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COMMITTEE ON FISHERIES

SUB-COMMITTEE ON AQUACULTURE

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IMPROVING THE SOCIO-ECONOMIC IMPACTS OF AQUACULTURE

SUMMARY

Improvement of socio-economic impacts of aquaculture is rendered difficult by the lack of their common understanding and the methods to assess them. This paper shows that the large spectrum of **aquaculture's socio-economic impacts** can be summarised into the sector's contribution to **food security, poverty alleviation and economic performance and growth**, and discusses different approaches for their quantitative assessment. While conventional econometric models can be used for this purpose, their requirement of rigorous time series data limits their application, especially in developing countries.

Less data demanding, user friendly indicators may be the most applicable tools for evaluating these impacts. However, they too require a minimum of accurate quantitative farm accounting data and aggregate aquaculture and non-aquaculture specific macroeconomic data which may not be always available in developing countries, especially for small-scale non-commercial and commercial producers. A combination of training small-scale farmers in record keeping, reviewing current FAO reporting methods and conducting regular comprehensive farm and export surveys to supplement official statistics sources could be one of the ways of overcoming this constraint.

The Sub-Committee is invited to; (i) comment on how Member countries perceive the contribution of aquaculture to national socio-economic development; (ii) comment on the application of the models and tools discussed in this paper in different countries including the constraints which might be expected; (iii) advise on the prospects of financial assistance and partnerships in refining and testing the applicability of the assessment tools discussed in this paper; and (iv) advise on how to proceed and the way forward on this important issue.

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INTRODUCTION

1. The socio-economic role of aquaculture is well documented and is likely to increase significantly in the future. Recent studies on future demand for, and supply of, fish and fishery products predict a sizeable increase in demand¹. Because fish supply from the capture fisheries in most countries is believed to have reached or be close to the maximum sustainable yield, this finding suggests that an increase in aquaculture fish supply could be one of the best ways of reducing the expected shortage of fish, at least in the short and medium run.
2. Experts agree that the potential of aquaculture to significantly reduce the gap between fish demand and supply is high. With existing resources and technological advances, fish output from aquaculture can be expanded in a sustainable manner. A sustainable development of aquaculture requires that, *inter-alia*, the sector's socio-economic benefits should accrue to a large social spectrum and not be retained exclusively by a small elite².
3. Recognizing the importance of improving and expanding socio-economic benefits of aquaculture, the Second Session of the COFI Sub-Committee on Aquaculture identified a thematic evaluation of social and economic impacts of aquaculture as one of the priority areas of work. The aim would be the improvement of these impacts. However, this task is rendered difficult by the lack of common understanding with regard to the impact of socio-economics in aquaculture.
4. Some experts suggest that, from the farmer's perspective, socio-economic impacts of aquaculture consist of its contribution to the livelihoods of communities and should be understood in terms of direct and indirect benefits. They argue that direct benefits include the provision of high-quality food, self-employment in case of small-scale farmers and incomes from sale of high-value produce. Indirect benefits cover the supply of aquatic products to local markets, employment opportunities for local communities and on larger farms, in seed supply networks, market chains and manufacture, repairs and other functions.
5. Within some forms of aquaculture such as cage culture, culture of molluscs and seaweeds and culture-based fisheries in public water bodies, aquaculture enables the poorest of the poor, in particular the landless, to benefit from common pool resources³. Indirect socio-economic benefits of aquaculture also expand to increased farm sustainability, for example through the construction of aquaculture ponds which also serve as small-scale, on-farm reservoirs⁴.
6. Other experts contend that the socio-economic impacts of aquaculture are usually regarded in terms of employment, generation of foreign exchange and food supply⁵. Others again insist that aquaculture is an important domestic provider of much needed high-quality animal protein and other essential nutrients generally at prices affordable to the poorer segments of the community⁶.
7. The issue of the lack of a common understanding of socio-economic benefits is exacerbated by the absence of a generally accepted method for assessing them. Where available,

¹ Delgado, L. Christopher, Nikolas Wada, Mark W. Rosegrant, Siet Meijer and Mahfuzuddin Ahmed. 2003. Fish 2020. *Supply and Demand in Changing Global Markets*. International Food Policy Institute and WorldFish Centre, pp.226.

