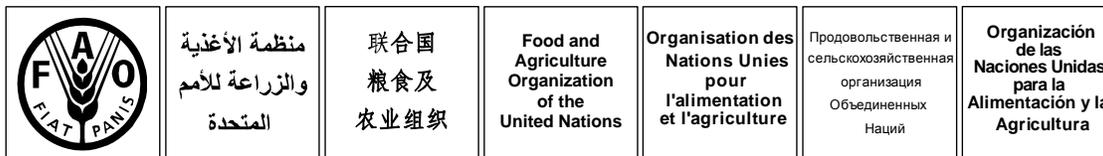


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COMMITTEE ON FISHERIES

SUB-COMMITTEE ON AQUACULTURE

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APPLYING SPATIAL PLANNING FOR PROMOTING FUTURE AQUACULTURE GROWTH

Executive Summary

Around the globe the availability of and access to aquaculture zones and sites with favourable characteristics, including those areas that minimize interactions and conflicts with other activities, represent constraints for the expansion of the sector. Meeting the future demand for food from aquaculture will largely depend on the availability of space for aquaculture. In countries where aquaculture is a novel activity, a comprehensive and coordinated spatial plan to secure an adequate allocation of space in waters and land for sustainable growth of aquaculture is under development. Moreover, in several countries where aquaculture is already well established, the spatial distribution of the sector has not been well planned.

The main purpose of the document is to raise the awareness of the need for spatial planning to ensure the allocation of space availability for aquaculture and to illustrate the benefits that can be derived from spatial planning when promoting growth in aquaculture. To achieve this, this document briefly describes current experiences and suggests a process for spatial planning which emphasizes the integrated management of land, water and living resources for the development and expansion of the sector in a sustainable and equitable way. The document also describes FAO's guidance in implementing spatial planning; recent developments and challenges in spatial planning for aquaculture; FAO assistance to States; issues for concerted action, and proposes action by the Sub-Committee.

The Sub-Committee is invited to:

comment on the information presented in this document, as appropriate, and suggest future activities to be undertaken by the Secretariat as well as by the Sub-Committee itself towards better spatial planning and space allocation for the sustainable growth of aquaculture in the coming decades.

INTRODUCTION

1. Global aquaculture production must increase significantly over the coming decades in order to ensure sufficient fish supply to the rapidly growing human population. Aquaculture cannot be practiced worldwide. It needs resources and requires a unique set of social, economic, environmental and governance conditions.
2. One of the major challenges of sustainable development of aquaculture is the sharing of resources such as water and land by the shared resource users with least conflicts. In many countries, the lack of adequate coastal zone management plans and subsequent site allocation has led to conflicts of interest and competition amongst users of land and water in particular, between tourism and aquaculture and has become a significant constraint for the development of marine aquaculture.¹
3. The unplanned development of aquaculture in some areas of the world has also triggered environmental and social concerns, which have influenced the way the public perceives aquaculture, often portrayed as negative, and most commonly based on the negative impacts of a few commodity species. It is important to build the image of aquaculture to widen the public acceptance of farmed fish². Spatial planning could be one of the means to achieving this goal.
4. There are examples of mariculture parks established to control the development of aquaculture by providing zones for clusters of small-scale farmers that can be monitored on a strategic basis in order to increase economic benefits by ensuring that production is undertaken in a sustainable manner.³
5. Over four decades have elapsed since integrated planning efforts began in the mid 1960s. There are many good examples of integrated planning, such as integrated coastal area management (ICAM) and integrated coastal zone management (ICZM).⁴ However, in many countries, these concepts have not been successfully implemented.
6. Difficulties arise when attempting to integrate the social, economic, environmental, and governance objectives of sustainable development into policy and legal frameworks. Disintegrated way sector planning and plan implementation along with the lack of political will seem to be the most common reasons. These problems are also common to other approaches such as, integrated watershed management or river basin management.⁵

¹ The Government of Turkey has gone to great effort since 2000 to resolve these conflicts. Site and area allocation plans have been prepared along the Mediterranean and Aegean coasts. Most of the marine farms have already left the well protected, near shore shallow waters and have moved to relatively exposed offshore areas to avoid resource conflicts and allow for expansion. FAO/MARA.2009. Developing a road map for Turkish marine aquaculture site selection and zoning using and ecosystem approach to management. FAO/TCP/TUR/3101.

