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The social and economic impact of aquaculture: a European review

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Abstract

This paper undertakes a preliminary evaluation of the social and economic impact of aquaculture from both empirical and theoretical standpoints. Drawing initially on background information collected for the Commission of the European Communities (CEC) in a recent study by the European Association of Fisheries Economists (EAFE), a number of important indicators and trends (e.g. production, employment, market structure) are examined which indicate that aquaculture is of increasing significance in many regions. Whilst some socio-economic information is available for all European countries, this information base is weak in comparison to that for biological and technical aspects of aquaculture and does not permit a comprehensive evaluation at the present time. In theory, however, the continued development of aquaculture will have a significant social and economic impact into the future. The nature of these effects and their implications, with particular reference to planning, resource allocation, and government policy are examined in some detail. Recommendations are also made for future research in this field.

KEYWORDS: Aquaculture, Europe, Economic impact, Social impact, Review.

Introduction

It is the primary aim of ~~this paper~~ to undertake a preliminary evaluation of the social and economic impact of aquaculture in Europe. From the beginning, it must be emphasized that the information base in this area is relatively undeveloped in comparison to biological and technical aspects of aquaculture, and does not allow a comprehensive evaluation to be carried out at the present time. There are many reasons for the poor status of this information base including the problem of identifying appropriate socio-economic indicators. At the recent Euraqua'92 Conference held in Brussels, J. Almeida Serra, Director General for

Fisheries, CEC, in his introductory speech alluded to such difficulties in noting that "The collection of statistics on the economic and social aspects of aquaculture in the European Community is not a straightforward process" (Euraqua '92, p.1).

However, it must also be stressed that the poor status of the information base does not properly reflect the significance of this subject area. Fortunately though, it may be observed that on a worldwide basis we are now witnessing a greater general interest in the social and economic impact of aquaculture as human populations expand, resources become more limiting and the need for effective economic policy with regards to the sustainable development of the aquatic environment becomes more pressing.

For this preliminary evaluation, we will use as a basis the large amount of background information collected for the CEC in a recent study of European aquaculture by the European Association of Fisheries Economists, EAFE (Shaw and Bailly, 1990). The paper will therefore be restricted to countries of the European Community (EC) rather than Europe as a whole.

Objectives

The four objectives of this paper are:

a) To present a brief overview of European aquaculture including production trends by species and by country, and some general comments on the structure of the industry and its economic significance.

b) To establish a framework by which the social and economic impact of aquaculture might be evaluated including the identification of key socio-economic benefits and costs.

c) To review the impact of aquaculture using the framework established in b) above.

d) To summarize the results of this preliminary analysis and briefly discuss the implications for government policy in the future. Some indication will also be given of the requirements and usefulness of research in this area.

Overview of European aquaculture

Total aquaculture production in the EC in 1989 exceeded 800 000 tonnes as shown in Table I. This represented 12% of all fish supplies from EC sources. The principal products are shellfish (mussels, oysters, clams) and fish (rainbow trout, salmon, carp).

In terms of value, as shown in Table II, production in 1989 was worth 1 400 million European Currency Units (MECUs) or 13% of all fish supplies from EC sources. The leading species by value were rainbow trout and mussels.

Table I. European aquaculture production 1983 to 1995 (estimated) by major product (thousands of tonnes) (from Shaw and Bailly, 1990)

Product	1983	1989	1995 (Estimated)
Mussels	482	497	538
Oysters	122	132	133
Trout	101	144	169
Salmon	3	35	52
Clam	13	15	23
Carp	7	9	10
Others	5	16	41
Total	733	848	966

Table II. European aquaculture production in 1989 by value of the major products (MECUs) (from Shaw and Bailly (1990) and data provided by the CEC)

Product	Value
Trout	412
Mussels	289
Salmon	182
Oysters	181
Clams	120
Carp	36
Others	179
Total	1 399

In terms of national production by value (Table III), the leading nations are France and Italy. France has significant oyster and trout industries, while Italy has a diverse aquaculture sector dominated by trout and shellfish. Interestingly, the shellfish sectors of both these countries are long-established and still use many traditional culture techniques even today.

As for the other countries, the UK has significant salmon and trout industries. Spain, Ireland and Germany produce both shellfish and finfish. Denmark is a leading trout producer and the Netherlands produces large quantities of mussels. Both Greece and Portugal which produce small quantities of finfish and shellfish have significant potential for further development. Detailed reviews of aquaculture in EC countries are provided by the EAFE study - Country Studies No. 1-11. (e.g. Shaw et al., 1990) and in the Main Report (Shaw and Bailly, 1990). An earlier OECD (1989) publication is also very useful.

