

Legal and policy components of the application of the ecosystem approach to aquaculture to site selection and carrying capacity

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Abstract

The sustainable development of aquaculture largely depends on the right selection of the site and the correct determination of the amount of biomass that can be supported by the ecosystem. In order to establish these aspects, the strategy of the Principles of EAA, held by FAO Expert workshop: Building an ecosystem approach to aquaculture, in Palma de Mallorca 2007, should be a guide for policy-makers. Legally speaking, all these principles are considered in the principles of international environmental law. Nevertheless, regulation varies among states. Different levels of authorities, policy-making processes and regulatory mechanisms are aspects that reflect different levels of application of the EAA principles, and therefore, different degrees of compromise with the aquaculture sustainability. This paper outlines the legal difficulties for the application of the principles of EAA for the aquaculture site selection and carrying capacity. For these purposes, the review is focused on the influence of each principle of EAA, from the principles of international environmental law perspective. The work includes a description of the requirements that legal and institutional frameworks should implement, in order to ensure a correct application of the Principles of EAA to the aquaculture site selection and carrying capacity.

Introduction

Site selection is one of the major concerns in aquaculture. The right selection of a site has influence not only in the potential of the activity but also in the social and economical sustainability. Besides siting, carrying capacity of environment is considered a requirement for an ecologically feasible aquaculture. Both requirements will be discussed in this review from the perspective of the ecosystem approach to aquaculture.

The three key principles to guide the ecosystem approach to aquaculture (EAA), agreed during the FAO Expert workshop in 2007 are¹:

- Principle 1: “Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society.”
- Principle 2: “Aquaculture should improve human well-being and equity for all relevant stakeholders.”
- Principle 3: “Aquaculture should be developed in the context of other sectors, policies and goals.”

From a legal perspective, all these principles, and particularly the first one, are considered in the principles of international environmental law. These principles are sovereignty over natural resources; responsibility not to cause damage to the environment of other states or to areas beyond national jurisdiction; principle of preventive action; precautionary principle; responsibility or polluter pays principle; cooperation principle; sustainable development; principle of common but differentiated responsibility, among others.²

Since principles in international environmental law are binding, they are expected to be followed up by states. Nonetheless, international environmental principles must always have their limitations in so far as they are drafted remotely from the actual circumstances and activities.³ Moreover, its implementation and law enforcement vary among countries. Therefore, legally speaking, the EAA principles could be reinterpreted by each nation. These reinterpretations explain the significant differences in the regulation of aquaculture site selection and carrying capacity from nation to nation. This review is focused on how the EAA principles have an influence in site selection and carrying capacity, and which considerations and recommendations could be considered by countries when aquaculture should be regulated.

Principle 1: “Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society”

As mentioned above, all the EAA principles are included in the principles of international environmental and sustainability law, but particularly the first one.⁴ Thus, it is reasonable to begin our analysis with the application of this principle to the aquaculture site selection and carrying capacity. This principle may be considered as a

¹ Soto, D., Aguilar-Manjarrez, J. & Hishamunda, N. eds. 2008. *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings. No. 14. Rome, FAO. 2008. 221 pp. (also available at www.fao.org/docrep/011/i0339e/i0339e00.htm).

² These principles are United Nations principles and have been incorporated into four catalogues, with two types of texts: “political text approved by high level representatives (heads of state and government or ministers)” –Stockholm Declaration, Rio Declaration– or text (...) emanating from selected bodies of lawyers and environmentalists [United Nations Environmental Programme and Commission on Sustainable Development], bodies which reflect nevertheless to a large extent the views of governments in spite of certain affirmations to the country”. Lang, Winfried, UN Principles and International Environmental Law, Max Planck yearbook of United Nations law (editors: Jochen Frowein and Rüdiger Wolfrum) (First Edition, Kluwer Law International, Great Britain, 1999), pp. 164.

³ Howarth, W. 2006. Global Challenges in aquaculture regulation, In D.VanderZwaag and G. Chao (eds). *Aquaculture Law and Policy: towards principled access and operation*. Routledge Taylor & Francis Group, London and New York. pp. 18.

