



SEACASE SUSTAINABLE EXTENSIVE AND SEMI-INTENSIVE COASTAL AQUACULTURE IN SOUTHERN EUROPE

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FRANCE

IFREMER – INSTITUT FRANÇAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER

CREAA – CENTRE RÉGIONAL D'EXPÉRIMENTATION ET D'APPLICATION AQUACOLE

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SUMMARY

The main goal of SEACASE was to develop tools for the maintenance of competitiveness, productivity and profitability of extensive and semi-intensive Aquaculture production in Southern Europe. This should also minimize its environmental impacts and improve the quality and public image of its products. The project was based on case studies covering a wide variety of extensive and semi-intensive coastal aquaculture systems within different geographical locations (Portugal, Spain, France, Italy and Greece). This should contribute to a better management of coastal areas of particular ecological interest, support sustainable production and create employment opportunities/security in rural zones with special emphasis on the socio-economic and patrimonial value of those systems. The results showed that those systems are not far from requirements for EU organic certification (CE n° 710/2009) and have an important ecological role in the sustainability of coastal wetlands. Quality assessment obtained during the project permits differentiation of the products coming from these systems, and quality markers may be a starting point for the creation of a complete certification system of non-intensive aquaculture products, at the European level. A more “natural image” could help to maintain the economic sustainability of this type of aquaculture, matching market demands of those consumers who are concerned with welfare considerations and environmental protection. In conclusion, the outcomes of SEACASE address the new strategy for European Aquaculture (COM(2009)162) with special emphasis on low technology aquaculture systems.

CONTEXT

Traditional extensive coastal and semi-intensive aquaculture systems in Southern Europe are facing difficulties, mainly due to increased competition for coastal areas by other types of uses and to market competition from low-priced products from intensive aquaculture. However, the positive effects of extensive and semi-intensive aquaculture in coastal areas – including environmental protection and restoration in areas of particular ecological interest, employment opportunity and development in rural and coastal areas - have been clearly recognised within EU policy. Optimisation of existing protocols, and development of new farming protocols to enhance the productivity of ponds and lagoons, or using certification to add value to products from extensive and semi-intensive systems, could render these activities more economically effective and attractive for new generations of farmers.

Although aquaculture as a whole is a business activity and should be managed for economic profitability, in some areas, extensive and semi-intensive coastal aquaculture has a societal function by structuring the territory and maintaining the ecosystem's functionalities and services derived from it. Furthermore, these types of systems are in general environmentally friendly activities and this image provides added value, which needs to be evaluated and promoted.

The concept behind the SEACASE project was the evaluation of the strengths and weaknesses of such systems in order to measure their sustainability. Furthermore, the case studies within the project addressed technical and management instruments, which ensure the strategic importance of such systems not only in terms of food security, but also for poverty alleviation in areas outside the European space.

PROJECT OBJECTIVES

QUALITY

- Development of environmentally-friendly farming protocols for certification opportunities;
- Promotion of Codes of Conduct in European Aquaculture;
- Promotion of product safety and animal welfare.

COMPETITIVENESS

- Development of technological improvements for optimizing the production of extensive and semi-intensive aquaculture systems;
- Better dissemination of knowledge on production processes in Southern Europe;
- Promote the diversification of aquaculture products;
- Promote income diversification strategies.

ENVIRONMENT AND SOCIETY

- Preservation of wetlands and coastal areas of particular ecological interest;
- Develop innovative diets to reduce waste output;
- Assess socio-economical relevance of the sector;
- Promote employment opportunities.

RELEVANCE OF SEACASE TO EU POLICIES AND REGULATIONS

1. **Commission Regulation (EC) No 710/2009** on organic aquaculture animal and seaweed production and **Commission Regulation (EC) No 889/2008** on Organic Regulation of Aquaculture products

In western Mediterranean and South Atlantic countries aquaculture in coastal lagoons and estuaries, including earthen ponds, is the traditional production system. The Council Regulation (EC) No 834/2007 had defined organic production and labelling of organic products which together with the new regulation on organic aquaculture animal and seaweed production (Regulation (EC) N° 710/2009) show that extensive and semi intensive farming systems currently used in Southern Europe are not far from requirements for EU organic certification according to SEACASE project results. The main bottlenecks to be implemented in such systems are the origin of aquaculture animals, the availability of organically certified feeds, the establishment of a management plan detailing bio security and disease prevention practices. Solving those limitations, organic is a potential strategy for valorization of the extensive and semi-intensive products. However this might not be immediately implemented, because the high cost of organic feeds (35%-40% higher), the shortage and prices of organic fry for on growing will increase the price of fish and there is not yet a clear image of the economic benefits of the association of organic to the extensive and semi intensive systems.