² De Silva, S.S. & Davy, F.B. 2010. Aquaculture successes in Asia: contributing to sustained development and poverty alleviation. In S.S. De Silva & F.B. Davy, eds. Success stories in Asian aquaculture, pp. 1–14. London, Springer.

³ The Government of the Philippines has implemented the establishment of mariculture parks as a possible way to monitor and regulate the development of aquaculture and increase social and economic benefits. Mariculture parks restrict the number of cages to a specific zone that is designated for aquaculture on a long-term basis. FAO. 2009. Environmental impact assessment and monitoring in aquaculture. FAO Fisheries and Aquaculture Technical Paper.No. 527. Rome, FAO. 57 pp. Includes a CD-ROM containing the full document (648 pages). (also available at www.fao.org/docrep/012/i0970e/i0970e00.htm).

⁴ GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP. 2001. Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). *Planning and management for sustainable coastal aquaculture development*. Rep.Stud.GESAMP, (68): 90 pp. (also available at www.fao.org/docrep/005/y1818e/y1818e00.htm).

⁵ FAO. 1999. *Integrated resource management for sustainable inland fish production*. Committee on Fisheries. Twenty-third Session. Rome, Italy, 15–19 February 1999. (also available at www.fao.org/docrep/meeting/w9880e.htm).

7. For the promotion of sustainable aquaculture in the coming decades, it is imperative that integrated spatial planning is effectively applied at both the national and regional levels.⁶ Such planning enables the identification and management of areas for the sustainable growth of aquaculture including potential integration into agro-ecosystems (where appropriate) into other coastal zone/watershed uses. The interactions between aquaculture and the surrounding natural and social environment and the influence it has on aquaculture, must also be taken into consideration.

8. In addition, a sound legal and regulatory framework should be in place for the planning, development and management of aquaculture. The framework should ensure that rights, including tenure rights, are secured and that roles and responsibilities and of all stakeholders, are clearly defined in order to minimize the negative impacts.

9. The main purpose of this document therefore is to raise awareness of the need for spatial planning to ensure the allocation of space for aquaculture and to illustrate the benefits that can be derived from spatial planning when promoting future aquaculture growth. It also outlines FAO's guidance in implementing spatial planning at the national level; recent developments and challenges in spatial planning for aquaculture; FAO's assistance to member countries; issues for concerted action; and proposes actions to be taken by the Sub-Committee.

The benefits of spatial planning

10. Some of the key benefits that a sound spatial planning process and system could provide include:

- i) a more coordinated and integrated approach to the use and management of the environment;
- ii) accountability and transparency by involving relevant stakeholders at all levels;
- iii) a better understanding of the cumulative and combined effects and the interactions among resource users and between users and the environment;
- iv) a more effective mechanism for the governments and agencies to deliver their commitments to sustainable development;
- v) greater clarity on policy and decision-making, and
- vi) a better understanding of the changes required to improve different enabling policy and regulatory frameworks.

11. A better spatial planning system can also deliver substantial economic benefits. For example, it could:

- i) provide greater guidance and confidence in future investments;
- ii) enhance the effectiveness of public and private financial and resource investment;
- iii) improve integration and reduce the duplication of effort and its associated waste of resources;
- iv) improve the speed, quality, accountability and transparency of decision-making;
- v) improve the effectiveness and consistency of regulatory compliance, therefore providing better conditions for open competition; and
- vi) provide an improved understanding of the implications of sustainable use and development of the environment as a component of economic growth.

