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Code of Conduct in Aquaculture Integrated Systems

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The deliverable 76 consists in a Code of Conduct dedicated to aquaculture integrated systems. The main objective is to provide the farmers with a practical document, simple to implement, to be used as a basis for production decisions and activities in aquaculture integrated system. The Code of Conduct do not include the specific recommendations concerning the intensive fish culture system, which is generally the first element in an integrated system.

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Code of Conduct in Aquaculture Integrated Systems

• Introduction

The Workpackage 5 (Product Certification) of the international European project *Sustainable extensive and semi-intensive coastal aquaculture in Southern European countries* (SEACASE) includes the elaboration of Codes of Conduct for the aquaculture systems studied during the project work. These case studies are typical of the countries involved, namely polyculture (Portugal), extensive polyculture (esteros) (Spain), integrated systems (France), valliculture (Italy), nursery ponds (Greece, Portugal, France and Italy) and eel ponds (France). These 6 systems correspond to 6 separate deliverables of the project. Specificities of each system justify the production of 6 different documents.

The Code here presented was designed to be used exclusively by extensive and semi-intensive farming systems, considering FAO definitions (FAO, 2008). These systems can be considered separately from intensive systems and have their own advantages and disadvantages. This Code was produced in order to make advantages more precisely defined and perceptible from insiders and outsiders, as well as to minimize some of the disadvantages. Consequently, it is applicable to systems that are recognized as “non-intensive”, which include:

Extensive aquaculture *- production system characterized by (i) a low degree of control (e.g. of environment, nutrition, predators, competitors, disease agents); (ii) low initial costs, low-level technology, and low production efficiency (yielding no more than 500 kg/ha/yr); (iii) high dependence on local climate and water quality; use of natural waterbodies (e.g. lagoons, bays, embayments) and of natural often unspecified food organisms. (FAO, 2008)*

And also include systems considered to be as

Semi-intensive aquaculture *- systems of culture characterized by a production of 2 to 20 tonnes/ha/yr, which are dependent largely on natural food, which is augmented by fertilization or complemented by use of supplementary feed, stocking with hatchery-reared fry, regular use of fertilisers, some water exchange or aeration, often pumped or gravity supplied water, and normally in improved ponds, some enclosures, or simple cage systems. (FAO, 2008)*

Semi-intensive systems can be considered as intermediate systems, somewhere between the natural conditions of the wild environment and the highly controlled intensive systems. The perceptible image of both the non-intensive farming as an activity, and the products obtained by these systems, must reflect their advantages (for example, more natural environment for the farmed species, feeding more close to what happens in nature, less human control and interference, lower densities to manage at the same time, etc.) and, at the same time, not hiding eventual disadvantages (like the use of artificial feeds, less uniformity of the lots, etc.). The complete and realistic information to the consumers, with the demystification of some wrong ideas, is considered as a key factor and the only way for achieving the market added value that the non-intensive products are expected to have.

• Objective

The general objective of these Codes is to provide a base document for producers of non-intensive farming within the EU, in order to give them voluntary and recommended general procedures, guidelines and attitudes to achieve a more sustainable production. It is expected that these codes may become the basis of a future voluntary certification system for non-intensive production which can be perceptible to consumers. It takes mainly into account the farmed animals, water and environment, work conditions along the fish chain and final consumers.

• Other Codes and Guides

There are many different Codes and similar guidance documents dedicated specifically to aquaculture and fisheries. Some examples are (Table 1):

Name	Organism	Products	Reference or website	Year
Code of Conduct of European Aquaculture	Federation of European Aquaculture Producers (FEAP)	farmed	http://www.feap.info/feap/code/default_en.asp	2000
Code of Conduct for Responsible Fisheries	Food and Agriculture Organization (FAO)	wild	http://www.fao.org/fishery/ccrf/en	1995
Code of Conduct of Australian Aquaculture	Australian Aquaculture Forum	farmed	http://www.pir.sa.gov.au/__data/assets/pdf_file/0007/42955/code_of_conduct.pdf	no date
Code of Conduct for Shrimp Farming	Marine Shrimp Culture Research Institute (Thailand)	farmed shrimp	http://www.thaiqualityshrimp.com/eng/coc/home.asp	2002
Code of Conduct	Washington Fish Growers Association	farmed fish	http://www.wfga.net/conduct.php	2002
Code of Good Practice for Scottish Finfish Aquaculture	Scottish Salmon Producers' Organisation	farmed fish	http://www.scottishsalmon.co.uk/aboutus/codes.asp	2003
Better Aquaculture Practice	Global Aquaculture Alliance (GAA)	farmed shrimp	http://www.gaalliance.org/code.html	no date
International Principles for Responsible Shrimp Farming	FAO, NACA, UNEP, WB and WWF	farmed shrimp	http://www.enaca.org/modules/shrimp/index.php?content_id=1	2006
Code of Conduct for Responsible Fishing Operations	Fisheries and Oceans, Canada	wild fish	http://www.dfo-mpo.gc.ca/fm-gp%5Cpolicies-politiques%5Ccccrfo-cccppr-eng.htm	1998
Environmental Best Management Practices for Aquaculture	Tucker C.S & Hargreaves J.A (eds)	farmed fish	http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0813820278,descCd-tableOfContents.html	2008