The Organic Aquaculture Certification System, already in use within Europe was carefully studied and discussed during the SEACASE project, as it was considered a very inspiring and useful system. Nevertheless, not all organic aquaculture production rules are easy to apply to extensive and semi-intensive farming systems, as these were mainly designed for highly controlled intensive systems. In addition, as the organic certification also applies to intensive aquaculture, it will limit the image benefits and added value that non-intensive may bring. Consequently, an independent and complete Certification system

must be created for non-intensive aquaculture, based on the experience obtained with the implementation of Organic Aquaculture.

Within SEACASE, six codes of conduct focusing on the non-intensive farming practices of each participating country were developed based on internal and external discussions, general collection of bibliographical data, and national reports on certification procedures. This process culminated in the development of a proposal for a Joint European Certification System for products from Sustainable Non-Intensive Aquaculture, which summarizes specific codes and suggests main guidelines for their implementation through a new and complete certification system. These codes must be considered as a support for discussion and sharing experiences among the different involved stakeholders.

The most important aspect of Organic Aquaculture Certification, that limit its application to extensive and semi-intensive farming systems, are:

- a) The number of chemical therapeutic treatments permitted per year in Organic Aquaculture is an example of a limitation that does not make sense in non-intensive systems. Although several prophylactic measures can and should be used to reduce the probability of disease in both systems, cages and high-flow tanks (typical of intensive systems) are completely different from earthen ponds and lagoons of huge dimensions (typical of non-intensive farming), where prophylactic measures are much more difficult to apply.
- b) Densities present on organic specifications also seem to have been designed for cages or other small structures typical of intensive farming, being completely different from the common densities of non-intensive systems, which have unique local characteristics that must be taken into account case by case.
- c) It seems paradoxical to operate at such low densities and still prohibit the use of oxygen, a common practice in southern countries where water temperatures easily rise above 25° C during the summer. Working without

oxygen at these temperatures has a negative impact on fish welfare and although Organic legislation allows the use of liquid oxygen under these circumstances, this might compromise the normalisation/standardisation of certification between countries. Considering that each country has the ability to decide on how many times the use of oxygen should be allowed, maybe an addendum could be made to Organic legislation to allow the use of oxygen above certain temperatures.

- d) Certification of the origin of eggs, juveniles or any other animals, whose input is necessary to start production cycles. Some non-intensive systems only count on the recruitment of wild juveniles from the environment, so it is impossible to certify their origin.

In conclusion, it can be said that Organic Aquaculture and Non-Intensive Aquaculture Certifications are different systems, despite showing some similarities and many comparable concepts. Therefore, their implementation should be independent and never mutually exclusive, as European aquaculture will benefit from the implementation of both systems.

2. **Council Directive 79/409/EEC** of 2 April 1979 on the conservation of wild birds

The SEACASE project did not intend to directly study the problems associated with cormorants and other ichthyophagous birds, but this necessity emerged during the study. Piscivorous birds have a significant impact on systems, such as valli and earthen ponds, oriented toward gilthead seabream production. A drop of 30% in annual production from SEACASE activities was directly imputable to ichthyophagous bird predation on seabream stocked in valli, and up to 42% of gilthead seabream weighing 160-1350 g were affected by injuries or scars made by birds. Their impact on stocked fish could be either direct, when they are successful in catching them, or indirect, because of the development of secondary infections or injuries in the escaped fish, or there can be a general lowering of performance due to different factors (e.g., stress, anomalies in lateral line as a consequence of scars, lower accessibility to local sites with higher