FAO guidance for implementing spatial planning

12. Spatial planning should consider the social, economic, environmental and governance objectives of sustainable development. This is especially relevant when aquaculture takes place in

⁶ Spatial planning refers to the methods used by the public sector to influence the distribution of people and activities in spaces of various scales. Spatial planning takes place at local, regional, national and international levels and often results in the creation of a spatial plan. Spatial planning also entails a system that is not only spatial but one that also engages processes and secures outcomes that are sustainable, integrated and inclusive.

common properties such as shared waters. The ecosystem approach to aquaculture (EAA) proposed by FAO is a useful framework in this context.⁷

13. In recent years, FAO has provided guidance on spatial planning, including aquaculture zoning and site selection with an ecosystem perspective, to many countries.⁸

14. The key requirements of spatial planning for aquaculture are a) the identification of dedicated areas for aquaculture development (zoning); b) the location of specific sites, and c) the involvement of all relevant stakeholders in the selection process, including those interest groups outside the aquaculture sector who share the resources.

15. Another requirement is the promotion of region-wide regulations, which aim to address cumulative impacts of resource use in all sectors, rather than local or site-by-site regulations. It would also ensure that carrying capacity estimations be socially and politically acceptable.

16. Furthermore, a participatory process is necessary in order to create ownership and to ensure acceptance and respect for aquaculture and the necessary political will.

17. Recommended steps for this participatory process may include:

- i) the scoping and definition of the system boundaries and the identification of stakeholders;
- ii) identification of the main socio-economic, environmental and governance issues and factors, including integration with other sectors when appropriate and external factors such as climate change, that will influence the selection of the aquaculture sites;
- iii) prioritization of the criteria through some form of risk assessment;
- iv) elaboration of an implementation plan for the aquaculture zoning and/or assignment of sites taking into account the corresponding implementation process, which includes reinforcing, monitoring and evaluation; and
- v) performing a long-term review of the zoning and spatial arrangement of aquaculture siting for planning. The entire process must be carried out under the national or local aquaculture policy goals and regulatory frameworks; the latter often need to be reviewed and modified as a result of such process.

18. Prior to and during the scoping process defined above, and in particular during the process of identifying main issues and criteria for the spatial planning, it is necessary to review whether the existing legal frameworks concerning the use of coastal zones and related activities support the objectives of the planning process and whether modifications to such legal frameworks are required. Water use rights, unfettered access to the foreshore, port access rights and regulations for maritime transport are often relevant factors for consideration.

19. The scoping process should also review any existing coastal zone management plan to establish whether it facilitates aquaculture development. Legal and regulatory frameworks should establish clear mechanisms for aquaculture zoning, site selection in waterbodies considered “common property” and the granting of tenure rights, including aquaculture licences.

20. The process of zoning and assigning sites must also take into consideration environmental standards and related issues, so that the impact of aquaculture activities on the environment and the impacts on aquaculture from other activities are minimized.

⁷ The premise of the ecosystem approach is in the Convention of Biological Diversity which defines the ecosystem approach as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. FAO. 2010. *Aquaculture development. 4. Ecosystem approach to aquaculture*. FAO Technical Guidelines for Responsible Fisheries No. 5, Suppl. 4. Rome. 53 pp. (also available at www.fao.org/docrep/013/i1750e/i1750e00.htm).

⁸ Ross, L.G., Telfer, T.C., Falconer, L., Soto, D. & Aguilar-Manjarrez, J., eds. 2013. *Site selection and carrying capacities for inland and coastal aquaculture*. FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6–8 December 2010. Stirling, the United Kingdom of Great Britain and Northern Ireland. FAO Fisheries and Aquaculture Proceedings No. 21. Rome, FAO. 46 pp. Includes a CD-ROM containing the full document (282 pp.).

