EXPERT CONSULTATION ON IMPROVING INFORMATION ON STATUS AND TRENDS OF AQUACULTURE

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GLOBAL ISSUES IN RELATION TO STATUS AND TRENDS REPORTING ON AQUACULTURE

SUMMARY

Considerable progress has been by FAO in the establishment of a global database on aquaculture statistics, but the process is still in the early stages of development and much more needs to be done to improve knowledge of the sector, particularly in view of increasing demands for information at the national, regional and international level by a variety of data users. The document highlights and discusses a number of interlinked institutional and technical constraints, with national, regional and international dimensions. Suggestions are presented for moving forward, including development of an international strategy to improve knowledge and enable sustainable management of aquaculture with the help of the donor community.

INTRODUCTION

1. Statistical information is the main foundation of status and trends reporting and for the derivation of various sector indicators. Despite the increasing need and appreciation for statistical data, the growing Internet-based national, regional and international systems which enhance accessibility and dissemination of aquaculture data and information, many countries still do not have an adequate system of statistics for aquaculture. Therefore international standards and practices for data collection methods and programmes, and for data management have yet to be fully developed and tested.

2. The need to improve aquaculture statistics and the information base on aquaculture in general, is not surprising. Though aquaculture has been practised for centuries, aquaculture management is a fairly new concern. Aquaculture was recognized only recently (March 2001) as an independent economic activity by the United Nations Statistical Commission (and defined as such in the International Standard Industrial Classification of All Economic Activities). Accordingly, the collection of statistical data

and other information on aquaculture separately from fisheries data is a recent endeavour in many parts of the world and much remains to be done.

3. Equally, global collection of aquaculture statistics by FAO is a relatively recent activity and is still under development, lagging behind systems for fisheries and agriculture. FAO has been reporting and promoting the reporting of aquaculture production statistics, separately identified within the total fishery production, for about 20 years only (i.e. since 1984).

4. Nevertheless, the growing importance and rapid growth of aquaculture requires closer attention to some aspects of data collection and their accurate reporting and analysis. It is important that effective statistical collection systems are established by all the major producing countries. Regional and international cooperation is required to improve data collection to adequate statistical standards, promote harmonized reporting for the sector and ensure the availability of reliable statistics as demanded by an increasing audience of data users.

INSTITUTIONAL ISSUES

5. There are difficulties involved with the collection of global aquaculture data. These can occur at the international level where FAO compiles the worldwide statistics; at the national level where the countries compile and submit their aquaculture statistics; and in the field within the country where proper data collection procedures need to be available and be followed. Additionally, problems can occur if there is a lack of, or poor, communication between any of these steps.

Quality of National Statistics

6. The problems associated with the international datasets are deeply rooted in national data constraints. In fulfilling its role as the compiler of the aquaculture data received from national reports, the most serious problems encountered by FAO have traditionally included for some countries a complete lack of reporting, a lack of timely reporting, a lack of complete reporting or a lack of accurate reporting. FAO works to encourage timely, accurate, and complete reporting from all countries, but primarily depends on the countries to respond properly to the questionnaires and data requests. When requested, the Organization provides assistance to Member countries for improving the collection, processing and dissemination of data and information through its Technical Cooperation Programme (TCP).

7. National statistical systems and capabilities differ widely among countries. Proper reporting and trends monitoring at the national level depend on a number of institutional and technical factors, e.g. the relative economic importance of the sector, how it is administered, the level of commitment and support for the collection of data and information, and the accuracy, completeness and timeliness of collected data.

8. The most frequently indicated constraints to proper data collection at the national level include varying combinations of the following factors:

- Poor understanding of the purpose of data collection and lack of coordination and linkage between information "users" and information "providers";
- Lack of high level commitment and inadequate support for involved government institutions at all levels to collect statistical information from, and to monitor the aquaculture industry;
- Lack of human capacity or facilities for the processing, storage and analysis of data.
- Poor or inconsistent quality of data and collection methods;
- Lack of proper licensing system for aquaculture establishments which prevents controlled growth of the industry and impedes collection of information from the establishments;
- Lack of quantitative assessment of small-scale rural (subsistence) and semi-commercial aquaculture[1];
- Dispersal of data in various institutions, in both the public and private sectors, and absence of systematic efforts by institutional aquaculture authorities to collect the dispersed information on a regular basis.

9. Many of the above issues, and others, have been recognized and discussed at length in earlier meetings, and means to address them suggested. The recommendations of three such meetings, during the period 1997 – 2000, are provided in Annex I.

10. It has been suggested by SEAFDEC that the lack of follow up on recommendations and high level commitment and support (in SEAFDEC member countries) "... *generally reflects the inability of fishery* (and aquaculture[2]) *statistics to have a demonstrable record in the provision of useful and reliable information for the decision-making process. The resources required for the collection of these data have decreased accordingly, and the quality, availability, reliability, accuracy and timeliness of data compiled at the national level are not satisfactory."* [3]

11. It is clear that countries need to collect aquaculture statistics for their own national interest, for policy-making, planning and management. The provision of statistics to FAO (and regional fishery bodies) is only of secondary importance. The usefulness of the national statistics depends on their accuracy and completeness. In view of the current status of aquaculture statistics, it is of the greatest importance that national aquaculture statistical systems are reviewed and improved.

12. FAO has conducted national and regional seminars to identify methodological shortcomings and how they may be rectified, and prepared detailed guidelines for the collection of aquaculture statistics (the Census guidelines). But, given the short history of aquaculture statistics, there is a need for a long term, sustainable and pro-active effort to assess and improve national aquaculture statistical systems. To succeed, even such a concerted effort will require conviction and commitment on the part of interested Member countries, particularly the major aquaculture producers, regarding the need for and usefulness of statistical and other information for policy, planning and management, ad assessment. Support from bilateral aid agencies will be essential.

[1] Semi-commercial aquaculture: refers to small enerprises where produce is mainly consumed by the producer and excess is marketed.
[2] Author's addition
[3] SEAFDEC. 2001. Report of the SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium . Bangkok, Thailand, 19-24 November 2001.

Coordination of Aquaculture Statistics and Status and Trends Reporting

Regional and global working parties on aquaculture

13. Unlike the international nature of some marine capture fisheries, aquaculture is largely a national concern. International commissions similar to those for capture fisheries do not exist for aquaculture; nor does an international mechanism similar to the Coordinating Working Party on Fishery Statistics (CWP). The CWP has considered and debated matters related to aquaculture statistics, but member organizations are mainly concerned with management of commercially important fish resources. Some have no mandate for the collection of aquaculture statistics, or for reporting on aquaculture.