trophic availability because of higher abundances of predator birds). Furthermore, they disrupt fish migration toward fish barriers, scattering fish on their way toward summer pasture zones and provoking death for cold during wintertime. A detailed review of this problem has been recently compiled by ICES¹ (ICES Advice 2009, Book 11). The pressure of ichthyophagous birds on fish is particularly significant because the greatest abundance of wintering ichthyophagous birds takes place when fish form large migratory aggregations toward seawater. Ichthyophagous birds augment their presence from the end of September, reaching a maximum on mid-October. Part of them nest in valli, especially where fish biomass is higher. Taking into account the large extension of extensive ponds and valli, and that almost all extensive productions are carried out in wetlands protected by the Ramsar Convention (Iran, 1971), or are SCIs (Site of Community Importance, according to the EU Habitats Directive, 92/43/EEC) or SPAs (Special Protection Areas, according to the Bonn Convention on the Conservation of Migratory Species of Wild Animals, 1979) or else WWF oases, the countermeasures allowed to prevent bird predation on stocked fish are totally insufficient. ICES has already reported on the lack of knowledge on the overall impact of predation by cormorants on the prey populations. The European Community should face this problem in order to identify best practices in protected areas to prevent excessive impacts by piscivorous birds on extensive aquaculture and natural fish populations. Extensive aquaculture has been for centuries the main driving activity that economically justified the expenses sustained by private parties to manage and maintain the vitality of such fragile ecosystems (as wetlands) but bird protection is at present making it no longer sustainable from an economic point of view in many areas, with profound ecological, social and historical consequences.

¹ International Council for the Exploration of the Sea.

3. **Council Regulation (EC) No 104/2000** of 17 December 1999 on the common organization of the markets in fishery and aquaculture products (and amending acts). L 17/22-49

Principles are designed for producers and interbranch organisations to exist and act in the collective name of producers. They are instrumental to market development and particularly to set certification schemes. Under certain conditions such organisations can be the channel to receive public aid. They are also key to any other purposes that request a coordinated action among the producers and to represent them. As soon as a significant quantity of a given production calls for market development action, so as to avoid the limitation of local markets, the status granted by this regulation may be of interest to producer associations.

4. **Council Regulation (EC) No 1198/2006** of 27 July 2006 on the European Fisheries Fund. L223/1-44

This regulation sets the principles to grant Community support to fisheries and aquaculture so as to reach the objectives of the Common Fisheries Policy. Recognizing that for structural reasons these cannot be achieved without appropriate support and that in many areas this is better placed at the European level, the regulation becomes the framework for distribution European funds. Art. 30 sets that in the case of aquaculture, among others, micro and small size enterprises should be given priority. This particularly applies to many of the situations encountered in extensive and semi-extensive aquaculture in Southern Europe. Environmental sustainability being a major concern of the CFP, any technical or organisational innovation that helps aquaculture to be well integrated in the natural environment should also find support from the European Fisheries Fund.

5. **COM (2007) 575 final.** Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. An Integrated Maritime Policy for the European Union. 16p.

The coastal zone management and sustainable development of aquaculture are two major concerns of the Integrated Maritime Policy for the EU. This communication advocates for a better articulation between the onshore activities and marine space. It recognises a need to extend planning exercises from land towards the sea and to integrate in land planning the potential consequences on the use of marine space and ecosystems. Extensive and semi-intensive aquaculture should be considered as an activity that can generate jobs while contributing to maintain functional ecosystems in the wetlands and lagoons with a very limiting impact on marine ecosystems. It places high expectations in the fact that products with high environmental performance will become more and more competitive as environmental restrictions increase worldwide. The quality of products in relation to public health is also emphasis. As closed or semi-closed coastal ecosystems are subject to toxic blooms that affect the aquaculture production, and particularly shellfishes, it is important that adequate monitoring systems and codes of practice be implemented.