² Ridler, Neil & Nathanael Hishamunda. 2001. *Promotion of sustainable commercial aquaculture in sub-Saharan Africa*. Volume 1: Policy framework. FAO Fisheries Technical Paper 408/1, pp 67. Rome, Italy.

³ Edwards, Peter. 2000. *Aquaculture, poverty impacts and livelihoods*. Natural Resource Perspectives, 56.

⁴ Edwards, Peter. 2000. *Aquaculture, poverty impacts and livelihoods*. Natural Resource Perspectives, 56.

⁵ Aguero, Max & Exequiel Gonzalez. 1997. *Aquaculture economics in Latin America and the Caribbean: a regional assessment*. In Charles *et al.* ed.; *Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography*, FAO Fisheries Circular No.932. Rome, Italy.

⁶ Tacon G.J. Albert. 2001. *Increasing the contribution of aquaculture for food security and poverty alleviation*. In Subasinghe, R. *et al.*, ed. *Aquaculture in the Third Millennium*. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, pp 63-72. Bangkok, Thailand.

evaluations of socio-economic impacts of aquaculture are limited to qualitative descriptions⁷. Qualitative assessments of the merits of many programmes, including aquaculture, have not always convinced policy makers of their relevance in national development agendas. In the specific case of aquaculture, the lack of hard evidence on its ability to significantly impact countries' socio-economic lives may contribute to explaining the often limited public support to this sector in many parts of the developing world.

8. The purpose of this paper is to contribute towards closing this void by identifying socio-economic impacts of aquaculture and discussing the progress made towards their quantitative assessment⁸. A clear understanding of these impacts and their measurement methods could pave the way to identifying the means by which to improve them.

IMPACT IDENTIFICATION

9. Aquaculture can and does contribute to **food security**.

10. "Food security exists when all people, at all times, have **access to sufficient, safe and nutritious** food to meet their dietary needs and food preferences for an active and healthy life"⁹. It can be inferred from this definition that food security includes three main dimensions, namely **availability** of sufficient *quantities* of food of appropriate *quality*, their **access** by households and individuals and their **utilization** for nutritious diets and adequate health¹⁰." Aquaculture can directly or indirectly contribute to all of these three major complementary, yet inter-dependent¹¹, dimensions of food security. With respect to **food availability** (which includes quantity and quality aspects), aquaculture contributes to **food quantity** through the **supply of aquatic products from domestic farming (direct food supplies)** to producing households and individuals for home consumption as well as to domestic markets for local buyers.

11. Its contribution to food quantity is also in terms of **supply-to domestic markets- of food** (aquatic and non-aquatic products) **imports** which are acquired from abroad through foreign exchanges earnings from aquaculture (**indirect food supplies**).

12. Aquaculture contributes to food **quality** by **providing nutritious aquatic food products**. It is widely accepted that seafood¹² is an exceptional source of high quality protein. Research has shown that a single serving of 150g provides 50-60 percent of an adult's daily protein needs, contains various vitamins and minerals and is typically low in saturated fats, carbohydrates and cholesterol (with the exception of prawns and squid)¹³.

13. The contribution to food quality is also through **health benefits** which are associated with consumption of aquatic food products. Recent studies show that consumption of two or more servings of seafood per week is associated with a lower prevalence of heart disease. Other health benefits of eating seafood include lowering blood pressure, possible improvement of symptoms of rheumatoid arthritis, improvement of eczema and decreased incidence of depression¹⁴.

⁷ Aguero, Max and Exequiel Gonzalez. 1997. *Aquaculture economics in Latin America and the Caribbean: a regional assessment*. In Charles *et al.* ed.; *Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography*. FAO Fisheries Circular No.932. Rome, Italy.

⁸ While aquaculture can have both positive and negative socio-economic impacts, negative impacts are generally a direct result of negative ecological/environmental impacts. Thus, this paper discusses only positive socio-economic impacts (benefits) of aquaculture.