14. Consequently, while many refinements such as zonation, sampling standards and surveys and definitions were introduced and evolved through statistical working parties of the International Fishery Commissions for marine capture fisheries, the international harmonization of terminology and standardisation of data collection procedures for aquaculture have been relatively neglected[4]; e.g. the first expert consultation on variables and terminology in aquaculture was convened in 1999.

15. Aquaculture statistics have not figured prominently in the work of CIFA[5] (Africa), COPESCAL[6] (Latin America), or the GFCM[7] (Mediterranean), though working parties of experts in aquaculture, or economics and statistics, have occasionally addressed problems of aquaculture statistics. However, statistical data and other information on aquaculture are now collected and maintained by SIPAM[8], which operates under the GFCM. Aquaculture statistics have received the most attention in Asia, mainly through joint meetings/workshops of FAO/APFIC[9] Joint Working Party on Fishery Statistics and Economics (JWP) and SEAFDEC, and occasionally, through the APFIC Working Party on Inland Fisheries and Aquaculture.

16. Regional projects on fishery statistics also have been focused almost exclusively on capture fisheries, as has the development of statistical software by FIDI. Almost all fishery statistical assistance and training provided by FAO and bilateral agencies has been related to the collection and processing of catch and effort data from artisanal and industrial fisheries.

17. Recognizing the need for an international mechanism to advise and coordinate work on aquaculture statistics, the 1999 SEAFDEC/FAO Ad Hoc Consultation on Variables and Terminology for Aquaculture Monitoring in Asia called for the establishment of a working group to assist (Asian) countries develop their capacity for the collection and processing of aquaculture data, and to help standardize and harmonize methodologies, terms and definitions.

Integration mechanisms

[4] Rana, K.J., R. Grainger, A. Crispoldi-Hotta. 1999. Present procedures and constraints for monitoring production and development of aquaculture and inland capture fisheries. SEAFDEC/FAO Ad Hoc Expert Consultation on variables and Terminology for Aquaculture Monitoring in Asia. 13-16 September 1999, Bangkok, Thailand.
[5] Committee on Inland Fisheries of Africa
[6] Commission for Inland Fisheries of Latin America
[7] General Fisheries Commission for the Mediterranean
[8] Information System for the Promotion of Aquaculture in the Mediterranean.
[9] Asia-Pacific Fishery Commission

18. There is need for integration of information from various sources, at all levels, to ensure the availability of inter-disciplinary information needed for policy-making and monitoring of the impact of policies and programmes in the light of new management perspectives. This will require integration of data collection across sectors at the national, regional and international level through appropriate institutional arrangements.

19. Cooperation between FIDI and regional bodies concerned with agriculture and fisheries statistics has been described elsewhere (EC:STA/2004/3), together with efforts to integrate all FAO fisheries and aquaculture information and databases through the FIGIS programme. In addition to FIGIS, efforts are underway to harmonize and integrate all FAO statistical databases (agriculture, fisheries and forestry).

20. Collation of information on aquaculture and of concern to aquaculture, is underway at the regional level for the Mediterranean region through SIPAM (see EC:STA/2004/3, Annex III). A sister system (SIPAL)[10] was designed earlier (1995) for Latin America through a FAO/Italy regional aquaculture project (AQUILLA II, GCP/RLA/102/ITA), but is not yet operational. A start was also made in 1998 to establish a regional system for the Gulf area, through the Commission for the development and Management of the Fishery Resources of the Gulf[11], and for Asia[12] (1998) through a cooperative effort with existing regional institutions (NACA, AIT[13], SEAFDEC, etc.). It was intended to eventually link these regional information systems as an inter-regional network with similar architecture and standards to enable exchange of information. Though the FAO can assist in the establishment of such a system, it will be sustainable only if it is need-driven and consequently hosted and supported by countries of the region. This is the case in the Mediterranean, where the regional HQ of SIPAM is hosted and supported by the Government of Tunis.

Participation and transparency

22. Participation in the establishment of standardized terms and definitions, improving national aquaculture statistics and in the preparation of FAO status and trends reports in aquaculture (i.e. *Review of the State of World Aquaculture*) have been described elsewhere (EC:STA/2004/3). Collaboration in the establishment of regional aquaculture information systems was also described in the preceding section.

23. Though the improvement of statistics and information systems for aquaculture has been pursued regularly in collaboration with FAO and Non-FAO regional bodies/ organizations, and with concerned national authorities, participation in the FAO reporting of status and trends in aquaculture has followed an *ad hoc* procedure. However, separate, in-depth reporting of aquaculture status and trends by FAO started only recently (1994) with three reports issued since then. External participation in, and review of the current report (*FAO Fisheries Circular* 886, Revision 2) have been quite extensive (EC:STA/2004/3, paragraph 30-32) and progress to date on this issue has been rapid and substantial.

[10] Information System to Assist Aquaculture Planning in Latin America and the Caribbean
[11] Second Meeting of the Ad Hoc Working Group on Aquaculture, IOFC Committee for the Development and Management of the Fishery Resources of the Gulfs, Kuwait Institute for Scientific Research, Kuwait, 18-20 May 1998 .
[12] FAO/NACA. 1998. Workshop on Aquaculture Information Systems. Bangkok, Thailand, 17-20 July 1998.
[13] Asia Institute of Technology

24. Nevertheless, though participation has increased, the process has varied for each of the status and trends reports published since 1994. Stabilization of the process, to the extent possible, would be both timely and appropriate. The role of national institutions and regional bodies, individual scientists, NGOs, and industry in the collection, analysis and reporting of information on status and trends should be defined. A procedure for their regular participation in a transparent, consensus-seeking effort should also be considered.

25. Consideration should also be given to earlier regional recommendations for the establishment of a working group on aquaculture statistics (Asia), as well as an inter-regional working party to assist in the assessment and improvement of national aquaculture statistics and the standardization of aquaculture terms, classifications and definitions; i.e. similar to the CWP on Fishery Statistics, but focused on aquaculture. In the interest of consistency within the Fisheries Department, special attention should be given to the ACFR recommendation[14] to establish a global review process to provide independent and objective support for status and trends reporting for capture fisheries (SOFIA[15]) to secure wider acceptance of its transparency and objectivity. This might be developed and conducted through the appointment of a global panel on the basis of expertise, not on affiliation (see Section on Quality Control and Assurance.