6. **DIRECTIVE 2008/56/EC** of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). L 164/19-40

Compared to intensive aquaculture, extensive and semi-intensive aquaculture exerts a reduced pressure and impact on the marine environment, and contributes to maintaining the good ecological status of wetlands such as marine bays, estuaries, salt-marshes and coastal lagoons. Among the 11 qualitative descriptors proposed to define the good ecological status of the marine area (0-200 nautical miles), four of them particularly associated with the environmental impacts of marine aquaculture:

- Descriptor 1: “the biological diversity maintained”

- Descriptor 2: “the ecosystem non altered by non-indigenous species ”
- Descriptor 5: “the human-induced eutrophication minimised”
- Descriptor 6: “sea-floor and benthos integrity”

Nevertheless, in this Directive, aquaculture is cited only in Annex III, in the indicative list of pressures and impacts considering eutrophication risk by nutrient and organic matter enrichment. However, in some types of semi-intensive aquaculture, such as in low technology earthen ponds where organic matter mineralization largely occurs inside the ponds, application of this aspect of the directive does not make sense. Within the case studies performed during the SEACASE project involving multitrophic systems and semi-intensive polyculture in earthen ponds, have shown that extensive and semi-intensive aquaculture systems may be an environment friendly activity, and impacts and pressures are negligible.

7. **COM (2009)162 final** Building a sustainable future for aquaculture: A new impetus for the Strategy for the Sustainable Development of European Aquaculture. 12 p.

This communication states that “the EU aquaculture industry of the future should be at the forefront of sustainable development. The appropriate measures must be put into place to ensure that our industry can take a lead role in the “blue revolution”, whether this concerns the production of aquatic food itself, technology and innovation, or the setting of standards and certification processes at EU and international level. In order to achieve this goal the Communication aim is to help spring about the conditions for a successful and sustainable aquaculture industry that can compete successfully in the market. The industry should be able to cover the whole supply chain including both high value and innovative products, which meet the needs of consumers in the EU and abroad...”. Extensive and semi-extensive aquaculture are a potential source of high value and innovative products in aquaculture. But to ensure their economic viability, collective schemes to set standards and to gain recognition of certification must be supported. The same applies to the cost of constraints set by environmental legislation and to ecosystem maintenance role of aquaculture that must be fully recognized.

Seven years after the first EU strategy for sustainable aquaculture development the new COM (2009)162 makes a critical analysis of the causes of stagnation of European production in the current delicate economic context and again highlights the challenges to be faced in pursuing the sustainable and competitive growth of European aquaculture. Despite the progress made, with an output of 1.3 million tonnes, a workforce of 65000 employees and a turnover of 1.3 billion euro, European aquaculture still has room for improvement, interventions and investments in order to ensure the environmental sustainability and economic viability of the sector. The loss of competitiveness of extensive and semi-intensive coastal aquaculture is not addressed directly in the Strategy but several of the challenges and proposed solutions for development in the sector can contribute to revitalizing extensive and semi-intensive productions. On the strength of the SEACASE project results, the following measures contained in the strategy need to be taken in order to guarantee the solidity and clarity of future European, national and local supporting policies: the maintenance of small and medium enterprises development and employment in rural and coastal areas; the application of the principle of subsidiarity and the introduction of mechanisms governing the participation of stakeholders at local and Europe-wide level; the simplification of the regulatory framework through the creation of aquaculture regulations to govern the sector and which is allowed sufficient scope in the reforms of Common Fisheries Policy; the implementation of coastal spatial planning, to defuse conflicts and to establish synergism between the aquatic activities and the environment, acknowledging the strategic importance of coastal aquaculture; the reduction of the administrative burden, especially for small and medium enterprises, the principle of environmental sustainability in European aquaculture and the implementation of European regulations (WFD) to guarantee an aquaculture-friendly environment in transitional and coastal waters; the implementation of environmental policies and instruments aimed at the development of forms of environmentally friendly aquaculture in the Natura 2000 sites; allocation of budget at European and national level for technological development at the service of sustainability and to further develop the knowledge-base for sustainable and competitive aquaculture practices; promotion of aquaculture's image and increased competitiveness by setting of

standards and certification processes. The SEACASE Consortium fully supports the vision and objectives of the strategy and further endorses the Commission's invitation "to recognise the importance of extensive and traditional forms of aquaculture and to consider the possibility of developing production in existing sites and facilities" addressed to member states and public authorities at national and regional levels.