⁴ Bermúdez, J. 2008. Legal implications of an ecosystem approach to aquaculture. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda, eds. *Building an ecosystem approach to aquaculture*. FAO/Universitat de les Illes Balears Expert Workshop. 7–11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings. No. 14. Rome, FAO. pp. 67–78. (also available at www.fao.org/docrep/011/i0339e/i0339e00.htm).

holistic or ecological approach, considering its ability to deliver functions and services from the environment, as a whole, to society. A holistic or ecological approach has specific implications when it considers carrying capacity and site selection.

1. Carrying capacity

Environmental carrying capacity is defined as “the maximum number of animals or amount of biomass that can be supported by a given ecosystem for a given period of time.”⁵ If we want to assess the suitability of a site for aquaculture, we need to predict potential future impacts of the planned activity.”⁶ The key issue of this principle is to estimate limits to “acceptable environmental change.”⁷ In the consideration of this issue it is important to keep in mind that the national regulation of aquaculture site selection must consider carrying capacity as a *logic step* in order to establish a sustainable legal framework for the activity. However, regulation of aquaculture varies among states and currently only a few countries apply a carrying capacity.⁸ Nevertheless, most countries use some form of environmental quality standards (for instance, based on fixed levels of nutrient inputs or amount of chemicals).⁹

Environmental quality standards set concentrations in the environment for certain compounds, below which unacceptable effects are expected not to occur.¹⁰ One problem of setting standards is that not all of them are legally enforceable. Many of them are fixed in guidelines that usually embody political commitments, rather than legally binding obligations.¹¹ Moreover, since the establishment of these standards implies that something is defined by policy-makers rather than by scientists, it is important to ensure harmonization and reduce the arbitrariness of the authority.¹² Here comes the idea of a compromise among the different interests and stakeholders, which are implied in the application of a standard. The ability to ensure carrying capacity could not be reached only with environmental or scientific requirements but also with social and political acceptance. In this point the application of soft law instruments must be considered as an important element of harmonization of legally enforceable standards.

2. Site selection

Success or failure of any aquaculture venture largely depends on the right selection of the site for it.¹³ Site selection is the process of selecting a certain space in the marine environment by examining environmental, technical, legal, administrative, social, economic and other related aspects, in order to set up an aquaculture project.¹⁴ Several factors are to be considered. The processes of site selection include scientific knowledge, tools and legal frameworks, as well as tools for decision-making and management.¹⁵ Therefore, policy-makers must examine a wide range of disciplines, from socio-economic aspects to environmental conditions.¹⁶

⁵ IUCN. 2009. Aquaculture Site Selection and Site Management, IUCN, Spain, pp. 201.

⁶ Ibid, pp. 204.

⁷ Costa-Pierce, B. 2010. Sustainable Ecological Aquaculture Systems: The Need for a New Social Contract for Aquaculture Development. *Marine Technology Society Journal*, 44 (3), pp. 92.

⁸ Holmer, M., Hansen, P.K., Karakassis, I., Borg J.A. & Schembri, P.J. 2008. Monitoring of environmental impacts of Marine Aquaculture. In: Holmer M., Black K., Duarte C.M., Marba N., Karakassis, eds. *Aquaculture in the Ecosystem*. Springer, pp 47–85.

⁹ Ibid, pp. 48.

¹⁰ IUCN, cit. (No 4), pp. 202.

¹¹ Ibid, pp. 202.

¹² Ibid, pp. 202.

¹³ FAO. 1987. Site Selection For Aquaculture: Aquatic pollution. Text by Kutty, M. In FAO Fisheries and Aquaculture Department [online]. Nigeria. www.fao.org/docrep/field/003/AC178E/AC178E00.htm

¹⁴ IUCN, cit. (No 4), pp. 266.

¹⁵ Simard, Ojeda and Haroun. 2008. The sustainable development of Mediterranean aquaculture: Problems and perspectives. *Options Méditerranéennes*, 62, pp. 120.

¹⁶ FAO, cit. (No 12).