Table III. European aquaculture production by value of national production (MECUs) in 1989 and relative to fisheries (% total landings) in 1986 (from OECD, 1989; Shaw and Bailly, 1990)

Country	Value	Relative to fisheries (%)
France	327	41
Italy	279	10
UK	206	25
Spain	200	3
Germany	118	45
Denmark	87	17
Portugal	58	n/a
Netherlands	54	14
Ireland	41	12
Greece	23	5
Belgium	5	n/a
Total	1 399	
Non-European Community examples for comparison (1986)		
Japan	1 850	21
USA	205	18
Norway	109	35
Canada	12	3

As well as the major species which currently dominate production (trout, salmon, mussels, oysters) in Europe, others being cultured at the present time include: bass, bream, catfish, eels, mullet, tilapia, turbot, and yellowtail.

Production systems range from the traditional and extensive valli-type systems operated in Italy and other Mediterranean countries to the highly intensive and modern pond and cage-culture systems now found throughout Europe. The EAFE Study (Shaw and Bailly, 1990) revealed that the different aquaculture systems have different cost structures and operating economies. In fact, because of the diverse nature of these systems it is difficult to generalize. For many species, however, beyond certain minima, economies of scale are not important in production systems, although they are important in the organization of marketing activities.

In terms of national fish supplies (Table III), the relative contribution of aquaculture compared to wild fisheries varies between the different countries, ranging from 3% for Spain to 45% for Germany. However, in general aquaculture is expected to make a greater relative contribution to supplies in the future. The aquaculture sector is expected to expand with the development of new technologies, new species and new markets for its high quality products.

Finally, it is should be noted that on a macro-economic scale aquaculture in Europe is relatively insignificant, producing less than 1% of European Gross National Product. This raises the question as to why does aquaculture as a means of utilizing natural and national resources throughout Europe attracts so much attention from public authorities? One important justification which is given is that aquaculture has a significant and positive social and economic function at a regional level, and particularly in those regions with depressed and marginal local economies characterized by high rates of unemployment, high emigration rates and containing communities who experience a generally low standard of living. This and other important issues will now be examined in some detail.

Identification of social and economic impact

In attempting to examine whether it is possible to rationalize the development of aquaculture in terms of a beneficial social and economic function at a regional economic level, it is appropriate at this stage to consider the type of analytical framework which might be employed.

In effect this serves to highlight the role of the economist in evaluating the use of scarce resources such as labour, capital, land and water, by any particular sector of the economy, whether this be aquaculture, agriculture, tourism, mining or heavy industry.

Economic analysis has, by virtue of the powerful tools at its disposal an important role to play in assessing the outcomes of allocating resources among different and often competing uses, in the coastal zone, for example (Edwards, 1987). Economic analysis should be seen in its broadest sense as a means by which policy-makers can receive guidance on the use of resources in order to promote the greatest return for society as a whole. In other words, economic (or social welfare) analysis as part of the policy evolution process allows one to evaluate alternatives and so reach priorities for development action, which will of course be influenced to a greater or lesser degree by political priorities.

It is important at this stage to define briefly some of the important concepts and terminology of economic analysis. Regretably, many of these are often used incorrectly by those (especially politicians) associated with aquaculture which leads to some general confusion.

Firstly, it should be emphasized that the importance of an aquaculture development or a fishery can be measured by either assessing the economic impact which it creates or by attempting to estimate its economic value. The important distinction in terms here is between 'economic impact' and 'economic value'. The economic impact of aquaculture can be defined in terms of changes in key parameters (e.g. fish prices, employment, farm output) within a local or national economy. The definition of economic value must be treated more rigorously. In simplest terms, the economic value of something is a reflection of its value or worth to society as whole. Economic value is quite distinct from financial value; the latter is expressed in terms of market prices whereas the former is usually expressed in terms of opportunity costs. Financial (market prices) can be converted to economic values

using adjustments to account for market imperfections. For a more detailed explanation of economic value see Gittinger (1983); Levi (1985).

Secondly, the relationship between economic impact and economic value can be understood by explaining the application of economic cost-benefit analysis (CBA) in assessing proposed public programmes or policies relating to resource development. CBA as a technique systematically identifies and organizes economic benefits (anything that contributes to an objective) and costs (anything that reduces an objective) in a number of stages, as follows:

Stage 1. Definition of the boundary of the analysis (e.g. regional aquaculture development project).

Stage 2. Identification of costs and benefits (e.g. provision of infrastructure versus increased fish supply).