• Key concepts for these Codes

The following are key-concepts that aquaculture-related codes tend to respect and try to implement (Consensus, no date):

Sustainability: aquaculture is an increasingly sustainable activity, and is developing in a way to complement traditional fisheries. Sustainability is now being used as a central idea for many legal diplomas, guiding and certification documents and other publications. Sustainability is a concept not easy to define, when applied to aquaculture: "**Sustainable aquaculture** is a system that can evolve indefinitely toward greater human utility, greater efficiency of resource use and a balance with the environment which is favourable to humans and most other species" (Consensus, no date). According to FAO, sustainable aquaculture involves *"management and sitting of farms and the use of natural resources – with their social implications and institutional orientations – that ensures economic viability, societal equity and acceptable environmental impacts"*. "**Sustainable development** involves devising a social and economic system, which ensures that these goals are sustained, i.e. that real incomes rise, that educational standards increase, that the health of the nation improves, that the general quality of life is advanced" (Consensus, no date). Many involved in aquaculture and certification systems believe that "*Sustainability in its true meaning can't be certified*" (Ojeda, 2008), due to the arguable character of expressions like "*a system that can evolve indefinitely*". But, within known and reasonable limitations, the concept can be understood, although not exactly certified. Products that are produced under sustainable systems can be certified to be as such.

Sustainability can be faced taking into consideration 3 components: environmental, economical and social. Environment is the most immediate and easily perceived component, but the sustainability of the economical and social components is now at the same level of importance.

Safety: seafood produced by aquaculture is by far more subjected to quality evaluations and controls than products harvested from the wild. Safety in all food items is expected by consumers and

searched by industry. Codes on farmed aquatic species must take into account the last available scientific and technical information about the safety of all aquatic products.
The safety of the work and workers in farmed product chain is also a basic concern in all produced Codes.

Dedicated marketing: seafood produced by aquaculture is generally more affordable than fish caught in the wild. This means farmed products must be understood as such, through clear information given to the consumers in order to allow an informed choice. Farmed products correctly identified and separated from the wild ones have specially dedicated market and consumers. If, as expected, wild products tend to be more rare and expensive, farmed products will benefit from an increasing market and value in the future. The creation of an adequate image among consumers is consequently a key factor for the future success of farmed products. A sign of these concerns is the actual obligation within EU of correct identification of the species and their origin for aquatic marketed species and derived products.

Traceability: in aquatic farming, traceability is the ability to follow the movement of a product of aquaculture or inputs such as feed and seed, through specified stage(s) of production, processing and distribution. Farmed products can be traced back right to the egg and to the parent fish. In all European countries, from a first stage of *recommended* traceability, this modern concept is now becoming compulsory for more products and processes. Codes of Conduct nowadays include references to traceability concerns.

Biodiversity: aquaculture can also be used to restock depleted fisheries for a wide variety of species, so it contributes also through this way to minimise environmental impacts of aquatic species.

Animal welfare: Animal welfare is nowadays one of the criteria used by the public when deciding whether a procedure or system is acceptable, so it is a necessary consideration for sustainability (Broom, 2008; EFSA 2009a).

• General data about aquaculture integrated systems

Non-intensive systems assume a great diversity in the Mediterranean area. Within the SEACASE project 6 different systems were selected as representative of the reality of project countries, each one corresponding to a separate deliverable and specific Code.