These have made the sitting choice the most controversial regulatory decisions in salmon aquaculture¹⁷, and this dilemma can be said for almost all culture types.

Currently, most countries have specific demands for the locations of the farms to avoid situating these near habitats of special interest (recreation, wildlife, fishing zones) and near industries and sewage outfall.¹⁸ Nonetheless, the correct aquaculture site selection implies to consider a *logic step*: estimate the carrying capacity of the site. In some cases, this factor allows establishment of different categories of sites. For instance: a) where fish farm will only be acceptable in “exceptional circumstances”; b) where areas are at the limits of their carrying capacity; and c) where there is a better prospect of satisfying nutrient loading and benthic impacts.¹⁹

In summary, only those areas in third category are likely to be acceptable for new fish farm development.²⁰ Nevertheless and as noted above, only a few countries apply a carrying capacity at the moment. Hence, regulators usually have few or no adequate procedures to establish such categories of sites. On a regional and international level, there is another problem. In many cases, siting decisions are made in response to singular applications. This is the *site-by-site* regulatory mechanism. This regulation – reactive, rather than proactive – ignores that many of the major concerns of aquaculture involve regional or cumulative impacts.²¹ The Environmental Impact Assessment could be a useful tool to solve this problem. However, in most cases it is carried out after the site is selected, so there is not currently a tool for site selection, but rather for the monitoring of the environment in regard to aquaculture development.²²

Recommendations

Countries should implement aquaculture carrying capacity, which implies more than emission or environmental quality standard. This factor will allow to establish different categories of sites and to identify those areas that are likely to be acceptable for aquaculture development. Since there is no consensus among stakeholders and countries in order to set acceptable ecological aquaculture impacts, it is important to ensure a harmonic regulation. There are different mechanisms. One of them is to define acceptable impacts by establishing criteria and variables to be used for estimating carrying capacity.²³ Another tool is the use of variables related to environmental quality or standards –for instance: primary production and sediment oxygen levels–.²⁴ In any case, the application of soft law instruments must be considered as an important element of environmental standards harmonization.

¹⁷ McDaniels, Dowlatabadi, H. & Stevens. 2005. Multiple scales and regulatory gaps in environmental change: the case of salmon aquaculture. *Global Environmental Change*, 15 (1), pp. 17.

¹⁸ Holmer *et al.*, cit. (No 7), pp. 48.

¹⁹ Howarth, cit. (No 2), pp. 24.

²⁰ *Ibid.*, pp. 24.

²¹ McDaniels *et al.*, cit. (No 16), pp. 17: “With site-by-site regulation it is difficult to address cumulative impacts, which underlie almost every significant environmental debate and has been widely recognized as a significant barrier to sound environmental management (Burris and Canter, 1997; Canter and Kamath, 1995; Orians, 1995; Smit and Spaling, 1995). In this case the inattention to cumulative impacts seems to have led to significant confusion over how to manage salmon aquaculture in the province. Regulators and policy-makers are unsure what cumulative impacts if any, fish farms will have on wild salmon stocks, other marine species, economic development, or even human health (Ellis, 1996; Leggatt, 2001; Pacific Fisheries Resource Conservation Council, 2002).”

²² Simard *et al.*, cit. (No 14), pp. 120.

²³ IUCN, cit. (No 4), pp. 202: “some of the most difficult issues that need to be considered include: The ecological component of carrying capacity that is to say, what are unacceptable ecological impacts? A series of environmental variables like low oxygen in the water (hypoxia), high chlorophyll a or particulate organic carbon (eutrophication), as well as damage to important habitats or species may be chosen. One example is the use of ‘exclusion criteria’ such as protected habitats or species, for example *Posidonia oceanica* meadows (distance > 800m) or maerl beds, as well as activities that could be harmful for aquaculture by causing harmful algal blooms (HABs) or polluted sites”.

²⁴ *Ibid.*, pp. 203.

