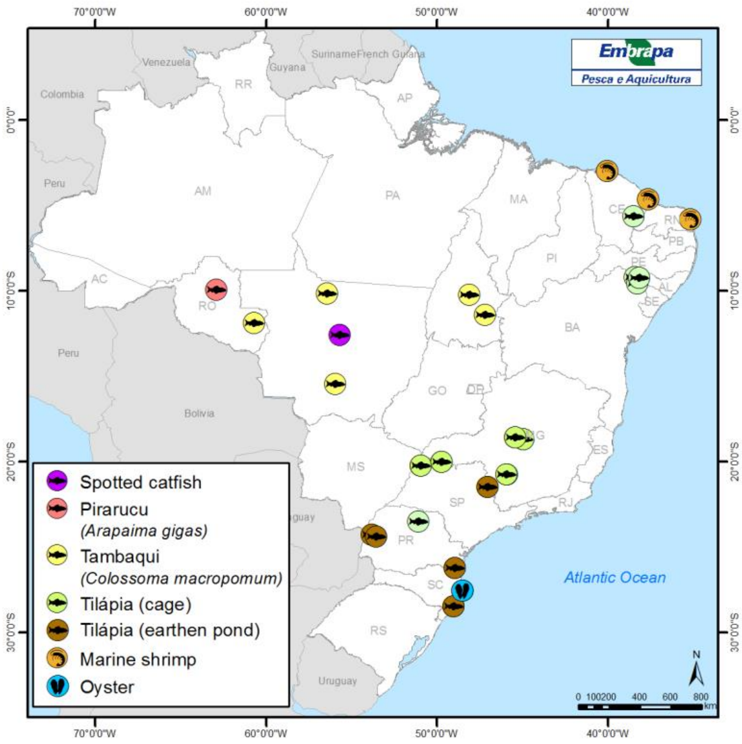

Figure 5: Panels locations and species studied in the Project Campo Futuro da Aquicultura.

By Marta Ummus in Muñoz, A. E. P.; Rezende, F.; Barroso, R.; Mataveli, M. 2016.

In order to analyze the results of the methodology, we present a sample of different types of findings developed from panels carried out by Embrapa in several aquaculture regions in Brazil.

Firstly, Table 4 shows some technical indicators collected in expert panels carried out in tilapia production zones in São Francisco Valley, Bahia State. Expert panel starts with the collection of the technical parameters and exploitation characteristics of the representative fish farmer in the region. These parameters are the basis to calculate the economic indicators, which are the main finding of the panel.

Table 4: Technical indicators and exploitation characteristics obtained from panel with tilapia fish farmers in São Francisco Valley, Bahia State (2015)

Indicators	Unit	Quantity
Main production system	net cage with 36 m^3	41
Size of land for support area	hectares	3
Duration of fish production cycle	days	180
Final feed conversion ratio	kg of feed/kg of fish	1,61
Final density	kg of fish/m^3	144
Initial weight of fingerlings	g	25
Final weight of fish (harvest)	g	1.100

Source: Munoz, A. E. P.; Flores, R. M. V.; Pedroza Filho, M. X.; Barroso, R. M.; Rodrigues, A. P. O.; Mataveli, M., 2015

Since technical parameters and farming characteristics are determined, the panel participants provide data concerning economic indicators of the typical fish farmer. In Table 5, this information is presented, considering the same region and species (i.e. tilapia in net cage production system in São Francisco Valley, Bahia State).

Table 5: Economic indicators used in the panels – Modal fish farmer of Tilápia in São Francisco Valley/Bahia state (2015)

Indicators	Unit	Quantity
Price of tilapia (gross profit)	R$/kg	R$ 5,50
Efective Operational Cost	R$/kg	R$ 3,50
Total Operational Cost	R$/kg	R$ 3,77
Gross profit margin	R$/kg	R$ 1,95
Net profit margin	R$/kg	R$ 1,73

Source: Munoz, A. E. P.; Flores, R. M. V.; Pedroza Filho, M. X.; Barroso, R. M.; Rodrigues, A. P. O.; Mataveli, M., 2015

Additionally, since the methodology is applied in several production regions, it is possible to compare the economic viability of a species in several geographical zones. Table 6 presents the example of a comparison of economic indicators of tambaqui in three different regions of Brazil. This information is instrumental for investors and policy makers in order to guide investments and support policies.