⁹ FAO (Food and Agriculture Organization of the United Nations). 1996. World Food Summit: Food for All. 13-17 November 1996. Rome, Italy.

¹⁰ Riely Frank, Mock Nancy, Cogill Bruce, Bailey Laura and Kenefick Eric 1999. Food security indicators and framework for use in the monitoring and evaluation of food aid programs. Arlington, Va: Food Security and Nutrition Monitoring Project (IMPACT), ISTI, Inc., for the U.S. Agency for International Development. January, 1999.

¹¹ For example, the improvement in food availability will tend to decrease food price and hence make food more accessible.

¹² Seafood in this document refers to all types of aquatic products destined for human food.

¹³ SFIC (Sports and Fitness Insurance Corporation) Seafood for Health. 2006. <http://www.sealord.biz>

¹⁴ SFIC Seafood for Health. 2006. <http://www.sealord.biz>

14. The supply of high nutritional value food is particularly important for vulnerable groups such as pregnant and lactating women, infants and pre-school children, especially in remote rural areas where the needs are generally acute.

15. The availability of food is a necessary condition for food security, but it is not sufficient. Food **access** is of particular importance. Should households' own food supply be insufficient, those without sufficient resources for food purchase will be living in food insecurity, even when there is enough food available in the country to feed all the mouths of the community (the "paradox of plenty"). Regarding **food access**, aquaculture contributes to food **affordability**, which is the major aspect of food access.

16. **Affordability** implies adequate financial resources to acquire appropriate food items for dietary and preference needs. It also implies relatively low food prices. By providing producing households and individuals with revenues obtained through sales of their produce and by creating direct and indirect jobs in communities and paying salaries and wages, aquaculture *enhances households' disposable incomes and their ability to purchase food items* which would otherwise be inaccessible. By increasing the availability (supply) of aquatic products to domestic markets, everything else remaining the same, aquaculture can *lower the price of these products*, thereby making them *affordable* and, thus, *accessible* to local consumers.

17. Besides affordability, access to food also depends on the physical, social and policy environments, which determine how *effectively* households are able to utilise their resources to meet their food security objectives¹⁵. In this respect, aquaculture's contribution to food access can come from its *investments in infrastructure and human capital* and its contribution to *government tax revenues*.

18. Food **utilization** is related to more micro dimensions of food security such as nutrition, food-preparing and sanitation knowledge, dietary habits and health conditions¹⁶. Aquaculture can contribute to these issues indirectly. For example, aquaculture's **tax payments** can help finance government's health education and health care programs as well as sanitation infrastructure, thereby making food utilisation more effective.

19. Besides long-term, chronic food security problems, food security also depends on transitional shocks such as natural disasters, diseases, food price shocks in domestic or world markets. By providing diversified aquatic products, aquaculture can increase the stability of domestic food supplies thus increase the country's resistance to some transitory shocks that may have negative impacts on food security. Likewise, by securing incomes and jobs of households and individuals employed in the sector and related activities, aquaculture can increase the households' resistance against transitory food insecurity.

20. Another important socio-economic benefit of aquaculture is its contribution to communities and countries' economic performance and growth. Besides supplying aquatic products for home consumption, generating sales revenues, creating employment and paying labour incomes, aquaculture can generate profits and produce tax and export revenues (foreign exchange earnings). Along with labour incomes (wages and salaries), profits¹⁷ (including producer and exporter's profits) and taxes, contribute to gross domestic products (GDP), which is a basic measure of economic performance. In addition, business profits from aquaculture and savings from employees in the sector provide funds for investments; e.g., in road, school, sanitary and other infrastructure. Good infrastructure and investment in human capital will stimulate economic activity, benefit local businesses and communities, and hence, enhance economic

¹⁵ Riely Frank, Mock Nancy, Cogill Bruce, Bailey Laura & Kenefick Eric. 1999. Food security indicators and framework for use in the monitoring and evaluation of food aid programs. Arlington, Va: Food Security and Nutrition Monitoring Project (IMPACT), ISTI, Inc., for the U.S. Agency for International Development. January, 1999.