Edwards et al. (1988) crystallized the general definition of integrated aquaculture systems (IAS) as occurring when ‘‘an output from one subsystem in an integrated farming system, which otherwise may have been wasted, becomes an input to another subsystem resulting in a greater efficiency of output of desired products from the land/water area under a farmer’s control.’’ And for Folke and Kautsky (1992) a sustainable integrated aquaculture system is successful when it mimics, as much as possible, the way of the natural ecosystem functions.

IAS are not used frequently in Southern Europe as land-based farming systems, although (i) in Northern Europe several combinations of species have been successfully attempted in sea-based fish systems (salmon-mussel-macroalgae), mainly in Norway and Scotland to reduce the environmental impacts, or (ii) in tropical freshwater aquaculture. It is predictable that these systems will be more frequently used in a near future, therefore SEACASE project assumed this type of systems as deserving to be considered separately as a case study.

• Implementation requirements (Pedro Pousão)

Selecting the farming system

The farming integrated system (species, water circuits, feeding regime, etc.) should be chosen taking into consideration not only the local specificities but also the local resources, in order to respect sustainability and environmental characteristics of the implementation region. Examples of possible interferences are: with local populations, fishermen and fishing areas, other farmers already established, other types of industry or human activities, protected areas or special regimes that regulate activities, wild animals like other fish or aquatic species, birds and mammals, etc.

For the specific case of integrated farming, the associated species (cultivated downstream/around the intensive system) must be farmed in an ecological extensive way (as a trophic web), in order to balance in good proportions algal biomass and herbivorous species, natural preys and predators.

Selection of location and farm layout

The selection of the final location should be a result of a careful study of all local possibilities and interferences, taking into account factors like pollution sources and competition with other existing activities. Farm layout should be planned considering the location, corresponding neighbourhood and technical requirements (*e.g.* wind direction) in order to take advantage of the area natural features.

For the specific case of integrated systems a large land/sea area must be available around the fishfarm to develop associated species production.

Conflicts and legislation

Farming implementation and activity should follow all local, regional, national, European and international rules and legislation. If legal conflicts arise, the help of professionals in the area of legislation, preferably in the specific area of aquaculture, should be searched.

• Facilities, equipment and labour

Buildings and solid structures

Many extensive farming activities are located in protected areas, where some human activities, for example the construction of additional or new buildings, is restricted or forbidden. As farming sites tend to grow and the need of new buildings can increase with time (slaughter rooms are a good example of a recent need that was not predictable some years ago), this must me taken into consideration from the implementation phase, as the rules of protected areas must be respected by farmers and professionals of other activities.

Pond design and management

Water from the lower layers of a pond is generally of poorer quality than that near the surface. This can be especially true in terms of suspended solids, oxygen demand and nutrients. Pond drains should be constructed to allow water to leave the pond from the surface, not the bottom. Existing drains that draw from the pond bottom and incorporate external structures to regulate pond depth should be modified, during regularly scheduled pond renovations, to draw water from near the pond surface.

Ponds must be used in series, preferably rearing one species per pond, permitting to manage each pond in optimal conditions for each species (oxygen level, depth, water retention time, …)

Technical requirements

The most adequate technical equipments and procedures should be preferentially used by farmers in order to assure the best possible conditions for the farmed animals, the workers and the surrounding environment. In alternative, the use of traditional techniques proven to be animal-, worker- and environmental friendly should also be promoted.

Personal and labour requirements
The number of workers and their corresponding qualifications must be in accordance with the predicted activities and taking into consideration that extensive farming is in many aspects a seasonal and variable activity, which increases management difficulties.

Ethical issues (child work, gender issues, fair-trade approaches)
Ethical issues like those related with child work, gender issues, fair trade and others that can become relevant with time should be considered and respected, in all possible aspects, by farmers.

• Water and waste

Water sources, quality, use
Water sources must be correctly predicted and chosen, and the corresponding water quality must be adequate for the species farmed, in order to guarantee not only the conditions for farming and growth, but also their welfare and health status. Legislation about water use is normally very specific and restrictive and must be respected.
Keeping oxygen levels up improves feed consumption and conversion, and it enhances the natural processes responsible for breaking down waste products and cycling nutrients within the pond. Organic matter will be more readily oxidized, the solubility of phosphorus will be reduced and nitrogen losses will be increased, all of which improve fish production and the quality of any effluents the pond may discharge. Aerators should be positioned and operated to minimize erosion of pond levees and bottoms.