Table 6: Economic indicators for Tambaqui (*Colossoma macropomum*) in earthen ponds, three production zones in Brazil (2015)

Indicators	Unit	Palmas-TO	Cuiabá-MT	Alta Floresta-MT
Price of tilapia (gross profit)	R$/kg	4,80	4,50	4,00
Efective Operational Cost (EOC)	R$/kg	3,85	3,77	3,56
Total Operational Cost (TOC)	R$/kg	4,62	4,43	4,32
Gross profit margin	R$/kg	0,95	0,73	0,44
Net profit margin	R$/kg	0,18	0,07	-0,32

Source: Pedroza Filho, M. X.; Rodrigues, A. P. O.; Rezende, F. P.(2015)

Data in Table 6 shows a higher value for total operational cost (TOC) for tambaqui production in Palmas-TO than Cuiaba and Alta Floresta-MT. Further research has evidenced that the lack of fish feed plants in Palmas-TO is the cause behind this elevated cost. Therefore, as consequence of dissemination of this information, public policy has been developed in order to stimulate the implementation of fish feed plant on this region.

Furthermore, panel findings enable comparisons between different regions and species. Figure 6 presents the total and effective operational costs (TOC and EOC) obtained from 10 panels promoted in several regions, regarding different species and production systems.

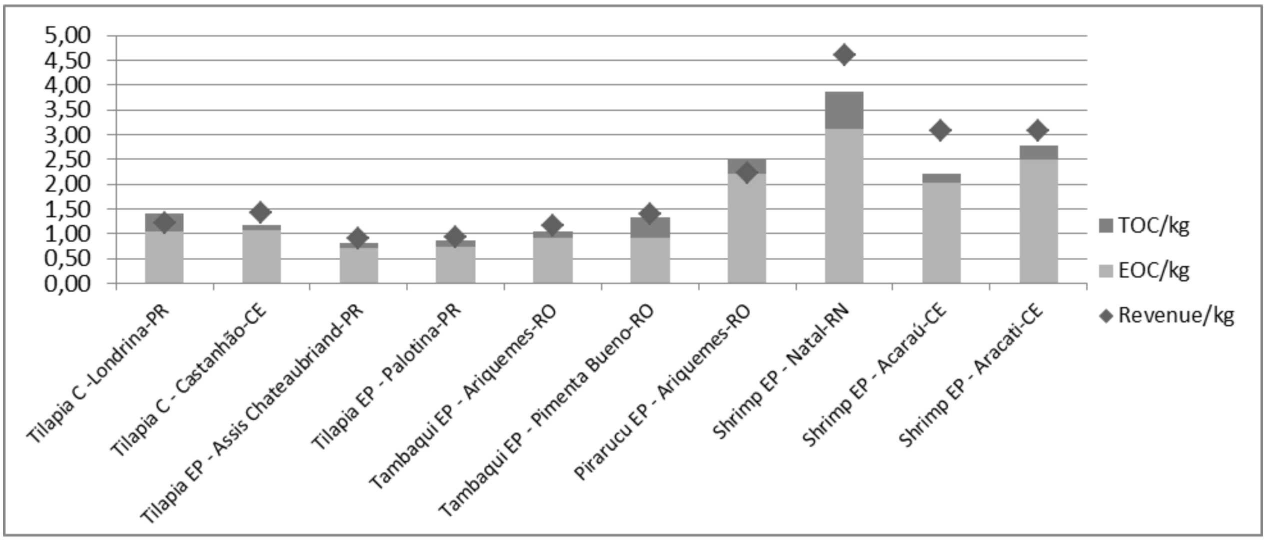

Figure 6: Comparison among economic indicators of three production zones in Brazil
Source: Pedroza, M.; Flores, R.; Muñoz, A. (2015). Obs.: C = cages; EP = earthen ponds.

Another important finding resulting from panels concerns to the inputs and fish prices. The input and fish prices are collected monthly for every region where panel has been carried out, by querying input suppliers via telephone. Thus, it is possible to build a historical dataset of input and fish prices variation along the year. Figure 5 shows the exchange ratio of fish (tambaqui) versus fish feed (as this is the most expensive input) for the region of Sorriso-MT. In other words, this information enables to evaluate the valorization of the fish by estimating how many fish (in kg) is necessary to buy one bag (25 kg) of fish feed (Figure 7).