¹⁶ Fan, Shenggen, Peter Hazell & Sukhadeo Thorat. 1999. *Linkages between government spending, growth and poverty in India*. IFPRI (International Food Policy Research Institute). Research Report 110.

¹⁷ Especially business profits in the case of large-scale commercial aquaculture.

performance and growth. Economic development, especially the development of isolated regions, discourages outward migrations and strengthens communities¹⁸.

21. **Foreign exchange earnings** (including those from aquaculture) are valuable resources. For developing countries in particular, they are used for important imports, including imports of production inputs such as machinery. As discussed above, they can also be invested in infrastructure and human capital, which helps raise labour and capital *productivity*. It is the growth in productivity which is the major driving force of economic performance and long-term (steady-state) **economic growth**^{19,20}.

22. A final complex dimension of the socio-economic benefits of aquaculture is its contribution to **poverty alleviation**. Poverty is a multi-dimensional concept which can be briefly defined as poor living conditions. Its immediate cause is the lack of real, financial and other resources. Some of its many symptoms include inadequate access to food, housing, nutrition, health and education²¹.

23. As economic growth is one of the major elements for poverty alleviation (and food security enhancement)²², it follows from this definition that the variables explaining the contribution of aquaculture to economic growth as discussed above can also be taken as general indicators of its contribution to poverty alleviation. In other words, by enabling small-scale producers to acquire sales income from their produce, large-scale farmers and corporations to create employment and pay wages and salaries to non-aquafarming, resource-poor and sometimes landless individuals, aquaculture enhances households' access to financial and other resources, thereby alleviating poverty. These resources can be used by households to purchase food, enhance nutritional and health status and/or access adequate housing and education services, thereby appeasing the symptoms of poverty. Likewise, by enabling commercial farms to generate sizable profits, export-oriented farms to generate export revenues and governments to collect tax revenues from commercial farms, aquaculture brings in resources for investments in growth stimulating, and, therefore, poverty alleviating government programmes.

TOWARDS IMPACT ASSESSMENT: PROGRESS MADE AND OUTSTANDING ISSUES

24. Although the roles of aquaculture in food security improvement and poverty alleviation have been well recognized, there are few systematic and quantitative evaluations of aquaculture's contribution in these two respects, especially from a macro-economic perspective²³.

25. In fact, "little or no hard statistical information exists concerning the scale and extent of rural or small-scale aquaculture development within most developing countries and LIFDCs²⁴ or concerning the direct/indirect impact of these and the more commercial-scale farming activities and assistance projects on food security and poverty alleviation"²⁵. In addition to being merely descriptive, these impacts are assumed. For example, the studies assume that increased production is associated directly with improved community employment and incomes, and increased export

¹⁸ Ridler, Neil & Nathanael Hishamunda. 2001. *Promotion of sustainable commercial aquaculture in sub-Saharan Africa*. Volume 1: Policy framework. FAO Fisheries Technical Paper No.408/1, pp 67. Rome, Italy..

¹⁹ Barro, Robert. 1999. *Notes on growth accounting*. Journal of Economic Growth, 4(2), 119-137.

²⁰ Romer, Pall. 1986. Increasing returns and long-run growth. Journal of Political Economy, 94(5), 1002-1037.

²¹ Maxwell, Simon. 1996. Food Security: a Post-modern perspective. Food Policy, 21(2).

²² Lipton, Michael & Martin Ravllion. 1994. Poverty and policy. In Jere Behrman and T. N. Srinivasan, ed., Handbook of Development Economics, Vol.3. Amsterdam, North-Holland.

²³ Charles *et al.* ed.; 1997. *Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography*. FAO Fisheries Circular No.932. Rome, Italy.

²⁴ Low-income, food-deficit countries.

²⁵ Tacon G.J. Albert. 2001. *Increasing the contribution of aquaculture for food security and poverty alleviation*. In Subasinghe, R. *et al.*, ed. Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, pp 63-72. Bangkok, Thailand.

earnings mean increased community welfare. Therefore, “positive impacts are extrapolated from assumed factors and rarely based on in-depth analysis”²⁶.