Water treatment and discard
Aquaculture, including all production systems, needs water and consequently provokes some sort of impact on the environment.
The main source of pollution associated to aquaculture is feeding which includes the particulate matter (faeces, uneaten feeds, and nitrogen-phosphorous compounds) and soluble material like N and P from shellfish and fish metabolism (the nutrient excretion like ammonia and urine).
The choice of adequate feeding methods is a powerful tool to reduce feed wastes, but the decision on the use of those methods is largely based on a cost-benefit analysis (equipment x labour), as some feeding methods have clear advantage for given species / fish sizes and farming systems.
Most aquaculture ponds must be drained for inventory adjustments or to allow for levee repairs and restoration of depth and slopes. When ponds must be drained, if possible avoid releasing water from the pond while it is being seined or immediately afterward. Holding the last 10 percent to 20 percent of the pond water for two to five days before discharge can significantly reduce nutrient loads in effluents because many nutrients are bound to particles of sediment, which can settle out of the water column before discharge.
Adequate treatments of the discarded water should be implemented and used regularly, in order to reduce the effects of farming in the aquatic environment. Improving pond design and create buffer areas for effluents, and the knowledge of the hydrodynamics of the receptor system in the vicinity of the farm, should be considered with the lay-out of the project.

• Farmed species

Species choice
In polyculture, species must be chosen taking into consideration the biological characteristics and advantages of each one and of the combination of the two, but also that they are necessarily different with specific needs.
In integrated aquaculture systems, species must be chosen taking into consideration the biological characteristics and advantages of each one and of the combinations between algae and herbivorous, preys and predators. Photosynthetic and detritivorous species will be preferably used to assimilate dissolved nutrients and reduce particulate detritus.

Decision about species should also consider the native species allowed and/or recommended in the farming areas or countries of location, in order to avoid unnecessary biological impacts such as the interferences with natural stocks (as it is impossible to avoid completely escapees from farms to wild environments). Domesticated organisms are most of the escapees and are related with genetic drift and inbreeding problems, because in captivity only a small population of parents is maintained. So, in the case of perceived important escapees, farmers should warn the local authorities and should give all possible collaboration in solutions and adopt new security measures to avoid escapes in the future.

Species sources and suppliers
Species suppliers must be identified companies with known experience in the farmed species market or new companies, ensuring, by adequate documentation, their origin and correct health status, as well as adequate transport conditions.

Transportation and international requirements
Transport of live animals for farming must be planned and performed following international and national transportation rules. All forms of transfer or transport imply some increase in the stress level, which means the concern with welfare of the species is a key factor to be faced and respected. The welfare must be considered also during the preparation for transport and the phases of post-transport handling (quarantine, stabilization periods, etc.). The eventual transfer of diseases with the transported fish should be avoided by all possible available methods.

Stock density
Fish should be kept, during all growth phases, at an adequate density (nr. fish/volume of water) to guarantee the access to sufficient oxygen and to avoid accumulation of undesirable organic compounds in the farm and in the environment. Stressed fish are also more susceptible to diseases, so farming at lower densities, improving water quality and avoid handling can improve the animals' natural resistance to diseases, also contributes to adequate welfare of farmed species. It should be remembered that one of the most important characteristics of non-intensive systems is the relatively low charge (density) of individuals in the farming water spaces, so densities must be kept as defined by FAO for extensive and semi-intensive systems during all farming stages. It should be remembered that one of the most important characteristics of non-intensive systems is the relatively low charge (density) of individuals in the farming water spaces, so densities must be kept as defined by FAO for extensive and semi-extensive systems during all farming stages. Fish density will be adapted to the carrying capacity of the integrated aquaculture ponds.

- Food

Feed choice, supply and transport
Feed suppliers must be identified companies with known experience in the farmed species market, which can guarantee, by adequate documentation, the origin of the ingredients and the stability and quality of the feed composition. In addition, it is important that suppliers guarantee feed supply rapidly and timely, and provide effective and up-to-date technical assistance. Transport and storage should be performed in accordance with legal requirements and must guarantee the best possible maintenance of the feed nutritional properties.

Use of genetically modified organisms (GMO)
Considering the present moment, in which clear scientific evidence about positive and negative effects of the extended use of GMO it is not yet available for most ingredients, SEACASE suggests a strict conformity in the usage of GMO crops within those approved for use in animal feed in the EU market (Regulations EC No. 1829/2003 and 1830/2003). Avoiding the use of GMO ingredients and products should be promoted whenever possible. The feeds used should clearly state if the feed is or is not GMO free. Whenever a GMO-free claim is made by the feed suppliers, supporting documentation must be asked by farmers to suppliers.