21. The four hierarchical carrying capacity categories used in aquaculture zoning and site selection are: physical, productive, ecological and social.
22. The physical category is based on the suitability for the development of a given activity, taking into account the natural conditions and needs of the species and culture system (site selection). Productive carrying capacity estimates the maximum aquaculture production and is typically considered at the farm-scale. Physical and productive should be considered as the economic elements of the carrying capacity. Ecological carrying capacity is defined as the magnitude of aquaculture production that can be produced without significantly changing the environment. Finally, the social carrying capacity addresses the level of development that causes unacceptable social impacts. Physical and production carrying capacity do not directly depend upon social values, whereas ecological and social carrying capacities do. Consequently, it is clear that prior to determining the ecological and social carrying capacity, any limits on the environmental variables of interest must be defined by society based on best available knowledge.
23. The use of the different carrying capacities requires harmonizing the environmental, social and multi-sectoral planning objectives. These three objectives and their relative importance (weights) differ among countries and across regions, making it socially and politically impractical to define a single standard for uniform compliance with regard to limits and thresholds. This process must be done with stakeholders within the defined boundaries of the system where the aquaculture zoning and site selection process is going to take place.
24. Aquaculture zoning can be used in planning to identify potential areas for aquaculture growth where aquaculture is new, and to help regulate the development of aquaculture where aquaculture is already well established. In some countries, aquaculture farms have been organized into small management groups such as “clusters”, “aquaculture parks”, “regions” or “zones” in order to increase social and economic benefits to small-scale producers by promoting and developing collective action.⁹ However, any clustering initiative would require prudent observation in order not to exacerbate biosecurity (disease) and environmental capacity issues through over concentrated development.
25. Examples of social and governance issues that guide spatial planning for aquaculture, and therefore the criteria for aquaculture zoning and site selection, include: resolution of conflicts; competing and complementary uses of land and water with other activities such as fisheries; maintaining quality of the environment; and promoting and facilitating private-sector aquaculture development.
26. Examples of environmental issues typically include: the type of species and production systems to develop; amount of space available for aquaculture development; “optimum” areas for practicing aquaculture; environmental conditions conducive for the optimal growth of aquaculture species; biosecurity and fish health management needs; and factors limiting carrying capacity.
27. Examples of economic issues include: economic viability of logistic and other servicing facilities to culture sites; cost alternatives of land and water use against the potential for aquaculture development.
28. Once the key criteria for spatial planning have been defined, essential data need to be obtained. The data, which can come from a wide variety of sources, will differ with location, species, farming system, and social and cultural conditions.
29. Virtual technologies encompass the essential tools for spatial planning, whether they are geographic information systems (GIS), satellite remote sensing, dynamic models or others. They are invaluable tools for data management, analysis and modelling, and play an important role in addressing the physical, productive, ecological, and social and economic categories of carrying

⁹ Examples of economic benefits from cluster management can be found at: Kassam, L.; Subasinghe, R.; Phillips, M. 2011. *Aquaculture farmer organizations and cluster management: concepts and experiences*. FAO Fisheries and Aquaculture Technical Paper. No. 563. Rome, FAO. 2011. 90 pp. (also available at www.fao.org/docrep/014/i2275e/i2275e00.htm).

capacity, in assisting spatial planning through sound decision-making. In addition to guiding and proposing solutions, virtual tools can be used to test “what-if” scenarios of proposed spatially related projects or processes.¹⁰

30. One interesting example of virtual technology is found in Norway. A Web-based decision support system called "AkvaVis" is presently under development as part of a new framework to manage environmental effects and area allocation in Norwegian aquaculture.¹¹ Demonstrations for locating Atlantic salmon and blue mussels are available at www.akvavis.no. The Web site is widely accessible and dynamic. It is adaptable, can accommodate new knowledge and can address demands arising from the industry, as well as from public and private stakeholders. It can be further integrated into other activities as part of marine spatial planning. Through a Web-based interaction comprising maps of any desired area, potential fish culturists can see the carrying capacity estimates of the new production unit at any specified time.

Recent development and challenges in spatial planning for aquaculture

Recent developments

31. Many countries have adopted, or are in the process of adopting, measures to address aquaculture land and water use conflicts through integrated planning. In fact, many countries have created authorized areas for the establishment of aquaculture activities in aquaculture exclusive zones.