Stage 3. Valuation of costs and benefits in two stages:
a) financial evaluation (e.g. market prices for commodities);
b) conversion of financial to economic values (expressed in terms of opportunity costs to allow for market imperfections in the allocation of resources between alternative uses).

Stage 4. Comparison of economic costs and benefits over time under various alternative scenarios to assess the net economic benefit (value) returned.

For the purposes of the analysis to follow, measures of economic impact can be included at Stage 2 of this simplified CBA approach whereas the economic value (net economic benefit) is determined at Stage 4. Social effects (e.g. new job opportunities, improved rural services etc.) do not lend themselves easily to this type of evaluation. A common approach is to categorize them as intangibles, identify them carefully and record their interaction with other factors within the analysis. For further information on CBA, including the application and limitations of the technique, see Pearce and Nash (1981), Gittinger (1982), and Mishan (1982).

Because of the limitations of the socio-economic database relating to European aquaculture, it is not possible to undertake a detailed economic evaluation at the present time using an economic CBA approach. However, using the limited data available, it is possible to document, quantify (where possible), and review the economic impact of aquaculture in Europe. This can be seen as a useful starting point for the type of economic CBA which might be performed at a regional level in the future. According to the framework identified above, we will extend the analysis to Stage 2.

A preliminary identification of some of the potential social and economic impacts (or benefits and costs) of European aquaculture is provided by Table IV. In effect this table provides an overview of some of the major issues which are the subject of debate between the proponents and opponents of aquaculture development in the EC. We will now proceed to examine some of the impacts (costs and benefits) which have been identified.

Table IV. Identification of the possible social and economic benefits and costs of aquaculture in Europe

Benefits
Increase in fish supplies
Reduction in fish price
Export earnings
Creation of employment
Conservation of social structure
Improved infrastructure in rural areas
Costs
Environmental damage
Conflict over resource usage
Creation of a resource sink
Disruption of social structure
Overfishing and reduced fish supplies
Loss of traditional occupations

Review of social and economic impacts

In order to undertake a preliminary review of the impacts (benefits and costs) of aquaculture, an approach we have decided to take is to ask a number of key questions which encapsulate many of the issues involved and to answer these with reference to specific examples.

QUESTION 1

Is aquaculture making a significant contribution to the supply of fish in Europe?

Answer

As shown in Table I, aquaculture production has increased during the 1980's and this trend is expected to continue in the future. By 1995, the total production of aquaculture in Europe is expected to exceed 900 000 tonnes. In addition, although wild sources will remain the major source of fish to the EC, the relative contribution of aquaculture is likely to increase due to the decline of wild stocks and the imposition of tighter fishing regulations.

The major role of aquaculture in Europe as seen by the EC is made quite clear in the text of the regulation CEC 4028/86: "Since the Community has a deficit in fish products it must endeavour to find new sources of supply" (Preamble, p.1). "Experience has shown that the development of aquaculture has helped to improve the position as regards the supply of fishery products; therefore further encouragement should be given to the sector" (Preamble, p.2).

Overall though, aquaculture products are seen by many to fill a distinctive niche in the market, that of the high value, high quality seafood product (e.g. smoked salmon, fresh oysters). These products will complement, rather compete with, the supply from wild fisheries in the marketplace (Joyce, 1991).

In the short- to medium-term, it should be recognized though that the main factors which will determine the development of aquaculture is the ability to develop markets, although environmental restrictions and disease may constrain developments for some species (Shaw and Bailly, 1990).

However, despite the generally optimistic forecasts for aquaculture development which are to be found in the literature, it is worthwhile noting the comments of those who are less than optimistic. The overview given by Wijkstrom (1989) is particularly interesting. He notes, for example, that the future role of European aquaculture in supplying fish products has not been analysed to any significant extent. However, in reviewing the relationship between aquaculture and wild fisheries in Europe, he explains that an increase in fish-culture may actually lead to a net decrease in the per capita supply of fish for human consumption in the long-term!

The most important factor here is the demand for fishmeal from transformation aquaculture processes such as salmon and shrimp farming. At present, fishmeal is manufactured from trash-fish species. However, if the demand for fishmeal rises significantly in the future as aquaculture expands, fishmeal producers will be able to compete for non-trash fish presently supplied to food markets. This effect will of course vary between regions depending on markets characteristics.

In contrast, aquaculture which is not dependent on fishmeal inputs, for example oyster and mussel farming, are more likely to be able to contribute to the overall supply of food products. In exploring the possibilities for future technological development in aquaculture, Wijkstrom comes to the conclusion that sea-farming (ranching) may ultimately be the answer to the problem of the "fish meal trap" and lead to an overall increase in fish supplies.