Feed characteristics and nutritional quality
Feeds must be chosen among suppliers that can guarantee, by written and legally valid documents, the ingredients used, their origin, their compliance to specifications and safety limits of undesirable substances (see also *ethical issues*). The feeds must be nutritionally balanced, according to the latest scientific evidence, so that they guarantee maintenance of health status, normal growth and promote animal welfare.

Feeding
The quantity and frequency of feed supply to fish should be regularly checked and accurately recalculated, in order to ensure all fish have access to food. It should also avoid, as much as possible, excess of non-eaten feed in the water, which causes a rapid degradation of the water quality, with consequent negative consequences in fish welfare and the environment.

• Farming

Handling and other current operations
Extensive and semi-intensive farming are, by definition and when compared to intensive systems, activities with lower human interference. All typical farming technical operations and procedures (calibration, removal of dead or ill fish, tank or pond transfer, starving periods, net crowding, fishing, pre-slaughter, stunning and slaughter operations) must respect this characteristic. Procedures must be carefully planned and performed having in mind the animal welfare, avoiding unnecessary suffering or pain and delays due to inadequate work planning or inadequate training of the workers. The removal of dead or dying animals must be done frequently, regularly and rapidly, to avoid interferences with health and welfare of the healthy remaining individuals.

Maintenance and control procedures
Maintenance is a very important component of any activity, including non-intensive farming. Farming equipments, instruments and machinery must be subjected to regular, planned maintenance operations (like cleaning, calibration, checking, etc.) in order to avoid unpredicted failures and/or shortening of the normal working lifetime. Farms, even extensive, tend nowadays to be complex and therefore systems to provide and register information about farm/water parameters should be used. This regular procedure will allow earlier problem detection and perceive the appropriate solutions. In addition, registration of monitored data can also be used for other recent legal demands, such as HACCP and traceability.

• Slaughtering and welfare

Fish (and also some invertebrates, like crustaceans and cephalopods) are nowadays included in consumer-perceived welfare concerns. Animal welfare can be related with many different aspects, like disease, injury, starvation, beneficial stimulation, social interactions, housing conditions, deliberate or accidental disease treatment, human handling, transport, pre-slaughter and slaughter procedures, laboratory procedures, mutilations, presence of abnormalities (physical defects), veterinary treatments or genetic changes. The most common concerns are about transport, farming, pre-slaughter and slaughter, both in routine procedures and in special slaughter needs, as in emergency slaughter for disease management. All terms are defined in the EFSA opinion on fish welfare (EFSA, 2009b).

Transport of species
Transport is always stressful for animals. The conditions, phases, biological parameters and legal requirements during transport and corresponding duration times should be studied previously and rapid solutions should be predicted to solve delays and difficulties, in order to obtain the best possible welfare during transport.

Farming and pre-slaughter (husbandry)

Farming operations like handling, feeding, calibration, sampling, etc., must be performed having in mind the animal welfare, adopting the best procedures, minimizing handling times and avoiding unnecessary suffering. Different species specific needs have been defined and summarized in the EFSA opinion (for example for seabass and sea bream (EFSA 2008a) and European eel (EFSA 2008b) and particularities associated with different rearing systems have been highlighted.

Pre-slaughter activities are nowadays considered as being as important (sometimes even more important) than slaughter procedures, in terms of potential for welfare improvement. They include environment parameters (*e.g.* vulnerability to predation), water quality, social interactions between species, starvation (or feed withdrawal) periods, calibration and other handling operations like: crowding in nets or tanks, fish transfer, stunning methods and all other operations before fish slaughtering (death). In each of these components welfare is nowadays of primordial importance and should be considered, mainly by choosing the best practices and by trying to minimize operation times and avoidable suffering.