32. In recent years, issues relating to the development of aquaculture in the General Fisheries Commission for the Mediterranean (GFCM) area, particularly in relation to coastal zone management, have come to the fore. Despite the growing role played by marine aquaculture in providing GFCM Members and their populations with a reliable source of seafood in a time of decline in the marine capture fisheries sector, conflicts between aquaculture activities and other uses of coastal zones are negatively affecting the development of these activities. As a result, GFCM has been implementing “allocated zones for aquaculture” (AZA) within the remit of the work of the Committee on Aquaculture (CAQ), in light of their potential as management tools for preventing conflicts with other uses of coastal zones while enabling aquaculture planning.¹²

33. Various countries worldwide have also started to use marine spatial management to achieve sustainable use and biodiversity conservation in ocean and coastal areas.¹³ Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have usually been specified through a political process. Characteristics of marine spatial planning include ecosystem-based, area-based, integrated, adaptive, strategic and participatory.

34. A strategy on spatial planning is considered one of the essential mechanisms to ensure sustainable marine capture fisheries and aquaculture development in the RECOFI region. FAO

¹⁰ Ferreira, J.G., Aguilar-Manjarrez, J., Bacher, C., Black, K., Dong, S.L., Grant, J., Hofmann, E., Kapetsky, J., Leung, P.S., Pastres, R., Strand, Ø. & Zhu, C.B. 2012. Progressing aquaculture through virtual technology and decision-support tools for novel management. In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, eds. *Farming the Waters for People and Food*. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010. pp. 643–704. FAO, Rome and NACA, Bangkok (also available at www.fao.org/docrep/015/i2734e/i2734e00.htm).

¹¹ Ervik, A., Agnalt, A.-L., Asplin, L., Aure, J., Bekkvik, T.C., Døskeland, I., Hageberg, A.A., Hansen, T., Karlsen, Ø., Oppedal, F. & Strand, Ø. 2008. AkvaVis – dynamisk GIS-verktøy for lokalisering av oppdrettsanlegg for nye oppdrettsarter – Miljøkrav for nye oppdrettsarter og laks. *Fisken og Havet*, nr 10/2008. 90 pp.

¹² AZA have been identified as a necessity for activities related to the sustainable development of aquaculture in the Mediterranean and Black Seas. At its 36th session held in Marrakech (Morocco) in March 2012, the Commission adopted a resolution on AZA (guidelines) (GFCM/36/2012/2).

¹³ UNESCO-Intergovernmental Oceanographic Commission. 2012. Marine spatial planning. In *Marine spatial planning initiative* [online]. France. [Cited 23 May 2013]. www.unesco-ioc-marinesp.be/marine_spatial_planning_msp

assistance to RECOFI Member countries has recently included the development of (i) a Regional Strategy on Spatial Planning for Marine Capture Fisheries and Aquaculture and (ii) a Spatial Planning Development Programme to implement the Regional Strategy. The guiding principles underpinning the outlined components of the strategy which are founded broadly on the ecosystem approach to aquaculture and fisheries, the principles of Marine Spatial Planning and finally by principles especially designed for the RECOFI region.

35. Good examples of integrated planning for marine environments are found in countries where marine spatial planning has been well established such as Canada, Norway, the United Kingdom, and the United States of America. However, marine spatial planning is not without its challenges; to be effective and sustainable, it needs to be integrated with various activities and jurisdictions, ecosystem-based, adaptive, place-based, strategic in forecasting and participatory. Conducting marine spatial planning in the coastal zone has the added complexity of considering land-based activities in assessing cumulative environmental effects.

36. Examples of successful integrated planning for coastal aquaculture are also found in the seas of East Asia. Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) has been successful in developing and implementing various Integrated coastal management (ICM) programmes for planning and managing the coastal area, using integrated, holistic and interactive approaches.

37. In Ireland, the unique Co-ordinated Local Aquaculture Management Systems (C.L.A.M.S.) process is a nationwide initiative which manages the development of aquaculture in bays and inshore waters throughout Ireland at the local level. In each case, the plan fully integrates aquaculture interests with the relevant national policies.