Continuity of content and organization

26. Although there is considerable similarity in the content and organization of the past the past two *Circular 886* (*Review of the State of World Aquaculture)*, there is also considerable differences. It would be both appropriate and timely to standardize both content and organization to establish continuity and allow comparability of information among reports.

TECHNICAL ISSUES: THE FAO AQUACULTURE STATISTICS DATABASE

27. The FAO global statistical database on aquaculture, FISHSTAT *AQ*, is still in the development stage. The database currently provides production (quantity and value) information by species, in three environments: inland, brackishwater and marine. FIDI is facing a number of technical constraints in the collection of aquaculture statistics due to lack of attention by some countries to timely and accurate reporting. The need to resolve these constraints is made more urgent by the increasing demand for additional information to satisfy new management perspectives, e.g. concerns about resources and the environment and how they are used, and the impact of policies and development plans, as well as changes in aquaculture production processes. Some of the more immediate constraints of the FAO aquaculture database are briefly considered below.

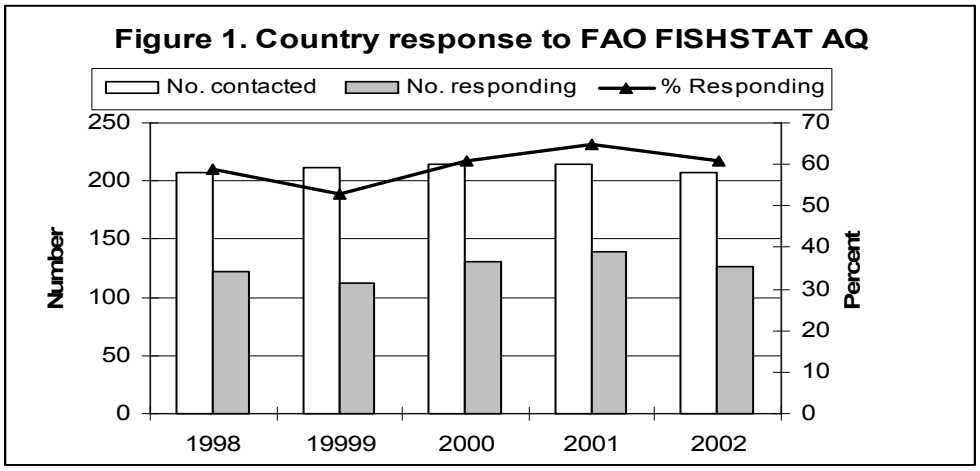
Country Response

28. The global FAO data set suffers from the little attention paid by some countries to timely and accurate reporting. During the early 1990s, approximately 60% of the

[14] ACFR. 1999. Report of the Working Party on Status and Trends in Fisheries. (ACFR/99/2). Rome, Italy, 6-9 December 1999.

[15] State of Fisheries and Aquaculture

countries approached did not report their aquaculture production to FAO. There has been a gradual improvement in the number of requests returned since then, with returns stabilizing at about 60% (Figure 1). In 2002, 61% of the countries responded.



Timeliness

29. Timely preparation of FAO aquaculture statistics is constrained by late submission of data by States. For example, in 2002, only 23 percent of the countries submitted their data for 2001 by the deadline of 31/08/2002 and about 27 percent submitted data in January - February of the following year (2003). The rest (50%) submitted between 1/9/2002 and 31/12/2002. In 1998 the corresponding figures were 25, 22 and 70 percent respectively.

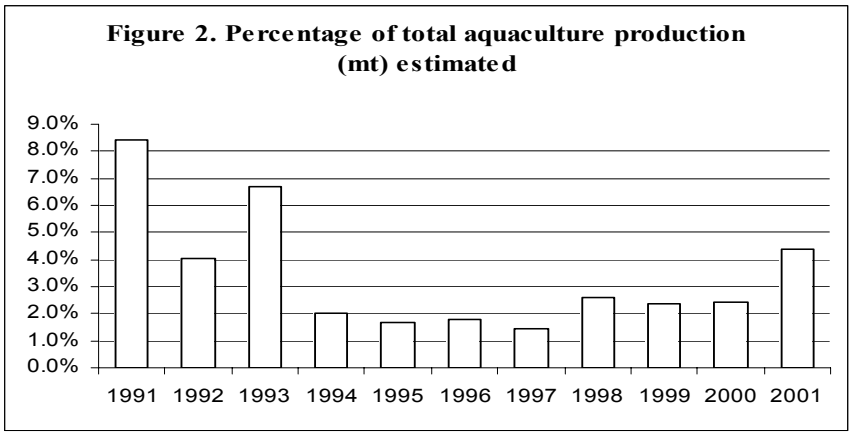
30. There is an urgent need to speed up the process of collecting, compiling, analyzing and disseminating national and international aquaculture statistics. Prolonged delays in the collection and publication of aquaculture statistics is a major source of frustration for data users. Limited resources for processing and lack of appropriate electronic tools and equipment slows down central collation, analysis and reporting of national statistics with additional delays in submission of statistics to FAO, because of the need to re-aggregate data. The current FAO Yearbook of Fishery Statistics for aquaculture, Volume 90/2, published in 2002, contains statistics only up to 2000. The same is true of regional statistics published by SEAFDEC for its member countries (Asia). The long time gap reduces the benefits of statistics in the decision-making process, as recent changes in production trends, and similar information that tends to become dated quickly, are not reflected in the published data. Such information may be especially misleading, for example when production approaches limits of sustainability and levels off, but less recent data indicates continuing growth.

31. Processing of aquaculture statistics has long since been computerized at FAO (EC:STA/2004/3). Further steps in the use of electronics may be computerized data collection and reporting through electronic mail. This would further reduce time requirement and increase efficiency. In order to fully utilize the potentials of computerization, the current wide diversity of computer hardware and software used by national agencies has to be reviewed or standardized. Alternatively, FAO could develop standard software for the compilation, processing and analysis of aquaculture statistics, as

it has done for artisanal fisheries, as has been recommended by the APFIC JWP (see Annex I). At present, the FAO FISHSTAT *AQ* questionnaire is being prepared in electronic form which can be downloaded from the FAO home page. In addition ARTFISH, the FAO statistical software for planning, collection and processing of artisanal fisheries statistics, is being adapted for aquacultural purposes.

FAO Estimated Data

32. As mentioned elsewhere (EC:STA/2004/3), in cases where data are not reported or are considered unreliable, FIDI makes estimates using the best available information which, in the worst situation, can be a repeated value from an earlier year. Such estimates are identified in the statistics database with the letter "F". A review of production (quantity) estimated made by FAO, expressed as percent of total aquaculture production quantity (fish, molluscs, crustaceans, plants & miscellaneous), shows a decline in the production value of estimates, from 8.4 percent of total production in 1991 to 2.4 percent in 2000, with an increase to 4.4 percent in 2001 (Figure 2). Prior to 1990, the quantity of global aquaculture production, based on estimates, was between 8 percent and 15 percent of the total production[16].