Slaughter phase

The slaughter method, normally combined with a previous stunning method, must be selected, among the technically available and possible options, in order to allow a low stress and rapid process, minimizing animal suffering and pain. All farmers contacted by SEACASE project are using immersion in ice slurry as a stunning/killing method, which in terms of welfare is not consensual. Until scientific and precise information is available to clarify many of the arguments and ideas about the use of ice slurry, the method will continue to be used. The present Code recommends that it should be improved at least in what refers to the time to obtain unconsciousness and subsequent death of all harvested fish. This means the temperature of the ice slurry should be as low as possible, as close to zero degrees Celsius as possible (obtained by increasing the relation ice : water), so the temperature differential between crowding spaces and harvesting containers is high and ensures rapid death. Other possible improvement is to increase the amount of ice slurry in relation to fish volume added each time (increasing the relation ice slurry : fish quantity), so the increase in the temperature of the ice slurry induced by fish addition is minimal and fish gets unconscious and dies quicker. For more details and recommendations one can refer to EFSA opinion, for example for seabass, seabream (EFSA 2009c) and European eel (2009d).

Emergency slaughter, killing or culling

If, for any reason, fish must be slaughtered urgently, for example due to the detection of a disease or other serious and unavoidable problem, one must always consider the stress, suffering, welfare and environment conditions. Extra hygiene measures must be adopted to ensure the reduction of the disease spread; the period of time until the problem is considered solved must be respected (if not legally established, the decisions must be based on a group decision within the farm or shared with other farmers).

• Disease management

General prophylaxis and therapeutic actions

Adequate prophylactic measures must be used as the first measure to increase welfare and to avoid diseases. When prophylaxis fails and therapeutic actions are needed, the more recent scientifically recommended pharmaceutical products and administration systems should be used, respecting local, national and international legislation. All products to be used must be approved by the authorities involved. The time period for the residuals elimination (withdrawal or elimination periods) must be observed before harvesting for commercial purposes. Measures of hygiene in fish production, the use of immunostimulants and fish vaccination may be used in order to prevent fish diseases. Drugs are used when fish diseases occur, but a few number is permitted and its application is often difficult in fish production.

Hygienic procedures

Priority should be given to good hygiene and other preventive efforts in containment of resistant infections in non-intensively farmed fish. The increasing of hygienic measures, with proper handling practices, will help to prevent infectious diseases, including parasites and virus, which cannot be treated with antibiotics. In non-intensive aquaculture, adequate hygienic measures must be planned, implemented, verified and continuously adjusted.

Immunostimulants

Immunostimulants, chemicals that stimulate the immune system, have vast potential in aquaculture and can be used prior to situations that could result in increased stress to aquatic organisms (handling, changes in temperature, larvae adaptation to artificial feeding), or increased exposure to pathogenic microorganisms like seasonal variations in microbial composition of the marine environment or high fish densities.

However, in non-intensive farming, the use of this kind of compounds should be kept to a minimum, as it is expected to have less stress and lower incidence of diseases in non-intensive farming systems and also because the long-term effects are not yet well known. If their use is unavoidable, caution is needed about the dosages, because inadequate doses may cause unwanted effects, suppressing the fish defence mechanisms. The administration period of immunostimulants is also very important. It is important that immunostimulants are used before an outbreak of a disease, to reduce the losses and increase welfare.

As the oral route is the most practical method for administration of immunostimulants, in extensive or semi-intensive systems it is impossible or too difficult to use the oral way, as artificial feed is only a part of the total food income.

Vaccination

Vaccination is a useful prophylaxis for bacterial infectious diseases of fish. Commercial vaccines are already available for vibriosis in sea bass and pasteurelosis in sea bass and sea bream. Vaccines are not 100 % efficient; the degree of protection of a vaccine depends on a number of intrinsic (age, physiological status of fish, species) and extrinsic factors (vaccine, the concentration of vaccine, route of administration, presence of adjuvants, water temperature), that must be taken into account when vaccines are applied to non-intensively produced fish. Final decision on vaccination procedures and/or buying already vaccinated fish must be taken by the producers.

Disinfectants

The external disinfectants are used for the control of infections from organisms on the surface of fish and to eliminate or reduce potential pathogens of physical spaces. The disinfectants that exist for disease control should be miscible with water or capable of being suspended in water at a therapeutic concentration.

The methods for external disinfection and treatment of fish disease include immersion and bath. The immersion is obtained by mixing the required quantity of disinfectant with a specific volume of water. As bath treatments are more appropriate for the treatment of fish relatively small tanks, in many of non-intensive systems this procedure is difficult to apply. Treatment by immersion needs the fishing and the transfer of the fish to smaller treatment tanks, which makes them also more difficult to apply on non-intensive systems.