38. A framework similar to marine spatial planning should be developed for “inland” aquaculture. Spatial planning for integrated watershed and river and lake basin management has also gained considerable importance.¹⁴ This management scale can range from as small as a cluster of farms (an aquaculture zone) to a waterbody that is shared locally, regionally or internationally. Common amongst them is the need for coordinated management to address key issues such as the potentially cumulative ecosystem effects derived from farm clusters; the potential impacts on biodiversity from escapees of alien species or alien genotypes; and the risks of disease outbreaks.

39. Given that the ecosystem approach to aquaculture and fisheries, and marine spatial planning concepts are now prevailing, it is necessary to think more broadly about the spatially based challenges in order to optimize aquaculture growth.

Challenges

40. Zoning can help address a number of issues, such as integrated management; risk assessment; coastal aquaculture development; expansion of mariculture further offshore; aquatic animal health (biosecurity); better management practices; watersheds management; and aquaculture in the context of competing, conflicting and complementary uses of land and water. Thus, finding optimal solutions to these issues depends, in part, upon finding a suitable zoning strategy supported by zoning policies.

41. Feedback received from participants during recent FAO training workshops on spatial planning indicates that the main obstacles for adequate aquaculture zoning processes are:

- i) limited understanding of the concepts and processes to aquaculture zoning and carrying capacity estimates;
- ii) lack of aquaculture master plans that include aquaculture zoning, and lack of political will and institutional interest to establish aquaculture zones;

¹⁴ Jenness, J., Dooley, J., Aguilar-Manjarrez, J. & Riva, C. 2007. *African Water Resource Database. GIS-based tools for inland aquatic resource management. 1. Concepts and application case studies*. CIFA Technical Paper. No. 33, Part 1. Rome, FAO. 167 pp. (also available at www.fao.org/docrep/010/A1170E/A1170E00.HTM).

- iii) conflicts between aquaculture activities and other user interests in coastal zones and waterbodies that ignore aquaculture rights and needs;
- iv) lack of institutional frameworks, including laws, regulations and norms for the allocation of space for aquaculture; and
- v) a general lack of resources and training to support aquaculture zoning initiatives.

FAO technical assistance

42. Site selection and carrying capacity considerations are amongst the most important initial steps for the success of aquaculture and need to be carried out in accordance with sustainability objectives and hence it has been incorporated into the new FAO Code of Conduct for Responsible Fisheries (CCRF) questionnaire under “Essential management instruments and measures”. Part Two of the new questionnaire on “Support mechanisms that facilitate the implementation of the regulatory measures” also includes relevant elements for spatial planning, such as the integration of aquaculture in coastal development and management plans and with watershed management or land use development plans.

43. FAO, in its efforts to assist member countries to increase aquaculture production in a sustainable manner, is making special efforts to address spatial planning for aquaculture by developing tools and key publications and by holding workshops under FAO’s helm in collaboration with other agencies.¹⁵ These workshops have focused on countries where aquaculture is a new sector and where there is a need to find appropriate areas for its expansion. Recent workshops have included, for example: (i) a workshop organized by the Aquaculture Network of the Americas (Red de Acuicultura de las Américas RAA; www.racua.org) that targeted government aquaculture personnel from Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua; (ii) a GFCM workshop targeting North African countries; and (iii) a Regional Commission for Fisheries (RECOFI) workshop on the Spatial Planning Development Programme for Marine Capture Fisheries and Aquaculture for RECOFI Member countries in the Near East.

44. FAO assisted Thailand, through a technical cooperation project, to improve operational decision-making on aquaculture management and development and expanded aquaculture planning and policy capabilities through an issue-driven, timely, geographically comprehensive and objective Aquaculture Information Management System (AIMS). The main outputs and experiences gained through this project should eventually serve as a “model” for the operational use of a comprehensive AIMS for all provinces in Thailand and similar projects in other countries in Asia could be established with similar needs and capacities.