Finally, it is important to overcome the *site-by-site* regulation process. Decisions on site selection are made on an individual basis in response to applications for tenure.²⁵ This mechanism ignores that many of the major concerns involve regional or cumulative impacts.²⁶ The question about size and distribution of aquaculture activity can neither be answered by considering local, site-by-site criteria, nor by a process that is reactive rather than proactive.²⁷ The problem of siting criteria has to be dealt with in a region-wide planning, through appropriate regulations aimed to address cumulative impacts.²⁸

Principle 2: “Aquaculture should improve human well-being and equity for all relevant stakeholders”

Aquaculture is a human activity, in this sense it should tend to human well-being, considering the wide range of people who are benefited or affected by it. This second EAA principle could be summarize in the aim of equity in aquaculture, which should be recognized in site selection and carrying capacity.

1. Site selection

After understanding the interaction between aquaculture and the environment, site selection is the next step towards an ecosystem approach to aquaculture. However, it includes social and economic development requirement as well.²⁹ According to the definition of sustainable development, a sustainable aquaculture should be *environmentally acceptable, economically viable, and socially equitable*.³⁰ The principle under analysis is focused on these last two components. There are many persons and groups who have interest in aquaculture, as well as those who are interested because they live near to aquaculture sites.³¹ Aquaculture should provide *well-being* and *equity* for all these relevant stakeholders, especially at local level, so it does not bring detriment to any sector of society.³² In this context, site selection is related with equity, or more accurately, is related with environmental justice. Clear legislation is key in this point. It must reflect these social and economic issues. For example, a legislation which strongly promotes aquaculture activities, could decrease prices of products from fisheries, and cause poverty among fishermen. Therefore, a legal framework that does not consider these aspects could cause a lack of legitimacy of the activity.

To integrate these components is not easy. If the rules of site selection are too strict, they could lead to a relocation of aquaculture facilities from one country to another one with less or no legal restrictions. This situation provides an easy way if not an excuse to run away from regulation. In this scenario, the benefits of aquaculture will not be *widely spread*. This implies an environmental justice problem that affects countries –and specifically, people who live near the sites– where aquaculture site selection have less or no restriction at all.

2. Carrying capacity

In the pursuit of improving human well-being and equity, several factors are to be considered, not only the ecological ones, but those related to human health and food

²⁵ McDaniels *et al.*, cit. (No 16), pp. 17.

²⁶ *Ibid.*, pp. 17.

²⁷ *Ibid.*, pp. 17.

²⁸ *Ibid.*, pp. 18.

²⁹ Simard, F. *et al.*, cit. (No 14), pp. 119.

³⁰ *Ibid.*, pp. 113.

³¹ Mazur and Curtis. 2008. Understanding community perceptions of aquaculture: lessons from Australia. *Aquaculture International*, 16 (6), pp. 604.

³² Costa-Pierce, B., cit. (No 6), pp. 93.

safety. In this context, it is evident that aquaculture carrying capacity is an important aspect in order to maintain an activity without health and environmental risks. Aquaculture water use and pollution can have damaging impacts on ecosystems, in particular in areas with low carrying capacity or where the carrying capacity has already been reached.³³ Regulatory authorities are interested in minimizing these negative environmental impacts through different mechanisms. The problem is that regulators and policy-makers usually are unsure of what impacts –and mainly cumulative impacts– aquaculture will have on marine species, economic development, or even human health.³⁴ Extensive investigation is necessary in order to determine when a risk is capable of being converted into a harm. Where research of this kind has not been undertaken, legislation may be justified on preventive or precautionary principle.³⁵

Another problem is the cost of the environmental protection. It is accepted that the costs of the fight against pollution should be borne by the polluter. This implies the application of the polluter pays principle (PPP) to the aquaculture activity. The polluter-pays principle is an economic principle. Applied to the field of aquaculture, this means an imposition of the cost of aquaculture pollution abatement on individual polluters, rather than on the public purse, to be passed on the consumer, and thus in the end reflected in the price of the product.³⁶ However polluter pays principle implies an obligation that is not easy to measure, neither to assign. In several cases PPP leads to bankruptcy or even to an illegal activity.