QUESTION 2

Has aquaculture generated new employment?

Answer

The creation of employment opportunities in depressed rural areas is often cited as one of the most important reasons why local and national governments have been willing to encourage the development of aquaculture. For example, in the West of Scotland, aquaculture employs some 5 000 people on farms and in associated industries such as fish-processing factories and feed suppliers, and there is a significant employment multiplier effect (McCunn, 1988).

In Europe as a whole there are thought to be over 53 000 people employed directly (full-time and part-time) in aquaculture, as shown in Table V. France has the largest aquaculture workforce (25 000 people). The shellfish industry in France is relatively labour-intensive

Table V. Employment in European aquaculture in 1989 (full-time and part-time) (from Shaw and Bailly, 1990)

Country	Employment
France	25 790
Germany	14 028
Spain	8 336
Italy	6 940
UK	3 300
Ireland	2 017
Denmark	1 693
Greece	788
Netherlands	378
Belgium	51
Portugal	n/a
Total	53 321

(Bailly, 1989). However, the continued introduction of new technology and mechanization will lead to a reduction in the size of the workforce. Both Germany and Italy also have a relatively large number of persons employed in aquaculture associated with the diverse range of production activities in both countries.

However, it is important to bear in mind that employment statistics for aquaculture throughout Europe are very weak. Indeed, it is suspected that the figures given in Table V substantially underestimate the actual level of employment. At the same time, although it may be claimed that aquaculture has generated a particular number of jobs in a particular country, there is at present no means of checking on whether these are new jobs or whether workers have simply transferred from one activity to another.

With regards to both income and employment multiplier effects, workers such as Shang (1990) have pointed out that there are many practical problems in the calculation of these measures of secondary benefits. Detailed information is needed about the relevant economy. In fact, because of the apparent constant misuse of multipliers, values quoted should be treated with caution.

Once again, in the case of salmon farming in the West of Scotland, it has been pointed out that although jobs have been generated, the rural communities may also be exposed to certain social and economic risks by the emergence of this new industry. In particular, communities which become heavily dependent on salmon farming, and switch away from more traditional occupations, may be increasingly vulnerable to external financial strains and 'boom and bust economics ' (Scottish Wildlife and Countryside Link, 1990).

QUESTION 3

Has aquaculture generated benefits for the consumer other than the increased supply of fish?

Answer

The three most obvious benefits have been a noticeable decrease in the price of some species, an improvement in quality and the creation of new products. In the case of fresh salmon in the UK for example, the retail price (adjusted for inflation) has declined over the past 5 years in comparison to other important species (Table VI), and undoubtedly there has been an increase in consumer surplus for this product. However, a continuing fall in market price, associated with oversupply problems and competition from non-EC producers may ultimately threaten the viability of the industry itself (Fishing News, 1991). The question of industry viability is explored further below.

In the case of shellfish, aquaculture production from isolated regions (away from population centres) ensures that consumers will receive a high-quality product with minimal health risks. In the case of the large-scale production of mussels in the Netherlands, the industry has developed a good reputation for a well-graded uniform product with good opportunities for product differentiation based on a steady supply of quality raw material.

QUESTION 4

Has aquaculture produced any other beneficial social impact?

Answer

It may be argued that aquaculture in the appropriate situation can be a focus for rural development and stabilization. Once again, the creation of employment opportunities in depressed rural economies has been important in regions such as the West of Scotland and the West of Ireland. For the regional economies of Brittany (France) and Northern Spain,

Table VI. Price trends for UK salmon in comparison to cod and lemon sole 1981-89 (average deflated price, £/kg) (from Shaw et al., 1990)

Year	Salmon	Cod	Lemon sole
1981	2.9	1.12	1.43
1982	2.9	1.32	1.66
1983	2.8	1.27	1.66
1984	2.7	1.23	1.45
1985	3.1	1.37	1.71
1986	3.3	1.42	1.60
1987	1.7	1.51	2.11
1988	2.3	1.39	2.00
1989	2.1	1.13	1.89

the labour intensive shellfish aquaculture industries continue to be an important source of full- and part-time employment.

However, it must also be recognized that aquaculture as a focus for rural development under the wrong circumstances is capable of producing as unsatisfactory an outcome as any other activity. If aquaculture is to be promoted as a new component in any rural economy, it must be carefully evaluated using a wide range of criteria (social, technical, environmental, economic, etc.). Without such evaluation, aquaculture may evolve into a 'resource sink', consuming capital, labour and intermediate products while generating few benefits in return. An extreme example here from outside Europe is the case of aquaculture development in Sub-Saharan Africa where nearly US$100 million had been invested in development projects in the 1980s. However, there has been but a negligible increase in fish production for this region (Neiland, 1990).