Structural Statistics

33. An immediate objective for improvement of FAO aquaculture statistics is to make accessible, as a database, information on structural statistics; i.e. production methods by main categories of cultured organisms, area of production & number of production units in three environments. The information is critical for the design of frame surveys and for deriving some resource use indicators.

34. Information on structural statistics (Sheet 1 of FISHSTAT *AQ* questionnaire) submitted to FAO by Member countries has not been reported due to the scarcity of

[16] FIDI. 1994. The quality of catch and aquaculture statistics submitted to FAO. In: SEAFDEC. 1994. Status of Fishery Information and Statistics in Asia. Volume II. Proceedings of the Regional Workshop on Fishery Information and Statistics. Bangkok, Thailand, 18-22 January 1994.

reporting and the dubious quality of the historical data. A recent review[17] of country submissions for 1999 showed that only 20 of 176 Member countries completed FISHSTAT *AQ* Sheet 1. Of these, 15 were from the top 30 producing countries; one was from the top 10 African producers; and 4 were from the top 10 Latin America producers. Only 13 of the 20 countries with complete structural statistics also completed Sheets 2-3 (production and value by species and environment).

35. As a result of FIDI initiative, the FAO Programme for the World Census of Agriculture 2000 has recommended the inclusion of aquaculture in the census. The Census is a statistical exercise to collect quantitative information on the structure of the food producing sector in Member countries. FIDI has prepared a guideline document[18] as a supplement to the Programme to assist countries improve their current surveys of aquaculture, and to provide a framework for those countries intending to develop databases on aquaculture information. The Supplement provides definitions, concepts, standards and guidelines for collecting internationally comparable structural aquaculture statistics.

Unidentified Aquatic Organisms

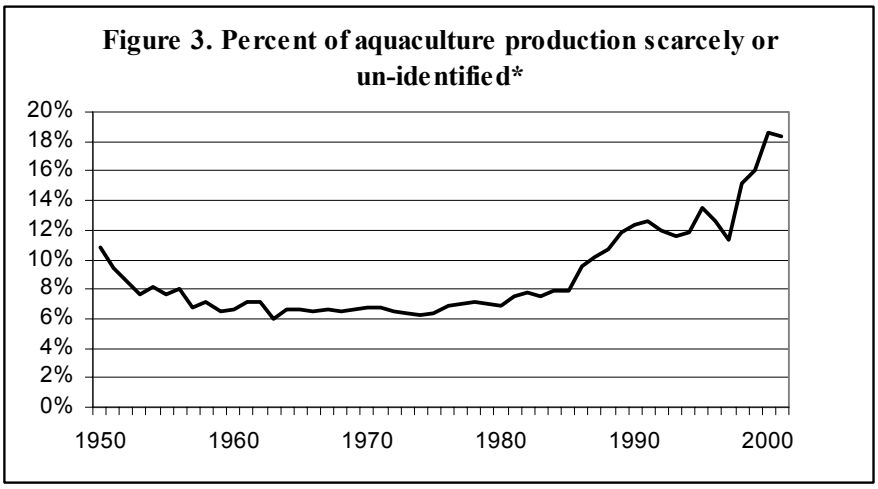
35. Often in reporting, large amounts of farmed fish are not identified to the species level and are either generically reported at higher taxonomic level (family, order, sub-order) or as an all-embracing miscellaneous category (e.g. "miscellaneous freshwater fishes"; "freshwater fishes nei"[19]). This is a major problem in the FAO aquaculture statistics database.

36. The percent of farmed aquatic organisms which are scarcely identified varied between six and seven percent of total aquaculture production (including plants) during the period 1958-1981 but has been increasing since then, reaching 18 percent in 2001 (Figure 3). This represents 7 million metric tonnes of farmed plants and animals. At the same time, the percentage of total aquaculture production identified to species level has decreased from about 92 percent in the late 1970s to 80 percent in 2001 (Figure 4). The problem is evident in both marine and inland aquaculture. Countries have been repeatedly encouraged to address this problem and to provide field enumerators with identification guides for the farmed species in question.

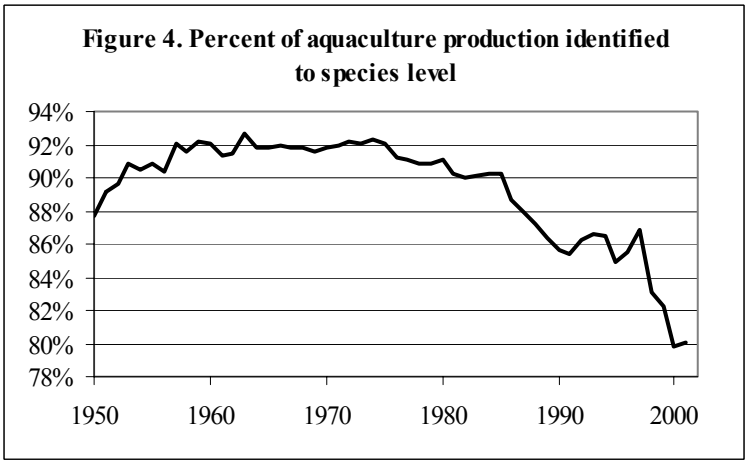
[17] FAO. 2000. Review of FAO selected aquaculture statistical data and related bibliographic background and reference material. (unpublished FIRI document)

[18] Rana, K.J. 1997. Guidelines on the collection of structural aquaculture statistics. Supplement to the programme for the World census of Agriculture 2000. *FAO Statistical development Series*No. 5b. Rome,FAO. 1997. 56p.

[19] nei = **n**ot **e**lsewhere **i**dentified



*scarecly or un-identified = un-identified + identified to family/order/sub-order



Harmonization of Terminology and Definitions

37. The COFI Sub-Committee on Aquaculture, in its first session in April 2002, identified improvement of the quality of aquaculture statistics, including establishment of unified standards and guidelines, and clearer definitions for data collection as a priority area of work for FAO[20] .