Recommendations

Aquaculture legal framework must allow to provide substantial benefits to mankind. It must also ensure environmental and social standards. Inevitably, this implies to define the boundary between permissible and impermissible activities. Every site selection process must provide a minimum standard for each individual siting decision, in order to ensure not to cause detriment to any sector of society. Arguments that justify adverse environmental impacts in developing countries, where the threat of poverty and starvation provides a justification, should be considered with caution.³⁷ This implies an environmental justice problem that can lead to a relocation of the activity in countries with no legal restriction or where restrictions are less strict. The principle under study implies that this argument is never acceptable in developed countries, where environmental expectations should be stricter.³⁸

From the carrying capacity perspective, the key issue here is to estimate the resilience capacity or the limits of acceptable environmental change. The problem is that regulators and policy-makers are not certain about cumulative impacts, if any, aquaculture will have.³⁹ One could visualize a potential role of local, informal, traditional knowledge regarding potential carrying capacities and impacts. This kind of knowledge may be highly useful into the regulatory process.⁴⁰

Finally, the ecological approach to aquaculture –and the improvement of human well-being and equity for all relevant stakeholders– must always consider two principles of the international environmental and sustainability law: the precautionary principle or approach and the polluter-pays principle. The first provides action to

³³ IUCN. Shrimp Aquaculture: High value for whom? 2008. IUCN, Holland, pp. 2

³⁴ McDaniels, T. *et al.*, cit. (No 16), pp. 18.

³⁵ Howarth, W., cit. (No 2), pp. 20.

³⁶ For a review of the polluter pays principle, see: Louise Larsson, M. 1999. The law of environmental damage: liability and reparation. Kluwer Law International, Sweden. pp. 90.

³⁷ Howarth, W., cit. (No 2), pp. 19.

³⁸ *Ibid.*, pp. 19.

³⁹ McDaniels, T. *et al.*, cit. (No 16), pp. 18.

⁴⁰ *Ibid.*, pp. 18.

avoid serious or irreversible environmental damages before a scientific certainty of harm could be achieved.⁴¹ On the other hand, the principle of polluter-pays is the basis of environmental management for the cost of environmental damage as well as its monitoring and rectification.⁴² The implementation of this principle –through licensing systems– can offer an important incentive for reducing aquaculture pollution.⁴³

Principle 3: “Aquaculture should be developed in the context of other sectors, policies and goals”

This principle could be interpreted as the integration or relationship of aquaculture with other activities. Since aquaculture activities should take into account the existing activities in the same area.

1. Site selection

Aquaculture has been recently developed, mostly in coastal areas. In these areas a large number of activities have been done before. As well as a variety of others economic activities, tourism is among them. Therefore, aquaculture is a newcomer, which has destroyed the *status quo* established by existing users.⁴⁴ Government priorities based on reasons of wealth and employment usually, make this competition for space a problem even more difficult to solve.⁴⁵

The conflict and overexploitation of stocks in fisheries have long consisted in expansion of fishing areas. The evolution of the fisheries shows a way to solve a problem that is not necessarily sustainable. In the case of aquaculture the problem of space has to be deal in a manner that has to be comprehensive, sustainable and ordered. Therefore the relocation of coastal aquaculture sites to new areas offshore should not be seen as the only solution. One aspect is the legitimacy of the activity. Policy-makers have generally carried forward a policy process in an old fashioned way, which meant that local population accepts the resource development and exploitation as a goal itself.⁴⁶ At present, however, more sophisticated policy-making is required: not only to promote industrial activity, but also to legitimize the process. As we have said before, acceptability of aquaculture is linked to the participation of all relevant stakeholders.⁴⁷⁻⁴⁸

In a legal framework, Advisory Committees are procedural instruments, which tend to deal with this issue. They are composed of groups of people affected by the installation of the aquaculture facilities or with the determination of the appropriate area for aquaculture. These Committees could be a real vehicle for participation and legitimacy whereby the community comes to an agreement on the best way to proceed.⁴⁹ But procedural instruments are not enough. Substantive instruments that take into account the territorial integration of the activity it is necessary to have. This implies spatial specialization and control of environmental effects. The policies of

⁴¹ IUCN, cit. (No 4), pp. 71.