8. **DIRECTIVE 2000/60/EC and DIRECTIVE 2008/105/EC** on of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council

Extensive bivalve culture is totally dependent on the quality of seawater considered in the DIRECTIVE 2006/113/EC of the European Parliament, and of the Council of 12 December 2006 on the quality required of shellfish waters. Bivalve culture must have a sea water of high chemical and microbiological quality. A better quality control in shellfish waters is essential to maintain the culture of bivalves in coastal wetlands, and promote its development. Integrated systems associating fish, algae and bivalve has seen major developments by scientific community and farmers at an experimental and pilot-scale levels in Europe and America. Policies and directives on quality of sea waters for bivalve culture should be amended in order to consider integrated systems as a possible development.

9. **COM (2009)163 final** Green Paper. Reform of the Common Fisheries Policy. 27 p.

The contribution of oceans and seas, as a source of food and energy is of considerable importance for the economic prosperity of the European citizens. However these large ecosystems are not inexhaustible, and face considerable problems like environmental degradation, loss of biodiversity and pollution, among

others. The new challenges resulting from climate change are demanding innovative solutions and initiatives. This was clearly stated by the new CFP, where the close integration of the different stakeholders involved on the fisheries sector is considered to be the key for the problem. The concept "from the net to plate" is the base to assure a full transparency to authorities and consumers about fish, a major source of high quality animal protein, and the healthiest fat in animal production.

The SEACASE project's main goal was to identify the potential of different types of low-impact aquaculture technology systems ensuring their economic and environmental future. Taking into account that growing concerns about food security in the EU and worldwide has become an important issue, the results of the project provide information about quality differentiation of fish produced among the intensive and non-intensive systems, and will thereby promote integration among retailers and producers. This integration might be carried out at the Regional Advisory Councils (RACs), established under the new CFP.

More than 75% of European fish stocks are being fished beyond the MSY (COM 163), but at the same time fish consumption is increasing in Europe, so aquaculture is the obvious answer. However, European aquaculture, which has the potential to become an important economic activity, has been stable during the recent years. In addition, the conflicts within the coastal area for setting new farms and the competition with low-priced products from intensive systems have had a negative impact on low technology systems. Within SEACASE technical improvements (development of eco-friendly feeds, better slaughter methods, and the use of molecular tools for species/strains identification), environmental integration (effluents quality, multitrophic systems, promotion of natural feeds, conservation of coastal areas), patrimonial and economic assessment were all integrated. The project results support the concept that extensive and semi-intensive models of Aquaculture as a food production sector should be a fundamental pillar of the CFP, and should be supported at a national level (within regional programmes) but also at the European level. Competition between extensive/semi-intensive systems and intensive ones should stop. The target market for both systems should be differentiated, and this will only be possible by addressing all the different stakeholders and reconciling their interests. The ecological approach highlighted

through SEACASE provides basic information to be further developed and improved, and supports CFP policy on the ecological sustainability of aquaculture, as new strategy to overcome the bottlenecks identified in COM(2009)162. The new ACFA (Advisory Committee for Fisheries and Aquaculture), at EU level, and the RACs, at the regional level, might play a key role as advisory boards to support the CFP. The SEACASE economic and patrimonial results demonstrated that there are some human activities whose value cannot be fully appreciated only by the market value, and such is the case for the aquaculture systems studied within the project. In particular, the extensive systems are public assets, which produce an ecological benefit higher than the economic return, as it will maintain natural habitats, supporting a wide species biodiversity in coastal areas. In the short term this should be included within the IMP (Integrated Maritime Policy) to ensure the protection of some marine ecosystems, and provide support to such activities. SEACASE case studies provide examples of good practice that might be promoted more widely, such as the contribution of coastal ponds/lagoons for the European Eel Management plan. The main source of EU support of coastal regions has been the cohesion policy, namely the structural funds, which had contributed for convergence regions to become more attractive to business. This support should be continued to foster the patrimonial heritage of extensive aquaculture and the management of coastal wetlands, and at the same time prioritize research strategies and provide adequately funded research programmes. The CFP should support initiatives leading to certification and labelling of aquaculture products coming from these systems, bring together producers organizations and retailers, and once again the RACs might play here an important role.