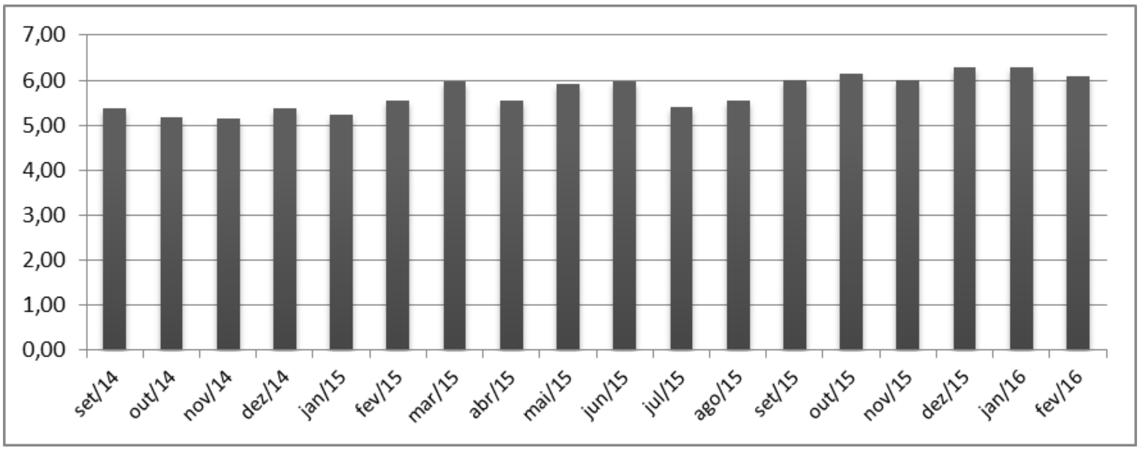

Figure 7: Exchange ratio of fish (kg) X fish feed (bag 25 kg and 28% of protein), Sorriso-MT
Source: Adapted from Flores, R.; Muñoz, A (2015)

As showed above, expert panels and TFA enable the collection of a large range of findings concerning economic data at farm level in aquaculture. However, this method presents some advantages and disadvantages that should be considered. A synthesis of the main pros and cons of the method is presented below:

Advantages:

» Strong reliability of data because information is provided by real producers
» Low cost of data collection compared to individual visits to farmers or survey
» Possibility of covering a large number of production zones in a large country

Disadvantages:

» Gathering economic data at farm level is complex because it is very dependent on farmer's capacity in providing reliable information
» Heterogeneity of producers' profile and difficulty in defining the typical farmer
» Mobilization of farmers in order to assure a representative sample in panels

5. Conclusions

This paper proposes to fill a gap in the economic data at the farm level on aquaculture and analyze the effectiveness of a participatory approach currently being applied by the Brazilian Agricultural Research Corporation (Embrapa) in the aquaculture sector of Brazil.

The methodology shows strong data reliability because information is directly provided by a representative sample of producers. Data reflects an agreement among the panel participants which is a more accurate representation of reality than statistical averages from surveys.

Moreover, data collection presents a low cost compared to individual visits to farmers or to survey methods. Continuous updating of databases and a high level of participation among producers are other assets of this methodology. Despite its effectiveness, the method also presents some challenges including: (a) heterogeneity of producers' profile and consequent difficulty in standardizing data, (b) logistic requirements related to organization of panels and (c) mobilizing producers to assure their presence at panels.

One important advantage is the ability to cover a large number of production zones at a fast pace, which is crucial in a large country like Brazil. For example, in large states like Mato Grosso (903.366,192 km²) it is possible to collect data in 3 fish farming regions in one week. Other advantage of this methodology is the low cost compared to other methods like census research. The main cost of data collection consists of travel into the production zone for a team of 3 people. This travel includes one panel with duration of about 4 to 5 hours and field visits to 1 or 2 fish farms. In order to ensure the economic data is updates, a trainee is in charge of monitoring input costs and fish prices by calling suppliers and producers by phone.

In contrast, the collection of economic data at the farm level is challenging because it depends on producers' abilities to provide reliable information. This capacity is directly related to producers' knowledge about fish farming production costs. Often, producers have difficulty describing all items because some costs are indirect (e.g. energy) or depend on the assessment and control of other technical parameters (e.g. feed conversion ratio-FCR, necessary to estimate the feed costs). In general, the higher the technological level of the producer the greater their control over production, enabling more reliable data collection. Furthermore, sometimes information is related to data which is strategic and, consequently, confidential. Therefore, farmers may provide this sensitive information in a biased way.

Indeed, one of the biggest challenges of the expert panel processes is related to the difficulty in obtaining reliable evidence-based results from empirical experience of panel participants. In order to overcome the risk of biased information many authors have proposed the integration of the expert panel with other methods. Among these other methods these authors highlight the use of triangulation of data by crossing literature-based evidence with panel results.

Concerning especially the research of economic performance in aquaculture sector, expert panels could be integrated to farm visits prior to the panels. The fish farm visits are particularly importante because the study of aquaculture economic perfomance envolves the analysis of many differents technical parameters, inputs and technologies. This approach has been applied by Embrapa in some of the aquaculture regions studied, with successfull results regarding data reliability.

In conclusion, the methodology has proven to be quite efficient at providing reliable data and giving producers a good knowledge about the local aquaculture production costs. As main contributions, the methodology can be easily transferred to extension service or aquaculture support entities (e.g. Unions, Producer Organizations, Cooperatives) in order to allow these agents to collect and disseminate economic information of aquaculture at farm level.

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