Chemotherapeutic agents

Any chemotherapeutic agent should be used only after proper disease diagnosis and following a previously made antibiogram.

The application of antibiotics in semi-intensive aquaculture is done through two different ways: orally, in the feed, or as a static bath treatment in earth ponds. The same difficulties previously mentioned for the use of desinfectants have to be considered also when antibiotic administration is needed.

The use of antibiotics in aquaculture is determined in the EU by the Council Regulation CE No. 2377/90 that establishes the maximum residue limits of veterinary medicinal products in foodstuffs of animal origin. This and all other kinds of legislation affecting the sector must be strictly followed.

Consumer safety and health
Fish diseases that can be dangerous for humans must be farmers' first concern, at all stages of production. Adequate prophylactic measures like immunizations, vaccinations and hygiene procedures are the most recent and adequate approach to prevent diseases in aquaculture, since normally when disease is detected it is too late to implement successful therapeutics.

• Environmental issues and concerns

Predators and protected areas
Farmers usually complain about facilities invasion by predators searching for the farmed species. Birds, mammals (and sometimes man) are the more frequently invaders seen at the farms. This is an environmental problem, because the fight against birds and mammals in protected areas is normally very restricted, and simultaneously a fish welfare problem, as farmed species are confined and are an easy prey if compared to the wild environment. Welfare is also compromised when fish appear with bird beak marks in the body, due to frustrated attempts to catch them. Measures should be taken to limit the access of predators to fish (*e.g.*, nets, physical barriers) or to keep predators far away from the farms (*e.g.*, scaring noises, mechanical devices). Measures that are lethal (hunting) or cause serious disturbances in the biology of predators should only be used under legal licence and supervision.

Fish escapes to wild environment
All possible measures should be taken in order to avoid species escapes from the farms to the free wild environment. In the case of an involuntary important escape occurs, the farmers will collaborate with authorities in order to take the adequate possible measures.

• Traceability

Traceability in aquaculture can be defined as *the ability to follow the movement of a product of aquaculture or inputs such as feed and seed, through specified stage(s) of production, processing and distribution*. Non-intensive farmers must assure the traceability of their products, from the ingredients used in feeds until the final distribution, and at all stages of the farming process.

• Food safety

Product quality of the seafood reared in the integrated system must be in agreement with the National and UE regulations before selling; in particular bacterial and chemical concentrations in macroalgae and shellfish products.

• Conclusions

General attitude
Farmers should collaborate with local, national and international authorities, in all aspects related to their activity.

Farmers should always search for the highest possible quality and freshness for their products, from production to consumer. As products from non-intensive farming have special characteristics which can be valuable for consumers, farmers should devote efforts to create and maintain a correct image and provide high quality product. A correct packaging and transport along with complete and clear labelling information about characteristics and correct use should not be disregarded.

Difficulties and constraints
It is difficult to design Codes of Conduct for specific types of farming systems, within the non-intensive group, as similarities between systems occur and this is difficult to do within Codes that tend to be general.
It is common that Codes of this kind are made and followed voluntarily by farmers and serve as a general guide to achieve the highest possible quality and value, and this is also the case of this Code.

• Recommendations

Need of technical and scientific information
For the next future, technical and scientific developments are needed to allow a more specific group of rules, leading to dedicated Codes of Good Practices, which tend to present more clear limits based on quantifications of measurable parameters. Especially in the area of non-intensive farming, there is a serious lack of information to serve as a base for more precise and clear recommendations or even compulsory rules or legislation.

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• Annexes

Glossary of main concepts

Accreditation It is a procedure, by which a competent authority gives formal recognition that a qualified body or person is competent to carry out specific task.

Aquaculture Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatics plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, and protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated, the planning, development and operation of aquaculture systems, sites, facilities and practices, and the production and transport.

Best Practice is a superior method or innovative practice that contributes to the improved performance of an organisation, usually recognised as "best" by other peer organisations. It implies accumulating and applying knowledge about what is working and not working in different situations and contexts, including lessons learned and the continuing process of learning, feedback, reflection and analysis (what works, how and why).

Brackish water water with a salinity intermediate between seawater and freshwater, usually showing wide salinity fluctuations. (FAO)

Certification Certification refers to proving that a product, or process, meets certain characteristics. This confirmation is beyond the producer's general information provided on product's common labels and is, although not always, provided by an external assessment.