10. COM (2009) 466 final Communication from the Commission to the Council and the European Parliament towards an Integrated Maritime Policy for better governance in the Mediterranean. 11 p.

The Mediterranean is of particular concern for the implementation of the European Integrated Maritime Policy. The human pressure on its fragile ecosystems is very high and continuously increasing. Setting an efficient governance framework to reach sustainability objectives is very challenging

regarding the number of countries and their differences in economic development and legislation. Lagoons, wetlands, delta and other transitional waters are key components of the ecological richness of the Mediterranean and they are the most threaten by urbanisation and water pollution. Very important aquaculture productions, of finfish and shellfish are found in these areas. Some have developed recently and are likely to face sustainability problems while others are declining. Developing coordinated policies, sharing experience and promoting a balanced development of aquaculture and protection of the environment in transition water is an essential contribution to the objectives set by this communication.

11. Common Agricultural Policy (CAP)

The development policies for the aquaculture sector should have to be 'equipped', as was done for rural development in agriculture, with instruments to support the enterprises involved and designed to reward utilization of the areas with methods having a high environmental value: in other words, defining a contribution to the extensive and environmentally friendly use of the areas involved. Only recognition of the environmental function of extensive production in aquaculture can justify support intervention that is not considered state aid liable to distort competition. In order to retain their varied functionalities, valliculture, culture in esteros, and other extensive systems, as with all activities having a strong environmental importance and expressing positive externalities in environmental terms, are in need of public intervention in order to enjoy equal market opportunities.

12. European Eel Management Plan

During the SEACASE project the high potential of earthen ponds and lagoons in the saltwater marshes of the Atlantic coast in France and in the Spanish South Atlantic coast as nursery for the European silver eel was demonstrated. Low chemical and parasitical contaminations and good ecological status are aspects

of particular importance. In spite of that, these marshes are often ignored within coastal management plans and research programs. Therefore, SEACASE decided to try to contribute to the sustainability of the endangered eel fishery, which is of high relevance to the European Eel Management plan. One of the main conclusions is that good management of those areas is needed, and the implementation of specific supporting measures alongside the stakeholders will contribute to the maintenance of those traditional ponds. SEACASE, after consultation with stakeholders, proposes concrete measures such as public-funded dredging, in exchange for eel restocking in marshes by pond owners. In addition, SEACASE developed monitoring tools to assess such restocking and other management measures to be implemented.

13. **Regulation (EC) No 1221/2009** on the Eco-Management and Audit Scheme (EMAS)

The EU Eco-Management and Audit Scheme (EMAS) is a management tool that helps public and private organisations to optimise their production processes, reducing environmental impacts and making more effective use of resources. The scheme is available since 1995 and has been revised several times (Regulation (EC) No 761/2001; Commission Decisions 2001/681/EC and 2006/193/EC) and recently by the Regulation (EC) No 1221/2009, with the integration of EN/ISO 14001.

The goal of this new regulation is to provide efficient instruments to enforce the green Europe's economies and to put in place the new environmental European legislation. EMAS has been included within other policies that have the same aim (Integrated Product Policy, Integrated and Pollution Prevention & Control). In case of aquaculture, the Regulation (CE) 1198/2006 on European Fisheries Funds (2007-2013) support EMAS in the framework of the aqua-environmental measures (art. 30) and consider granting compensation for the use of aquaculture production methods helping to protect and improve the environment and to conserve nature. EEF promote the participation of SMEs into EMAS and allow member state to fund initial costs incurred by aquaculture enterprises to join

EMAS certification, as well as investments for structural works aimed at rebuilding installation and improving water circulation in aquaculture enterprises.

The application of the voluntary Eco-Management and Audit Scheme (EMAS) to extensive and semi-intensive aquaculture systems may help to improve the transparency of the productive process and to reduce conflicts for space in coastal areas with other users within ICZM. Considering the growing environmental concerns and the public pressure for environmentally friendly products and services, EMAS may offer a unique chance to extensive and semi-intensive systems to demonstrate their good environmental performances and to certificate the investments in environmental protection and in the sustainability of farming operations.