Inter-sectoral harmonization

38. The more holistic monitoring of aquaculture which is required to manage the sector in a broader ecological perspective, and the increasing interaction of aquaculture with other sectors, particularly agriculture and fisheries, will require greater harmonization of data and information to permit inter-sectoral integration of information

[20] COFI Sub-Committee on Aquaculture. 2002. Report of the first session of the Sub-Committee on Aquaculture. Beijing, PR China, 18-22 April 2002. *FOA Fisheries Report* No. 674. 30 p.

and comparison among sectors for decision-making. Although much standardization has taken place through international and regional co-operation, and is still continuing, there are many unique aspects to each country's system, based on local needs and capabilities.

The FAO definition of aquaculture

39. The FAO definition of aquaculture defines the conditions under which an activity can be classified as aquaculture, for statistical purposes. The current definition (Annex II) is widely used and accepted by international fishery bodies; e.g. Eurostat, ICES, SEAFDEC, etc[21]. Many of the problems encountered in the application of the definition in the past (e.g. differentiation between aquaculture and "fisheries enhancement", "culture-based fisheries", holding and fattening of wild juveniles, fish aggregation devices, various interpretations of the "ownership" concept, etc.) have been largely resolved in consultation with the CWP, by (a) use of separate questionnaires, one for aquaculture and another for capture fisheries and separate collection of statistics for the two sectors, to obviate the need to subtract aquaculture from total production to obtain production from capture fisheries (and related problems), and (b) the preparation and dissemination of a proposed classification of various aquaculture and capture fisheries practices in table form to add clarity to the definition (EC:STA/2004/3, Annex I).

40. The wording of the current FAO definition presents problems in the distinction between capture fisheries and aquaculture due to the increasing levels of intervention in the management of aquatic resources, particularly in inland fisheries (e.g. stocking, fertilization, predator removal, environmental engineering, etc.). These interventions have created a continuum of activities from production without intervention (fishing from wild stocks) to production from organisms grown in a fully controlled environment (thus including ownership). Consequently, the definition for aquaculture for statistical purposes must draw a pragmatic, though informed, line to separate activities of capture fisheries from those of aquaculture. A revised *working definition* of aquaculture with a suggested classification table was prepared for use in the World Census of Agriculture 2000 (Annex II) and published in 1997 in the aquaculture guidelines prepared for the Census. The guidelines were approved by ad hoc consultations and by the Asia and Pacific Commission on Agriculture Statistics (APCAS). However, the guidelines, including the revised definition, have not yet been tested for census taking and may require revisions before formal adoption.

Other terminology and classifications

41. *Hatchery output.* Information submitted to FAO on hatchery output for stocking aquaculture facilities and to the wild has not been published by the FAO due to problems with the data stemming from improper interpretation of terms used in the questionnaire (e.g. larvae, fingerlings, juveniles, etc.) and differences among countries in designation of life stages. The Census guidelines for aquaculture address this problem, but the FISHSTAT *AQ* instruction sheet still lacks adequate guidelines. The guidelines also suggest increasing the scope of information on seed production to include use of wild seed in aquaculture (e.g. for culture of groupers, tuna, milkfish, carps, catfish, etc.), for monitoring of natural resource use and environmental impact.

[21] Eurosta : Statistical Office of the European Union; ICES: International Council for the Exploration of the Sea; SEAFDEC: Southeast Asian Fisheries Development Center

42. *Compartmentalization of aquatic environments.* The use of "inland", "brackishwater" and "marine" designations for aquaculture has created problems of interpretation due to variations in how countries define brackishwater, and lack of adequate guidelines in the FAO instruction sheet. Again, the Census guidelines propose a way of dealing with this matter but clarifications are still lacking in the FAO instruction sheet. Asian countries and the CWP have recommended merging of the coastal and marine environments as "marine" or "coastal" while maintaining the "inland" designation[22, 23, 24]. The Census guidelines for aquaculture suggest use of freshwater, brackishwater and marine.

43. *Aquaculture systems*. Though the FISHSTAT *AQ* Sheet 1 provides a column for "Method of Culture", this refers only to the physical facilities of aquaculture. Typologies/classifications for the main aquaculture systems are yet to be developed even on a regional basis.

44. *Glossary.* The development of a glossary of agreed definitions of terms used in aquaculture is fundamental to the development of nationally and internationally harmonized systems for monitoring and reporting on the aquaculture sector. The glossary would facilitate international comparison of trends, outputs, resource use, etc. and should fundamentally include those variables and terms that are required for developing and managing aquaculture and for preserving the aquatic environment. A proposal was made by FIDI to this end in the context of an ad hoc expert consultation in Asia in 1999[25] which approved the idea and requested countries to submit to FAO national glossaries of terms used in aquaculture and aquaculture monitoring to assist in the process. Resource limitations at FAO have not allowed progress on this matter.

Guidelines and Instructions

45. Some of the above concerns indicate a need for more substantial guidelines for the completion of the FAO questionnaire and for proper interpretation of its terms. It may be useful to include in the guidelines the following statements that:

- FAO recognizes that opinions differ, from country to country, of what activities constitute capture fisheries and aquaculture and that completion of the FAO questionnaire may require the re-aggregation of national data according to the FAO definition. However, this is deemed necessary for standardization purposes and to enable accurate trend analysis.
- The FAO definition of aquaculture has no legal connotations at the national, regional or international level.

[22] SEAFDEC-FAO. 1999, Draft Report of the SEAFDEC-FAO Ad Hoc Expert Consultation on Variables and Terminology for Aquaculture Monitoring in Asia, 13-16 September 1999, Bangkok, Thailand. 32p. (un-published)
[23] SEAFDEC. 1994. Report of the Workshop on the Status of Fishery Information and Statistics in Asia. Bangkok, Thailand, 18-22 January 1994. 54 p.
[24] FAO. 1992. Report of the fifteenth session of the Coordinating Working Party on Atlantic Fishery Statistics. Dartmouth, Nova Scotia, Canada, 8-14 July 1992. *FAO Fisheries Report* No. 473. Rome, FAO. 1992. 34 p.
[25] Immink, A.J. and K. J. Rana. 1999. Harmonization if tems and variables and their definitions: A practical review. (SEFDEC-FAO/AQ99/WP10). SEAFDEC/FAO Ad Hoc Consultation on Variables and Terminology for Aquaculture Monitoring in Asia. Bangkok, Thailand, 13-16 september 1999.

46. Suggestions for amplifying the guidelines and definitions in the instruction sheet of the FAO questionnaire have been proposed and approved in the context of an expert consultation[26] and need to be revisited and formalized.

EXPANDING THE SCOPE OF INFORMATION AND REPORTING

47. Changing management perspectives and the globalization of concerns about resources and the environment are changing requirements for information. The type of information required for management varies with the stage of development of the aquaculture sector and its importance in the national economy, as well as management objectives. How much information and routine, long-term data are essential and how reliable the data should be has to be determined on a case by case basis.