26. Moreover, despite the abundant literature on the role of aquaculture in economic development, there is no documented approach of assessing the impact of aquaculture on economic performance and growth. Most studies are interested in predicting fish demand and supply and the potential or desirable contribution of aquaculture to meeting the expected demand²⁷.

27. One approach to filling this gap could be to borrow from experience in agriculture and conduct dynamic econometric simulations using “**Ad hoc Macro Economic Models**”²⁸. Results could provide valuable information on aquaculture’s total contribution to a country’s economic performance and growth over time. However, such models seem to have limited applicability in aquaculture. They require intensive time-series data which may not be available, especially in most developing countries where record keeping is generally poor and often inaccurate.

28. Another option could be the “**Input-Output (also known as Computable General Equilibrium-CGE) Models**” which are often used to simulate the impact of a given sector on the economy. Unlike macro-economic models which are specified *ad hoc* and estimated econometrically from time-series data, these models have more solid microeconomic foundation and are usually constructed with the aid of “Social Accounting Matrices (SAMs) (also known as Input-Output Tables) which provide detailed structural information regarding inter-sectoral relationships within an economy. Nevertheless, their application in aquaculture too appears difficult. The required SAMs are not always available, particularly in developing countries. Even if they were available, SAMs may not be detailed enough to have aquaculture as a distinct sector.

29. The third option is to use the **simplified versions of the “Input-Output” models**. An example of these is the “Semi Input-Output” models²⁹. These models depict the interactions between the sector of interest and the rest of the economy and do not usually require SAMs (input-output tables) as they are estimated from aggregate data, which are generally available from government statistics.

30. Being less data demanding and since data on the aquaculture sector in developing countries is limited, this approach may be the most applicable tool for evaluating the sector’s total contribution to economic performance and growth. However, the treatment of the rest of the economy as one sector is an over simplification that does not accurately reveal the detailed impacts caused by aquaculture. In light of this situation, the Secretariat has been working on alternative methods of completing this task while addressing these issues.

31. With respect to assessing the impact of aquaculture on food security and poverty alleviation, indicators have been developed to measure the impact of aquaculture on food availability, food access and food utilisation. These indicators were developed on the basis of the following assumptions, which, in turn, follow from the discussion above on the identification of these impacts: (1) Food security and poverty are closely related and food insecurity is mostly a consequence of poverty; (2) Poverty is a complex phenomenon which has many manifestations. Therefore, it cannot be analysed by means of a single indicator; (3) Poverty is multidimensional, but, “income and consumption are the most important dimensions in defining poverty, as, for the

²⁶ Agüero, Max and Exequiel González. 1997. *Aquaculture economics in Latin America and the Caribbean: a regional assessment*. In Charles *et al.* ed.; *Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography*. FAO Fisheries Circular No.932. Rome, Italy.

²⁷ For example, IFPRI and WorldFish’s Fish 2020 Supply and Demand in Changing Global Markets. 2003. *FAO’s Historical Consumption and Future Demand for Fish and Fishery Products: Exploratory Calculations for the Years 2015/2030*. FAO Fisheries Circular No.946. CenterWorldBank,WorldFish Centre, FAO.

²⁸ Block, Steven & Peter Timmer. 1994. *Agriculture and economic growth: conceptual issues and the Kenyan experience*. Development Discussion Paper No 498. Harvard Institute for Economic Development.

²⁹ Delgado, Christopher, Jane Hopkins & Valerie Kelly. 1998. Agriculture growth linkages in Sub-Saharan Africa, pp139.

poor, what matters most is that they have at least a sustained income to meet minimum consumption needs during periods of natural calamity and other economic disasters³⁰.

32. A series of indicators have also been developed to **assess the impact of aquaculture on economic performance and growth**. Specifically, these indicators measure the static and dynamic contribution of aquaculture to national GDP, employment, labour income, government tax revenues, national foreign exchange earnings, labour and capital productivity, and investments in infrastructure and human capital as discussed earlier in this paper.