⁴² Kutty and Pillay. 2005. Aquaculture: principles and practices. Blackwell Publishing, India, pp. 17.

⁴³ Midden and Redding. 1998. Environmental management for aquaculture. Chapman & Hall, London, pp. 203.

⁴⁴ IUCN, cit. (No 4), pp. 167.

⁴⁵ Ibid, pp. 166.

⁴⁶ Kaiser and Stead. 2002. Uncertainties and values in European aquaculture: communication, management and policy issues intimates of “changing public perceptions”. Aquaculture International, 10 (6), pp. 483.

⁴⁷ Simard, F. *et al.*, cit. (No 14), pp. 113.

⁴⁸ Kaiser and Stead. cit. (No 46), pp. 484: “It is necessary to take time constraints into account, and to anticipate and deal early on with the danger of building too high expectations from participatory approaches (...) On the one hand, one needs to avoid making the process too cumbersome, or onerous, as this carries the danger of alienating some interests, loosing sight of the purpose. On the other hand, one may need some visible results in order to strengthen the stakeholders’ belief in the utility of the process.”

⁴⁹ Howlett and Rayner. 2004. (Not so) “Smart regulation”? Canadian shellfish aquaculture policy and the evolution of instrument choice for industrial development. Marine Policy, 28 (2), pp. 181.

Integrated Coastal Zone Management aim to achieve this purpose. They integrate a contractual logic and include the participation of other partners, through the use of consultation processes, around common goals.⁵⁰

2. Carrying capacity

The general objective of the carrying capacity process is to provide *appropriate knowledge* to the administrative authorities and other decision-making bodies in order to plan the activity.⁵¹ This appropriate knowledge is important at a local and at a regional level, but the question of what role aquaculture should play in the international level is not answered through taking into account values and technical information in an overall decision-making process.⁵² Even more, internationally speaking, at present there is not an organization with a specific mandate related to aquaculture.⁵³ Thus, there is no authority with the power to enact a comprehensive international regime to shape and moderate the cross-scale impacts of decisions regarding aquaculture at the national and lower levels.⁵⁴

The above situation has an influence in the national legal and policy management of aquaculture. Therefore, the question about what role aquaculture should play in national economies is answered through the interaction of various international agreements and the institutions that administer them, as well as through the influence of national, sub-national and transnational institutions on these international regimes.⁵⁵

Hence, authors distinguish different levels of authority, each of which must answer different questions about aquaculture activities. The institutions with regional jurisdiction have better access to region-wide information and resources to study and regulate regional impacts. They must decide about the size and distribution of the aquaculture activity in a specific region.⁵⁶ On the other hand, local level has reduced resources, information and technical expertise, even though they are legally entitled to determine local land uses. Thus, they must define where farms should be sited in the short term.⁵⁷ This level decision involves the application of siting criteria and process. The siting criteria and process are expected to reflect economical, environmental and social considerations.⁵⁸

Recommendations

There are many people and groups who are concerned about aquaculture, especially those who are interested because they live near to aquaculture sites. The concept of *acceptability* is linked to the participation of all relevant stakeholders.⁵⁹ Therefore, policy-making should not only focus on the use of policy instruments to promote industrial activity, but also those required to legitimize the process.⁶⁰ Since we are engaged with 'socio-environmental conflicts', rather than 'social' or 'environmental' in a fragmented way,⁶¹ the manner in which conflicts can be avoided, negotiated and resolved are key aspects of the legal framework. In some cases, the participation of the stakeholders takes place in the

⁵⁰ McDaniels, T. *et al.*, cit. (No 16), pp. 19.

⁵¹ IUCN, cit. (No 4), pp. 167.

⁵² McDaniels *et al.*, cit. (No 16), pp. 14.

⁵³ Bermúdez, J., cit. (No 3), pp. 70.

⁵⁴ McDaniels *et al.*, cit. (No 16), pp. 14.

⁵⁵ *Ibid.*, pp. 14.

⁵⁶ *Ibid.*, pp. 15.

⁵⁷ *Ibid.*, pp. 15.

⁵⁸ *Ibid.*, pp. 15.