Certification body or entity It refers to competent and recognised body that conducts certification and audit activities. A certification body may oversee certification activities carried out on its behalf by other bodies.

Certification scheme A certification scheme is a collection of processes, procedures and activities conducting to certification. A credible certification scheme is built on three steps: standards setting, accreditation and certification.

Code of Conduct Codes of Conduct are sets of written principles and expectations that, although voluntary, are considered binding for any person who is member of a particular group that adopts the Code.

Extensive aquaculture production system characterized by (i) a low degree of control (e.g. of environment, nutrition, predators, competitors, disease agents); (ii) low initial costs, low-level technology, and low production efficiency (yielding no more than 500 kg/ha/yr); (iii) high dependence on local climate and water quality; use of natural water bodies (e.g. lagoons, bays, embayments) and of natural often unspecified food organisms. (FAO)

Freshwater water with a consistently negligible salinity. (FAO); water with less than 1,000 milligrams per litre (mg/L) of dissolved solids (USGS)

Good practices of aquaculture those practices of the aquaculture sector that are necessary to produce quality food products conforming to food laws and regulations. (FAO)

Group Certification Certification for a group of farmers, normally considered for small-scale aquaculture farmers, for whom individual certification is cost prohibitive and who have key characteristics in common, e.g. common marketing of the product as a group, homogeneity of members in terms of location, production, system, products. The group has an Internal Control System to ensure compliance with the standards by all members of the group. The group of facilities or operations that are considered collectively may be in close proximity to each other, share resources or infrastructure (e.g. water sources, or effluent discharge system), share a landscape unit (e.g. watershed), have the same production system, involve the same farmed species, or other common characteristics as appropriate.

Integrated aquaculture aquaculture system sharing resources - water, feeds, management, etc. - with other activities; commonly agricultural, agro-industrial, infrastructural (wastewaters, power stations, etc.). (FAO)

Integrated farming occurs when an output from one subsystem in an integrated farming system, which otherwise may have been wasted, becomes an input to another subsystem resulting in a greater efficiency of output of desired products from the land/water area under a farmer's control.

Intensive a**quaculture** system of culture characterized by (i) a production of up to 200 tonnes/ha/yr; (ii) a high degree of control; (iii) high initial costs, high-level technology, and high production efficiency; (iv) tendency towards increased independence of local climate and water quality; (v) use of man-made culture systems. (FAO)

Labelling The concept of "labelling" is a physical support (paper or other material) that provides consumers with information about the object to which it is fixed. Some "label" systems can rely only on informatics (data available by the use of computers, internet, etc.) but generally there is information directly attached to the product.

Monoculture The cultivation or culture of a single crop or species to the exclusion of others. (FAO)

Organic aquaculture the farming of aquatic animals and plants, without or with limited use of synthetic fertilizers, pesticides, antibiotics, growth hormones and feed additives (EU directives have decreed that nothing captured or harvested from the wild can be labelled as 'organic', as the history and production conditions have to be precisely known at a reasonable cost).

Polyculture the rearing of two or more non-competitive species in the same culture unit. (FAO)

Seawater coastal and offshore waters in which the salinity is maximal (around 35 ppt) and not subject to significant daily and seasonal variation.

Semi-intensive aquaculture systems of culture characterized by a production of 2 to 20 tonnes/ha/yr, which are dependent largely on natural food, which is augmented by fertilization or complemented by use of supplementary feed, stocking with hatchery-reared fry, regular use of fertilisers, some water exchange or aeration, often pumped or gravity supplied water, and normally in improved ponds, some enclosures, or simple cage systems. (FAO)

Standard Document approved by a recognised organisation or entity, providing for common or repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory under international trade rules. It may also include or deal exclusively with terminology, symbols, and packaging, marking or labelling requirements as they apply to a product, process of production method.

Sustainability Sustainability covers three pillars, which represent environment viability, socially equitable, and economical viability. According to Hardwood, "*sustainable aquaculture is a system that can evolve indefinitely towards greater human utility, greater efficiency of resource use and a balance with the environment which is favourable by humans and most other species*"

Sustainable development management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves (land), water, plants and (animal) genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable. (FAO)

Traceability The ability to follow the movement of a product of aquaculture or inputs such as feed and seed, through specified stage(s) of production, processing and distribution. The documentation and other evidence by which a certified product can be traced back from each buyer to each supplier through the chain of custody all the way to the certified production area from which it originated.