The development of an EMAS certification for extensive and semi-intensive production has less disadvantages respect to organic production certification and may easily improve farm management in relation to environmental issues. EMAS may assist extensive and semi-intensive aquaculture farms to conduct an environmental review considering all environmental aspects of farming activities, the legal and regulatory framework and existing environmental management practices and procedures. After the environmental review, the responsibilities, objectives, procedures, training needs and monitoring procedures are established in a specific environmental management system specific for each farm. The application of EMAS to aquaculture was already successfully experimented in Italy in three coastal farms using intensive technology. The EMAS certification project improved farm management in relation to environmental issues, provided a statement to the three farms of their environmental performances and assisted farmers to get appropriate incentives.

RELEVANCE OF SEACASE FOR SUSTAINABILITY

Competitiveness

Maintaining the profitability of extensive and semi-intensive rearing, which when well managed are environmentally friendly production systems, improves the image of aquaculture and fits the ecosystem approach of the new EU aquaculture strategy. Identification of these types of production is important for consumers with environmental concerns and allows fair competition with intensive fish production. The issue of developing labels relying on positive images of these activities is essential. Furthermore, the possibility of combining aquaculture with multifunctional (tourist, educational, recreational, etc.) activities involving new generations of managers represents a focal issue for management continuity and the conservation of a traditional activity, both of which are essential for ecosystem protection.

SEACASE results indicate several ways to improve the productivity of extensive and semi-extensive fish farming in coastal ponds while maintaining or improving the sustainability of the activity. Case studies on integrated systems, polyculture systems and on the use of eco-friendly feeds supply the technical basis for improving competitiveness under the umbrella of sustainable procedures. Nevertheless, to obtain a complete and realistic vision of the economic and social profitability of these production systems, it is important to move forward in the evaluation of these benefits in terms of environmental and societal value.

Quality criteria measured during the SEACASE project showed it is possible to differentiate fish (seabream) reared under extensive or semi-intensive systems from those of intensive systems. Moreover, their good nutritional balance confers a great advantage, which can be communicated to consumers. The diversity of sensory characteristics observed, mainly in extensive systems, according to the location of the activity, can be used as a criterion of market segmentation, but it would probably need an analysis from a consumer point of view in terms of acceptability.

Nevertheless, the offer of a range of different products reared in environmentally sound conditions (no feed or feed controlled for its low impact to the environment in terms of water pollution) with specific characteristics can contribute to the development of this kind of activity. Moreover, consumers' choices are more and more driven by health considerations as well as environmental protection concerns and therefore the commercialization of a product with a more "natural image" could help to maintain or develop a sustainable aquaculture activity in certain areas.

Certification means value and sustainability. Currently, many high-quality aquaculture products are sold together and confusingly mixed with others of lower quality. Since consumers are not able to make a clear distinction between these products, the final price they are willing to pay is lower than it would be if they were sold separately.

Value-added products from non-intensive aquaculture will certainly contribute to the sustainability and future stability of these traditional farming systems with different organoleptic characteristics. Growing awareness amongst consumers of the attributes (high quality, freshness, exclusivity, etc.) that characterize aquaculture products from extensive, semi-extensive and semi-intensive systems is expected to foster their support for these activities, known to be closer to wild conditions and to have lower environmental impacts. This will obviously increase the competitiveness of traditional systems, by creating very interesting and exclusive niche markets for high-quality value-added products.

Environmental issues

The preservation of the ecological functionality of an extensive basin is closely linked to specific management planning. Each natural or managed infrastructure displays its own dynamics, which has to be addressed: each one of them is subjected to specific anthropogenic pressures from watersheds, which demand appropriate regulatory action at structural, functional and legislative levels, applying common rules. The management of these infrastructures requires the identification of appropriate physical, chemical and biological descriptors and their continuous

monitoring. The integration and elaboration of these data should be used to interpret ecosystem dynamics, to predict the direction towards which these infrastructures are evolving and thus to manage it by means of appropriate measures.