45. Marine aquaculture, in particular off-the-coast aquaculture, offers significant opportunities for sustainable food production and for the development of many coastal communities, especially in regions where the availability of land, nearshore space and freshwater are limited. FAO has been actively assisting countries to plan for the expansion of mariculture. During 2010, a Technical Workshop on “offshore mariculture” in Orbetello, Italy was conducted to provide an overview of the current situation and future prospects for expanding mariculture further offshore through the analysis of eight reviews and the opinion of experts. The workshop proceedings entitled “Expanding mariculture further offshore: technical, environmental, spatial and governance challenges” is forthcoming. An FAO Fisheries and Aquaculture Technical Paper entitled “A global assessment of potential for offshore mariculture development from a spatial perspective”¹⁶ was published in 2013.

¹⁵ Spatial planning of aquaculture falls well within the new strategic planning process that is going to guide FAO’s work in the next medium-term plan 2014–2017. SO2 gives high priority to two guiding themes: (i) taking full account of all three dimensions of sustainability (environmental, social and economic); and (ii) the imperative need to achieve an orderly transition to more sustainable practices, hence facilitating their adoption by very large numbers of producers and resource managers. FAO. 2013. *The Director-General’s Medium Term Plan 2014–17 and Programme of Work and Budget 2014–15*. Rome. 159 pp. (also available at www.fao.org/docrep/meeting/027/mf490e.pdf).

¹⁶ Kapetsky, J.M., Aguilar-Manjarrez, J. & Jenness, J. 2013. *A global assessment of potential for offshore mariculture development from a spatial perspective*. FAO Fisheries and Aquaculture Technical Paper No. 549. Rome, FAO. 181 pp.

Its purpose is to call attention to the potential for aquaculture in areas where it is under developed, most recently in the realm of off-the-coast and offshore mariculture.

46. FAO has been active in promoting the use of spatial planning tools (i.e. GIS and remote sensing) in fisheries and aquaculture since 1985, and has demonstrated the capabilities of these tools when addressing aquaculture and fisheries issues, mainly for strategic planning. Promotional activities have been carried out by means of technical publications, information systems, workshops, training courses and field projects.¹⁷ Several technical publications related to spatial planning have been generated in recent years, and more are forthcoming or under preparation.¹⁸

47. FAO has also been active in assisting countries in reviewing and developing legal frameworks that promote the development and management of aquaculture, including establishing mechanisms for spatial planning, issuance of tenure rights, and the protection and enforcement of such rights. The review and development of legal frameworks are conducted in a participatory manner, which also takes into account technical information and advice, relevant standards and best practices, as well as concerns and needs of stakeholders.

48. In many countries where aquaculture is new, there is a need to allocate appropriate areas for its development. FAO is currently assisting the Kingdom of Saudi Arabia in identifying aquaculture potential along the Red Sea and Arabian Gulf coasts, whilst considering in certain areas the other potential uses of the coast. In this context, aquaculture zones are being identified to be designated for aquaculture development through a participatory process with relevant stakeholders. By analyzing satellite images and other coastal data, maps of potential areas for onshore, near shore and offshore aquaculture were developed taking into consideration necessary buffers between aquaculture and sensitive habitats, areas where aquaculture is not permitted and areas of potential conflict for aquaculture. Carrying capacity of the identified potential areas was then estimated using a precautionary approach that allows for an estimate of the potential coastal aquaculture production in the Kingdom of Saudi Arabia.

49. FAO has also been assisting countries such as Cameroon, Mauritania and Ghana to prepare national aquaculture strategies and national development plans including the identification of potential areas to allocate zones for aquaculture. Therefore, spatial planning can be of immense value to a country in the allocation of its scarce resources. In developing countries, a spatial plan can also meet the requirement of international development banks and donor organizations to make loans or to provide technical assistance to selected national projects with a clear understanding of the resources available and the benefits that can be accrued.

Issues for concerted action

Processes required for spatial planning

50. Support technical and policy guidance to improve current practices towards a more holistic and integrated planning of aquaculture zoning and site suitability.