⁵⁹ Simard *et al.*, cit. (No 14), pp. 113.

⁶⁰ Howlett, M. and Rayner, J., cit. (No 49), pp. 172.

⁶¹ Barton and Floysand. 2010. The political ecology of Chilean salmon aquaculture, 1982–2010: A trajectory from economic development to global sustainability. *Global Environmental Change*, 20 (4), pp. 741.

environmental impact assessment process, which should consider social standards as well. In other cases, participation is led through regional aquaculture advisory committees. The strategy behind such an approach is to obtain a vehicle whereby the entrepreneur and community come to an agreement on the best way to proceed.⁶² Other institutional structures are: co-management arrangements, multi-stakeholder processes, development and empowerment-oriented co-management organizations, and more widespread civic science and policy communities.⁶³

From the administrative perspective, the problem is that local governments usually find themselves under significant pressure to block applications for siting of new aquaculture facilities.⁶⁴ The application of the coordination principle should avoid this conflict. This principle implies that different actors have different responsibilities. Institutions with regional jurisdiction must decide about the size and distribution of the aquaculture activity in a specific region, whereas local authorities –with reduced resources and information– must define where farms should be sited. Therefore, it is expected that the institutional or governmental structures should be compatible with the multiple level of decision required to address an environmental problem involving.⁶⁵

Conclusions

Regulation of aquaculture site selection and carrying capacity vary among states. The analysis of the legal framework allows us to conclude the following:

1) **From the environmental perspective.** Carrying capacity allows to identify where aquaculture should be developed, establishing of different categories of sites. Therefore, carrying capacity should be considered as a *logic step* in order to establish a sustainable legal framework for aquaculture. Nevertheless, currently only few countries apply this parameter. From the site selection perspective, aquaculture should avoid the *site-by-site* regulatory mechanism. This regulation –reactive, rather than proactive– implies that siting decisions are made in response to singular applications and ignores that many of the major aquaculture concerns involve regional or cumulative impacts. The problem of siting criteria has to be dealt with in a region-wide planning.

2) **From the improvement of human well-being and equity perspective.** Several factors are to be considered in order to improve human well-being and equity. Aquaculture carrying capacity is an important aspect of them. The problem is that regulators are usually unsure of what impacts aquaculture will cause. Where research has not been undertaken, legislation may be justified on the precautionary principle. On the other hand –and in the context of improving human well-being and equity– it is accepted that the costs of the fight against aquaculture pollution should be borne by the polluter.⁶⁶ Aquaculture site selection should also aim to provide *well-being* and *equity* for all the relevant stakeholders, especially locally. But to integrate these components is not easy. In many cases, a strict regulation of site selection can lead to a relocation of the aquaculture in countries with no legal restriction, or where restrictions are less strict. This implies a problem in relation with environmental justice. Non-binding legal instruments (or so-called soft law instruments) play an important role in the solution of this problem.

⁶² Howlett, M. and Rayner, J., cit. (No 49), pp. 180.

⁶³ McDaniels, T. *et al.*, cit. (No 16), pp. 20.

⁶⁴ *Ibid.*, pp. 18.

⁶⁵ *Ibid.*, pp. 20.

⁶⁶ Haylor and Bland. 2001. Integrating aquaculture into rural development in coastal and inland areas. In R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery & J.R. Arthur (eds). *Aquaculture in the Third Millennium*. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20–25 February 2000, pp. 77.

3) **From the social perspective.** The objective of the carrying capacity process is to provide appropriated knowledge to the administrative authorities, in order to plan the activity. In the legal framework, it is common to find different levels of authority. Institutions with regional jurisdiction, with higher access to region-wide information and resources, must decide about the size and distribution of the aquaculture activity in a specific region. On the other hand, at local level it must be defined where the farms should be sited in the short term. From the site selection perspective, acceptability of aquaculture is linked to the participation of all relevant stakeholders. Therefore, a sophisticated policy-making is required: not only to promote industrial activity, but also to legitimize the process. Advisory Committees and Policies of Integrated Coastal Zone Management aim to achieve this purpose.

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