48. Any increase in the scope of collected statistics, to be practical, must be considered in the context of national needs and priorities, data collection costs and national capacity, and the trade-off between the scope of coverage and data accuracy. **T**he costs of gathering additional data may well mean that in reality a compromise between accepting risk (based on lack of, or inadequate knowledge) and financing the collection of additional data will be made in many cases[27].

49. A more holistic approach to aquaculture analysis and management requires more quantifiable information covering issues such as:

- Socio-economic performance,
- Resource utilization and efficiency,
- Distribution and consumption of products;
- Contribution of subsistence and semi-commercial aquaculture to food security; and
- Environmental performance.

Optimally, the collected information also should enable the calculation of performance and sustainability indicators, as needed.

Minimum Requirements

50. The FAO/COFI Sub-Committee on Aquaculture (COFI/SCA), during its first session in April 2002, suggested that as a minimum, the following information should be collected and reported to FAO[28]:

Structure[29]

- Number and types of installation, and their location, size and capacity.

Production volume

[26] FIDI. 1999. Proposed changes to the aquaculture questionnaire FISHSTAT *AQ* and possible changes in the scope for monitoring aquaculture production and development. (SEAFDEC-FAO/AQ99/1P08). SEAFDEC/FAO Ad Hoc Expert Consultation on variables and Terminology for Aquaculture Monitoring in Asia. 13-16 September 1999, Bangkok, Thailand.

[27] CWP. 1999. Report of the eighteenth session of the Coordinating Working Party on Fishery Statistics. Luxembourg, Grand Duchy, 6-9 July 1999. *FAO Fishery Reports* No. 608. Rome, FAO. 1999. 62 p.

[28] COFI. 2002. Report of the first session of the Sub-Committee on Aquaculture.Beijing, Chin, 18-22 April 2002, *FAO Fisheries Reports* No. 674. Rome, FAO. 31p.

[29] Headings are author's additions

- Estimates of total production of fish, by species of major commercial importance, by aquatic environment and types of site, in terms of weight.

Socio-economics

- Estimates of total farm-gate value of aquaculture products by species (These data are essential in assessing the relative importance of the sector within the national economy, and combined with costs, provide an indication of income from aquaculture);
- Unit prices at farm-gate level (product prices) by species; (This information, combined with data on costs, can provide indices of productivity, and is used in economic analyses and market studies);
- Number of aquaculture workers and labourers, whether permanent or occasional;
- Estimates of net earnings from aquaculture; and
- Data to verify information on the contribution of aquaculture to rural development.

Distribution and consumption of products

- the estimation of data on the domestic consumption of aquaculture products; and
- Data on export quantity and value.

51. Accordingly, in addition to improving the quality of, and filling the gaps in country statistics submitted to the FAO at present, the scope of aquaculture statistics will also have to be expanded to include socio-economic data (other than value of production), including the assessment of the contribution of rural aquaculture to household food security, and marketing. This responds to Article 7.4.5 of the CCRF: "*In order to ensure sustainable management of fisheries* (including aquaculture)[30] *and to enable social and economic objectives to be achieved, sufficient knowledge of social, economic and institutional factors should be developed through data gathering"*.

Socio-economic, Consumption and Marketing Data

52. The development of economic and social statistics has lagged behind that of production and biological data. Such statistics are essential for estimating the net benefits that a nation derives from its aquaculture sector and its distribution, for measuring the impact of policy and management decisions and monitoring the economic evolution of such decisions over time. Consumption and export information will clarify domestic and international demand for aquaculture products, including consumption patterns, product prices, trade, and market opportunities. However, the collection of information on aquaculture exports will not be possible in most cases except where labelling for origin is adopted. The Census guidelines include collection of information on employment in aquaculture by gender and age group.

53. The new information on the contribution of aquaculture to rural livelihoods is in line with FAO's focus on poverty reduction and improving household livelihoods. At present, large numbers of small aquaculture units dispersed in rural areas, such as households practising integrated agriculture and aquaculture for semi-commercial purposes and home consumption, are often omitted from national surveys due to the dispersed nature of the production units and related logistic problems and high survey costs. Despite the critical contribution of these practices to food security, human nutrition and poverty alleviation in many rural areas, their individual generation of small economic value is the reason that they are frequently neglected in surveys. Cost-effective methods,

[30] Author's addition

tools and standards need to be established for the survey of small rural aquaculture units. In this connection, optimum use should be made of existing agricultural surveys[31].

54. In view of limited resources and the collection of data relevant to socio-economics and rural development, as well as consumption and marketing by other agencies, there is need to improve national inter-agency communications and coordination so that the best use can be made of all data collection schemes (e.g. population, labour, household surveys) to obtain aquaculture data. This could be accomplished by establishing national working group(s) comprising aquaculture and other statisticians, as well as technical specialists, and would maximize the use of existing available data for the needs of multiple users[32].

Performance Indicators

55. The COFI/SCA list of minimum statistical information, does not include data to enable calculation of performance and sustainability indicators for planning, monitoring and evaluation; for CCRF and other international reporting requirements and, possibly, in support of exported products (i.e. in response to any eco-labelling requirements). In this regard, it has been recommended (for Asia) [33] that a range of indicators should be used to reflect ecological, social, economic and institutional objectives that should be accommodated in the national statistical framework. Earlier, the NACA/FAO Conference on Aquaculture in the Third Millennium (2000) recommended initiation of studies to identify practical indicators of performance, as well as indicators of future potential, for the management of aquaculture and the associated aquatic environment.

56. The FAO Fisheries Department has, and continues to formulate or co-ordinate the preparation of standards, guidelines and indicators for sustainable development of fisheries and aquaculture. These are published in the FAO series *FAO Technical Guidelines for Responsible Fisheries* and other Fisheries Department publication series as appropriate. Publications relevant to aquaculture are described in Annex III. In addition, the Department will provide assistance in the development of guidelines and standards on various aspects of aquaculture in the context of a project on "Responsible Aquaculture Development and Management", prepared as part of the activities of "Fish Code: Global Partnerships for Responsible Fisheries", an inter-regional, externally-funded FAO programme to assist countries implement the CCRF. Funding for the project is being sought at present.

