

Integrated mariculture

A global review



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Illustration by Doris Soto.

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Edited by

Doris Soto

Senior Fishery Resources Officer (Aquaculture)

Aquaculture Management and Conservation Service (FIMA)

FAO Fisheries and Aquaculture Department

Rome, Italy

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Preparation of this document

Considering the demonstrated relevance of integrated aquaculture for livelihoods and environmental sustainability in inland ecosystems, in 2005 the Aquaculture Management and Conservation Service (FIMA) of the Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department began a study on “integrated mariculture”. The main goals were to assess the current practice of integrated aquaculture and its potential in marine environments envisioning to use this information for the development of technical guidelines. The initial stage of this project included three desk studies encompassing global views of practices and future prospects for integrated aquaculture in coastal and marine areas in three climatic zones: temperate, tropical and Mediterranean Sea as a special Mediterranean enclosed ecosystem. Since integrated aquaculture can be considered a major tool for the implementation of an ecosystem approach to the sector, these global reviews were also presented and discussed during the Food and Agriculture Organization of the United Nations/Universitat de les Illes Balears Expert Workshop on *Building an ecosystem approach to aquaculture* convened in Palma de Mallorca, Spain, from 7–11 May 2007.

The commissioned review papers describing integrated aquaculture in coastal and marine environments were technically supervised by Mrs Doris Soto, Senior Fisheries Officer (FIMA).

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Abstract

While the concept and practice of integrated aquaculture is well-known in inland environments particularly in Asia, in the marine environment, it has been much less reported. However, in recent years the idea of integrated aquaculture has been often considered a mitigation approach against the excess nutrients/organic matter generated by intensive aquaculture activities particularly in marine waters. In this context, integrated multitrophic aquaculture (IMTA) has emerged, where multitrophic refers to the explicit incorporation of species from different trophic positions or nutritional levels in the same system. Integrated marine aquaculture can cover a diverse range of co-culture/farming practices, including IMTA, and even more specialized forms of integration such as mangrove planting with aquaculture, called aquasilviculture. Integrated mariculture has many benefits, among which bioremediation is one of the most relevant, and yet is not valued in its real social and economic potential although the present document provides some initial economic estimates for the integration benefits derived from bioremediation. Reducing risks is also an advantage and profitable aspect of farming multiple species in marine environments (as in freshwaters): a diversified product portfolio increases the resilience of the operation, for instance when facing changing prices for one of the farmed species or the accidental catastrophic destruction of a crop. Yet such perspectives are far from being considered in mariculture where, on the contrary, there is a tendency to monoculture.

Modern integrated mariculture systems must be developed in order to assist sustainable expansion of the sector in coastal and marine ecosystems thus responding to the global increase for seafood demand but with a new paradigm of more efficient food production systems. Successful integrated mariculture operations must consider all relevant stakeholders into its development plan government, industry, academia, the general public and non-governmental organizations must work together and the role of integrated mariculture within integrated coastal zone management plans must be clearly defined.

There is a need to facilitate commercialization and promote effective legislation for the support and inclusion of integrated mariculture through adequate incentives particularly considering the reduction of environmental costs associated to monoculture farming. Bioremediation of fed aquaculture impacts through integrated aquaculture is a core benefit but the increase of production, more diverse and secure business, and larger profits should not be underestimated as additional advantages.

In many cases, more research is needed to further integrated mariculture – particularly regarding the technical implementation of a farm. At this level, an important issue is to adopt adequate management practices that avoid or reduce the likelihood of disease transmission within and between aquaculture facilities or to the natural aquatic fauna. Also, careful consideration should be paid to the selection of species used in polyculture or integrated multitrophic aquaculture to reduce potential stress and suffering of culture individuals. Integrated aquaculture should be looked upon as a very important tool to facilitate the growth of marine aquaculture and promote sustainable development.

Soto, D. (ed.).

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Acronyms and abbreviations

AIT	Asian Institute for Technology
AARM	aquaculture and aquatic resources management, Asian Institute for Technology, Bangkok, Thailand
ASP	active suspension ponds
BFRI	Bangladesh Fisheries Research Institute
BMPs	better management practices
BOD	biochemical oxygen demand
BIFS	brackishwater integrated farming systems
CSSP	Canadian shellfish sanitation program
CPG	Charoen Pokphand Group
CZM	coastal zone management
DDP	dams and development project, United Nations Environment Programme
DFO	Fisheries and Oceans Canada
EAS	European Aquaculture Society
EAA	ecosystem approach to aquaculture
EEA	European Environment Agency
ECASA	ecosystem approach to sustainable aquaculture (an EU-funded framework)
EJF	Environmental Justice Foundation
ENGO	environmental non-governmental organization
FCR	feed conversion ratio
GAMBAS	Global Assessment of Mekong Brackishwater Aquaculture of Shrimp
HP	habitat preservation
IAAS	integrated agriculture-aquaculture systems
ICAR	Central Institute of Freshwater Aquaculture, Indian Council of Agricultural Research
ICES	International Council for the Exploration of the Seas
ICLARM	International Centre for Living Aquatic Resources Management (presently WorldFish Center)
IFAS	integrated fisheries-aquaculture systems
IFREMER	French Research Institute for Exploitation of the Sea
IMT	integrated multitrophic
IMTA	integrated multitrophic aquaculture
INTAQ	integrated aquaculture
IPMS	increasing profits from multiple species
IPUAS	integrated peri-urban aquaculture systems
IRR	internal rate of return
ISDA	integrated services for the development of aquaculture and fisheries
JIRCAS	Japan International Research Center for Agricultural Sciences
MEDPAN	Network of Managers of Marine Protected Areas in the Mediterranean
NACA	Network of Aquaculture Centres in Asia/Pacific
NELHA	Natural Energy Laboratory of Hawaii Authority
NPV	net protein value
PAS	partitioned aquaculture systems
R&D	research and development
R&D&C	research, development and commercialization

SEAFDEC	Southeast Asian Fisheries Development Center
STREAM	Support to Regional Aquatic Resources Management
TFP	total factor productivity (ratio of an index of total output to an index of all factor inputs)
WM	waste management/mitigation
WT	treating culture water + culture environment
WIOMSA	Western Indian Ocean Marine Science Association
YHD	yellow head disease