With regard to aquaculture development in the EC, the problems currently facing the salmon industry highlights a number of key issues relating to the role of aquaculture in regional aquaculture development. In particular, should aquaculture be seen as a focus for economic development, with regional selective assistance schemes providing capital investment for business development, or, should market forces alone dictate industry development and structure?

It can be argued that given the high risk associated with aquaculture activities, any inclusion of explicitly short-term social objectives (employment, business type, etc.) as a trade-off against viability and profitability leads to a danger that enterprises will be selected with a poor chance of long term survival. Those businesses that are financially strong are more likely to survive in the face of adverse changes in the environment and by supporting the strongest businesses, social as well as economic objectives will be achieved (Shaw and Bailly, 1990).

Finally, it should be noted that social issues such as income distribution and labour/community mobility have not been studied with reference to the European aquaculture to the best of our knowledge. In other parts of the world, particularly SE Asia, the social impact of aquaculture has been given more attention. For example, Bailey (1988) provides an interesting study of the social impact of shrimp aquaculture development.

QUESTION 5

Has aquaculture produced significant economic benefits where development has occurred?

Answer

This is the most important question overall and one which is the focus of intense debate between opponents and proponents of aquaculture. It is also the most difficult to answer given the poor status of the social and economic databases. The available information (*prima facie* evidence relating to economic impacts) seems to indicate that aquaculture can generate significant social and economic benefits at a regional level.

Up until now there have not been any detailed studies in Europe to attempt to quantify the potential economic value of proposed aquaculture development projects or programmes (*ex-ante* evaluation). As shown above, it is possible to identify the more obvious economic impacts (costs and benefits) which might be used as a basis for future CBA-type studies.

For any CBA approach though, it cannot be denied that major problems exist in attempting to evaluate and compare the numerous variables that could be included in any study. For example, how might one compare or prioritize the objectives of increased fish production or generation of employment with the objectives of wilderness conservation or preservation of social structure? Or in other words how does one rationalize a decision taken over the use of resources in a particular activity such as aquaculture (as opposed to an alternative) in a particular region? For many people with an interest in aquaculture or the regions where aquaculture is developing, the question is often one of how to rationalize economic (and social) development with environmental protection. (Of course there is also likely to be a significant political element here which we have not really touched on in this paper).

The situation is particularly acute in many coastal zone areas where marine aquaculture has developed (Neiland and Nowell, in press). Government policy-makers are increasingly faced with difficult decisions over access to resources in such situations. Few countries in the world have any form of co-ordinated coastal zone management plan, and there is an obvious need to examine the possibilities for the integration of activities in order to avoid resource usage conflicts and prevent environmental damage while sustaining an appropriate level of economic activity.

It can be argued that economic analysis techniques such as CBA have an important role to play in addressing such important issues. Within the last 10 years, there has been a significant development of methodology to allow the evaluation of factors such as environmental impact of new developments (Winpenny, in press). While admitting that such techniques have their limitations, proponents such as Pearce and Nash (1981) prefer to emphasize their usefulness as follows: "... the discipline of CBA (or a similiar formal technique) at least forces the process of evaluation to list all gains and losses and to weigh up their relative values. This may seem a small virtue. But in a world where decisions are made more often than not on irrational assessments, it could remain the single most important attribute of any calculus designed to assist the decision-making process" (p.4).

Finally, while emphasizing the poor status of the social and economic databases for aquaculture in Europe throughout this paper, it should be pointed out that the CEC has recently funded a series of Europe-wide socio-economic studies in aquaculture. The results will be a welcome addition to the existing information-base.

Conclusions and recommendations

a) The social and economic impact of aquaculture has not been subject to rigorous evaluation, and information in general is very limited in this field.

b) The available evidence *(prima facie)* indicates that aquaculture can generate significant social and economic benefits at a regional level.

c) The increasing competition and conflict between aquaculture and other resource users calls for a rigorous examination of the possibilities for the integration of different sectors of the economy, and the evolution of government policy.

d) It is clearly the case that although the important issues relevant to aquaculture development can be agreed upon by all interest groups, the major problem facing policy-makers is how to decide on priorities for action.

e) Economists, alongside other disciplines have an important role to play in providing information on the interaction of important variables to assist decision-making policy evolution.

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