QUALITY CONTROL AND ASSURANCE

57. As noted above, the quality of submitted country statistics varies significantly depending on sources and methodologies employed and there are serious doubts about reliability for some countries. Very often this is difficult or impossible to substantiate due

[31] COFI/SCA. 2002. Needs for better reporting on the status and trends of aquaculture. (COFI:AQ/I/2002/5). First session of the COFI Sub-Committee on Aquaculture. Beijing, China.18-22 April 2002.
[32] APFIC. 1997. Status of Fishery Statistics in Asia. Report of the first session of the APFIC Joint Working Party on Fishery Statistics and Economics. Bangkok, Thailand, 19-23 August 1997. *RAP Publication* 1997/43. 24p.
[33] SEAFDEC. 2001. Report of the SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium . Bangkok, Thailand, 19-24 November 2001.

to the absence of alternative information. Quality control measures practised by FAO in relation to statistical data submitted by Member countries are described elsewhere (EC:STA/2004/3, paragraph 8-10). The decline of the FAO field programme in recent years has eliminated an important avenue for quality control, while the absence of an equivalent to the non-FAO regional (capture) fishery bodies precludes the possibility of even basic, preliminary screening of data by such bodies.

58. As in the case of capture fisheries, despite some improvement in national statistics of some countries, analyses (based on aquaculture production statistics)[34] are still constrained by the availability and quality of data, and while concerns about data quality are often expressed when the results of the analyses are reported, the analyses do not take account of uncertainty in any systematic way, due to the difficulty of assessing the level of uncertainty in most cases. In view of this, improvement of the quality of aquaculture statistics should be a priority concern and effective and practical validation or quality assurance procedures should be established for this purpose to the extent possible[35].

59. The criteria, definitions and methods for quality assurance in status and trends reporting were by reviewed by the ACFR Working Party on Status and Trends of Fisheries (ACFR:STF) for capture fisheries and are summarized in Annex IV. They are equally applicable to aquaculture. However, the ACFR Working Party noted that methods outlined in the table for a consensual process might be difficult to implement. The criteria for the process (report/analysis preparation) should be that it is transparent, responsive, independent and consensual. The criteria for the concluding results of reports should be that they were relevant, and that they were credible and quality-controlled, and also that the processes and the results should be subject to both internal and external peer review to the extent practicable[36].

60. The ACFR:STF also agreed in principle that where peer review processes have taken place in the institution "owning" the information, whether through working groups and/or a scientific committee, information provided by that institution should be considered as "peer reviewed". It was recognized that quality would vary among regions according to available data and analytical capacity and that the principle should be to make available the "best available scientific evidence" rather than try to apply uniform quality standards.

61. In relation to the generation and communication of status and trends reports, the ACFR:STA reached certain conclusions which are also applicable to aquaculture as well: "*..it was recognised that at national, regional and international levels the process is most often founded on the efforts of Working Groups; and that this practice will continue"* and offers the best way to gather reports for the global synthesis. *"* However, it was noted that sometimes "*…status and trends reports are the result of work by individuals, in some cases through reviewed journal publication but in many cases simply as documents lacking formal peer review"*. The question of how to authenticate and use such reports as contributions to regional or global syntheses needs to be addressed.

[34] Author's addition
[35] ACFR. 1999. Report of the Working Party on Status and Trends of Fisheries. (ACFR/99/2). Rome, Italy, 6-9 December 1999
[36] *Ibid*.

62. Working Groups offer a primary level of peer-review and their reports may also be validated by internal and external peer-review.

CONCLUSIONS AND SUGGESTIONS FOR A WAY FORWARD

63. The formulation of aquaculture policies and management strategies should be based upon the analysis of reliable and timely information. The strengthening of national statistical systems as an integral part of a planning and decision making process should be a major national objective in the drive towards sustainable aquaculture.

64. Strengthening the base for sustainable aquaculture development and management through improved data collection and analysis requires a multifaceted approach in the sense that (i) there is a national awareness of the need for data to underpin decision-making, planning and assessment, and a national commitment to provide data, (ii) there is consultation with data users so that they get the data required for their work, (iii) there is appropriate data collection mechanisms and data management systems, and (iv) FAO and non-FAO regional fishery bodies and other appropriate institutions, organizations and individuals are involved in assessments of status and trends in aquaculture.

65. Aquaculture statistics should be consistent in terms of *comparability*, *continuity* and *reliability*. Substantial improvements in national systems may come from the following actions at the national level: (a) integrating the statistical system with the management system, (b) allocating adequate resources to the collection of information and capacity building, (c) establishing national statistical standards and survey methodologies, (d) promoting better co-ordination of national statistical programmes, and (e) providing timely, reliable and meaningful information to users.

66. Considerable progress has been made by FAO in the establishment of a global database on aquaculture statistics, but the process is still in the early stages of development and much more needs to be done to improve the database, particularly in view of increasing demands for information at all levels by a variety of data users.

67. The main issues still requiring attention at the global level in order to improve the global reporting on status and trends of aquaculture include:

- Inadequate institutional framework, quality assurance, transparency and participation;
- Incomplete harmonization of terminology and classifications;
- Unclassified or incompletely identified aquatic organisms;
- Lack of and/or incomplete reporting by countries;
- Inappropriate methodologies for collecting information on aquaculture and institutional limitations at the national level; and
- Inadequate scope of collected information.

68. Owing to the importance of status and trends reports, and the scrutiny they received, the ACFR:STF recommended that the global system of status and trends reporting for capture fisheries be advanced by *improving completeness*, *expanding the scope of reporting* and *enhancing quality assurance*[37]. The ACFR:STF recommendations,

[37] ACFR. 1999. Report of the Working Party on Status and Trends of Fisheries. (ACFR/99/2). Rome, Italy, 6-9 December 1999

with minor modifications (see following paragraph), also address most of the key issues in aquaculture reporting.

69. The global system of status and trends reporting for aquaculture can be advanced by:

- Increasing completeness of the data (e.g. reliable structural aquaculture statistics, and seed production; species identification, etc.);
- Harmonizing methodologies, terms and classifications;
- Expanding the scope of current reporting, which is primarily focused on production and value, to include other dimensions of aquaculture (e.g. economic and social aspects, consumption and distribution of products; rural aquaculture, etc.);
- Enhancing quality assurance and credibility by (a) renewing commitment to collect and report aquaculture data, conduct research, and build capacity, (b) greater involvement of regional groups and experts, and (c) improving documentation, transparency, and peer review processes; and
- Developing tools and software to facilitate and expedite the collection and processing of data at all levels.