Wetlands morphology management and restoration are the basis of land production potential. As many areas suffer from a lack of hydraulic intervention this potential is diminishing every day and further ability to reuse such hydrosystems would incur extra costs to get back appropriate design and hydrology regimes. Natural infrastructure management to avoid silting, channel restoration to ensure appropriate hydrodynamism, hydraulic interventions based on lagoon and earthpond ecological and landscape features are the basic tools required to develop a productive strategy. Traditional conservation approaches aimed at leaving lagoons to their natural dynamics are destined to put them at the mercy of evolutionary processes, which generally lead to silting up and erosion. A legislative framework should be devised to allow hydraulic and other works in coastal lagoons and wetlands to be rapidly evaluated, regulated and implemented.

The environmental importance of the areas focused by SEACASE project is well recognised. However, SEACASE demonstrated that the role of these fish farming systems in the maintenance of the environmental value of these ecosystems is not well recognized by society and by many stakeholders. For instance, losses due to predation by wild fauna, with booming populations fomented by fish farming activity, are not being compensated. It is recommended to design strategies and tools to reward the sustainable utilization and maintenance of areas of high environmental value. In addition, the SEACASE Consortium recommends that extensive and semi-intensive aquaculture systems (land-based and sea-based) are formally considered compatible with coastal protected areas (Natura 2000, Marine Protected Areas)

SEACASE showed how extensive and semi-intensive farming activities together with other traditional methods that are no longer practiced moulded particular landscapes and social activities that still prevail after many decades or centuries in some places. Farmers wish to continue the aquatic activity, but recognition of their role in preserving wetlands needs to be acknowledged by society.

RECOMMENDATIONS FOR FUTURE RESEARCH

The SEACASE Consortium believes that the present project was important to assist the implementation of future policies that promote sustainable extensive and semi-intensive aquaculture systems in Southern Europe. The major issue of concern on environmental sustainability of extensive and semi-intensive production is related to the use of natural resources (wild seed, fish protein). SEACASE provide technical innovations to enhance resources conservation and to reduce environmental impact of extensive and semi-intensive farming practices. Still, the Consortium also believes that such implementation would strongly benefit from further support R&D and the knowledge-base for sustainable and competitive aquaculture activities, and that this effort would benefit from an European coordinated effort. Therefore, the SEACASE Consortium recommends the allocation of European budget for further research on:

- a) Development of hatchery techniques, preferably semi-intensive (mesocosm-based), for the complete replacement of wild seed with hatchery juveniles in a selected number of species of interest for non-intensive aquaculture;
- b) Preservation of genetic variability of hatchery juveniles by means of new genetic databases of natural population and of existing broodstocks, with the cooperation of European commercial hatcheries;
- c) Increased productivity and protection of fish welfare in extensive system through a deeper comprehension of gene networks playing a role in the cold adaptation process and marker assisted selections (MAS) of cold tolerant fish strains.
- d) Identification of fish welfare indicators and assessment of different non-intensive farming practices, including slaughter, on fish welfare.
- e) Development of methods to monitor biomass and feed intake in semi-intensive systems, and assess the relative contributions of formulated feed and natural food.
- f) Optimization the relative density of species used in polyculture under multitrophic approaches.
- g) Identification of effective prophylactic measures in order to minimize risks of disease outbreaks

- h) Techniques to optimise water flow and solids removal, maintaining water quality and minimizing environment impacts.
- i) Further work on cost-effective environmentally friendly, eventually organic, fish feeds, while maintaining fish quality under the consumers' perspective.
- j) Evaluation of production losses in extensive and semi-intensive fish farms due to ichthiophagous and other predators, and development of animal-friendly techniques to prevent major losses and/or creation of compensation to farmers for providing an environmental conservation service.
- k) Patrimonial assessment of all major of extensive and semi-intensive production systems, in order to evaluate and propose mechanisms for supporting farmers whom contribute with non-market benefits to public-interest wetlands.
- l) Collection and integration of information on coastal wetlands used for extensive and semi-intensive aquaculture practices into the Pan Mediterranean Wetland Inventory (PMWI) to promote the conservation and a wise use of Mediterranean wetlands, also for aquaculture activities.

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