33. The underlying assumption which guided the development of these tools is that “sectors in an economy are interdependent”. Thus, besides contributing to economic performance and growth directly (through own value addition and employment creation), the aquaculture sector can also indirectly contribute to national economies through its impacts on other sectors of the economy (be it through purchases from and sales to these sectors, through triggering employment creation and income generation in these sectors or through investments in infrastructure and human resources which, in turn, enhance productivity).

34. For each of these indicators, the type of data needed for their estimation and, when possible, their sources, are extensively discussed. Data permitting, illustrative examples of how these indicators can be estimated in a given country are also provided.

CONCLUSIONS

35. This paper has demonstrated that the socio-economic impacts of aquaculture are complex, but that they all converge into its contribution to food security, poverty alleviation and national economies and growth.

36. Mainly because of the limited availability of rigorous time series data in aquaculture, especially in developing countries, conventional econometric models are of limited use in estimating these impacts. Yet, systematic and quantitative information about the socio-economic impacts of aquaculture on society is essential for governments and development agencies to appreciate its merits. A proper understanding of these merits enables the formulation of suitable policies to help develop the sector into a mature and sustainable contributor to local and national economies and to society's wellbeing. To ease the assessment of these impacts in developing countries, alternative, less data onerous indicators are suggested.

37. However, while these indicators are less data demanding and relatively easy to compute than other methods, they nevertheless require a minimum input of accurate quantitative data. Specifically, in addition to aggregate non-aquaculture specific macro-economic data Such as GDP, employment, labour income (wages and salaries), tax revenues, export revenues, investments and consumption which are generally available from official statistics, they require farm accounting data including costs (labour and other variable inputs costs, fixed costs) and revenues (production levels and sales prices). They also require non-farm data such as aquaculture exports. However, such data are rarely available separately from capture fishery exports.

38. While accounting data with respect to costs and revenues are generally available for large-scale commercial aquaculture enterprises, they are often lacking in the case of small-scale and non-commercially oriented operations; either their record keeping is poor or it is inexistent. Yet, they can play important roles in many households' livelihoods.

39. Inadequate data on exports could also render the application of these instruments difficult. For example, although data on aquatic commodity exports are available from official statistics such as in the FAO's FishStat+ or UN's Comtrade, they may not be helpful in estimating some of these indicators particularly on aquaculture's contribution to food availability; they represent the total aquatic commodity exports which aggregate products from both capture and culture. The

³⁰ IFAD (International Fund for Agriculture Development). 1992. The State of the World Rural Poverty. An inquiry into its causes and consequences. Jazairy, I., M. Alamgir & T. Panuccio. Immediate Technology Publications, London.

unmatched product categorizations for production and export data add to this complexity. Again, in FAO's FishStat+, the aquaculture production data are categorized as "tilapia", "catfish", "shrimp", etc. Yet, the aquatic commodity trade data in the same source are categorized as "fillets", "fresh water fish", etc. Without a match between data on production and data on exports, some indicators cannot be calculated directly.

40. To resolve these outstanding issues, it seems important to: (a) initiate and train small-scale and non-commercial farmers in record keeping; (b) review the reporting methods so as to have clear and coherent aquaculture specific data; (c) combine official statistics sources with other secondary sources of data; and (d) conduct regular comprehensive farm and export surveys.

41. This exercise is not a one-time activity; nor can it be a one-man task. In addition to FAO Fisheries Department, the task requires concerted efforts between all players in the sector including, but not limited to farmers, traders of aquaproducers, exporters, research and educational institutions, and policy-makers. Above all, it requires adequate financial resources.

SUGGESTED ACTION BY THE SUB-COMMITTEE

42. The Sub-Committee is invited to:

- comment on how Member countries perceive aquaculture's contribution to national socio economic development;
- comment on the application of the models and tools discussed in this paper in different countries including the constraints which might be expected;
- advise on the prospects of financial assistance and partnerships in refining and testing the applicability of the assessment tools discussed in this paper; and
- advise on how to proceed and on the way forward on this important issue.