Understanding and implementing regulations

51. Many countries lack adequate legislative and regulatory frameworks that allow for robust and effective spatial planning. Where regulations exist, they are often not implemented or misinterpreted. In addition, existing regulations are fragmented, sector oriented, and create overlaps and inconsistencies. Efforts should focus on developing sound regulatory frameworks where there is a

¹⁷ Meaden, G.J. & Aguilar-Manjarrez, J., eds. 2013. *Advances in geographic information systems and remote sensing for fisheries and aquaculture*. Summary version. FAO Fisheries and Aquaculture Technical Paper No. 552. Rome, FAO. 98 pp. Includes a CD-ROM containing the full document (425 pp.).

¹⁸ Aguilar-Manjarrez, J., Kapetsky, J.M. & Soto, D. 2010. *The potential of spatial planning tools to support the ecosystem approach to aquaculture*. FAO/Rome. Expert Workshop. 19–21 November 2008, Rome, Italy. FAO Fisheries and Aquaculture Proceedings. No.17. Rome, FAO. 2010. 176 pp. (also available at www.fao.org/docrep/012/i1359e/i1359e00.htm).

regulatory gap, or ensure that overlapping and conflicting laws and regulations are harmonized. The reformed regulatory frameworks should facilitate integrated planning and should establish requirements for the issuance of licences and other authorizations for specific aquaculture proposals or activities. Adequate provisions should be established for monitoring, as well as for enforcement in the case of contraventions or non-compliance.

Regional collaboration

52. Create or support mechanisms in order to address and facilitate information exchange on spatial planning and encourage collaboration amongst sectors, nations and regions at all levels. Spatial planning issues for aquaculture and fisheries can be quite different, but they have many kinds of needs that are common to both. Similarly, technical innovations and data applied for other purposes such as coastal area management and water resources assessments can also be useful for aquaculture. For the sake of economy as well as to promote cooperation, opportunities to realize synergies when designing and implementing a spatial plan need to be pursued in close consultation with all relevant stakeholders.

Capacity building in spatial planning

53. Support capacity building for integrated planning and for estimates of carrying capacity and optimal zoning and site selection related to the various kinds of culture systems in use. Virtual tools can assist in the identification, analysis and possible allocation of specific geographical areas for aquaculture; they are particularly useful in countries that have limited natural resources and that are in high demand by competing users. An enabling environment, therefore, is crucial in order to adopt their use. There is also a continuing need to gauge needs, priorities and capacities (human resources, infrastructure, finances) to implement the use of appropriate models and tools so that capacity-building initiatives can be matched to existing capabilities.

Aquaculture inventories

54. Inventories of the location and status of existing (and abandoned) farms and farming areas are an essential step that can ultimately improve siting and management. At watershed, aquaculture zone and farm levels, there is a need for spatial inventory of aquaculture including species, culture systems, and production being recorded, in order to estimate environmental and social impacts. Member countries need to make this activity one of their priorities in order to implement spatial planning. For a relatively inexpensive initiative, the benefits can be great. An excellent starting point for a spatial inventory of aquaculture with attributes that include species, culture systems, and production is FAOs National Aquaculture Sector Overview map collection (www.fao.org/fishery/naso-maps/naso-home/en).

Proposed actions by Member countries and FAO

55. It would be advisable that FAO Member countries who have not yet done so, put in place:

- i) spatial zoning in their aquaculture development policy;
- ii) a comprehensive and coordinated “spatial planning process” to ensure integration with other sectors and that the potential and needs of aquaculture are taken into account, to secure an adequate allocation of space in waters and land for sustainable growth of aquaculture; and
- iii) a “spatial planning system” for aquaculture zoning and site selection that can be implemented at any spatial scale.

56. FAO will continue to make available and disseminate studies and technical advice to help Member countries in their planning. This could include an assessment of the level and quality of planning, and the identification of options for improvement in relation to policy and legal frameworks, information management, permitting and licensing, and consultation.