70. Simultaneous action at the national and international level will be required to address the institutional and technical constraints discussed above and to improve the quality of aquaculture monitoring and reporting. Key actions have been identified repeatedly by experts and country representatives (mainly in Asia) in a number of meetings. Clear emphasis is placed on the technical and institutional aspects of improving the quality of national aquaculture statistics, including establishment, adoption and use of unified standards and guidelines for data collection. Improvement of national statistics would have the most impact on improving the quality of global status and trends reporting on aquaculture.

71. Well-focused sub-regional and regional projects can play a catalytic role in improving national aquaculture statistical monitoring systems. Such projects constitute reference points for receiving and processing feedback information, experiences and requests for technical advice, and are also a source of technical support by means of technical consultations, training courses, and workshops. Small technical assistance projects at the national level are also very useful in the early stages of statistical monioring programmes. They provide solutions to problems that, due to the chronic shortage of funds invested in aquaculture statistics by many fishery administrations, would otherwise take longer to be addressed and resolved. Projects at national level aim primarily at self-sustaining statistical programmes and for this purpose incorporate substantial training and technical advice[38].

72. Given the long term nature of the required effort to accomplish the required improvements, it seems appropriate that FAO should address international aspects of these issues in the context of a practical and sustainable international strategy with bilateral support at both the international and national levels. The strategy would provide

[38] FIDI. 2000. Inland fishery and freshwater aquaculture production statistics in Asia/Pacific – some suggestions for heir improvement. APCAS/00/13. Eighteenth Session of the Asia and Pacific Commission on Agricultural Statistics, Bali, 6-10 November 2000.

a framework for the improvement of knowledge and understanding of aquaculture status and trends as a basis for policy-making for sustainable development of the sector.

73. The COFI Sub-Committee on Aquaculture (COFI/SCA) recommended that FAO develop an approach for improving information on aquaculture status and trends similar to that developed for capture fisheries through the Technical Consultation on Improving Information on Status and Trends of Capture Fisheries (2002). The elements of such a strategy for aquaculture, adapted from that for capture fisheries, could include:

- Building national capacity and developing software to facilitate the collection, processing and analysis of data and its timely presentation;
- Developing and promoting the use of standardized terms, definitions and classifications;
- Improving completeness of FISHSTAT *AQ* database by filling the gap between requested and submitted information;
- Improving the quality of submitted data;
- Expanding, within reasonable bounds, the scope of status and trends reporting;
- Developing methods and approaches for the collection of data on rural aquaculture;
- Defining the role of local, regional, and global scientific working parties as a vehicle for status and trends reporting, capacity building, and quality assurance;
- Establishing appropriate arrangements with entities that could contribute useful scientific information, that specify roles and responsibilities, and identifying needs and opportunities for new regional arrangements where appropriate they do not now exist; and
- Developing practical methods and criteria for quality assurance.

SUGGESTED ACTION BY THE CONSULTATION

The Consultation is invited to consider the main issues raised in this document, and the suggestions made to deal with some of them, and to recommend practical ways and means of mitigating these constraints. The consultation is also invited to elaborate an international strategy as suggested in the document, for consideration by FAO as a framework for future action and external financial support. A suggested draft strategy is provided in document EC:STA/2004/Info.4 to facilitate deliberations and discussions of the Consultation.

ANNEX I

RECOMMENDATIONS FOR IMPROVING AQUACULTURE STATISTICS AT THE NATIONAL LEVEL

NACA/FAO Conference on Aquaculture in the Third Millennium, 2000[39].

Purpose of data and information collection

- *Improve awareness that data and information are collected to meet the information needs of the target users i.e., data and information collection is not an end in itself; it must be used to support and facilitate policy-making and management decisions.*
- *Strengthen national capacity to determine data needs of target users and identify types and scope of data to be collected and compiled.*
- *Promote awareness among data and information providers regarding the purpose of data collection through improved feedback and sharing of benefits attained from use of information derived from the data provided.*
- *Assess cost-benefits of data collection. Data and information collection, compilation and analysis are costly to both the agencies that collect data and to data providers. The costs associated with data and information collection and analysis should be matched by benefits to all stakeholders resulting from informed decisions and subsequent policy and management interventions.*
- *Initiate studies to identify practical key indicators of performance, as well as indicators of future potential, for the management of aquaculture and the associated aquatic environment.*

Utilization of data and information

- *Promote coordination and integration of the activities relating to collection, compilation, analysis, dissemination and utilization of information as an integral part of the sector management and planning at all levels.*
- *Improve the understanding of the purpose of the information base.*
- *Facilitate development of analytical and forecasting tools and their adoption and application.*
- *Improve the availability and accessibility of data and information through targeted analysis, synthesis, packaging and delivery.*

Effective communication and presentation

- *Improve the availability and accessibility of data and information through targeted analysis, synthesis, packaging and delivery.*

Relevance, reliability, timeliness and completeness of data and information

- *Strengthen national aquaculture data and statistics systems, including improving linkages with relevant agencies, institutions and related sectors.*
- *Improve the quality of the data and information collected and ensure that it is sufficient to facilitate forecasting of impacts and implications of policy and management interventions.*
- Upgrade the capacity of institutions and the skills of personnel involved in data collection and compilation at the local and field levels.

[39] NACA/FAO. 2000. Report of the Conference on Aquaculture in the Third Millennium. Conference on Aquaculture in the Third Millennium, 20-25 February 2000. Bangkok, Thailand. NACA, Bangkok and FAO, Rome. 120 p.

Internationally comparable and compatible methodologies for data and information handling

- *Give high priority to the establishment of internationally agreed-upon norms, definitions and classifications.*
- Encourage and promote national efforts to harmonize and standardize the methodologies used for aquaculture data and information handling.

Capacity of national programs

- *Give greater emphasis to national capacity building, particularly …… data and information collection at local and field levels; analysis and synthesis of data and information; and effective presentation and communication*

SEAFDEC-FAO Ad Hoc Consultation on Variables and Terminology for Aquaculture Monitoring in Asia, 1999[40]

Appropriate national actions for the improvement of aquaculture monitoring

- *As human and financial resources for developing aquaculture monitoring systems are often among the limiting factors, countries are encouraged to maximize the use of available data.*
- *There is need to examine the scope of the data collected in view of the changing data needs for outputs as well as processes involved in aquaculture production.*
- *Human resource development of statistics personnel at different levels, particularly training of primary data collectors, should be encouraged.*
- *Countries may consider existing arrangements, such as technical Cooperation for Developing Countries (TCDC) and the Technical Cooperation Programme (TCP) to meet training and other requirements.*
- *Each country should consider establishing a national multidisciplinary coordination mechanism to continuously develop and monitor aquaculture statistics programs at national and local levels.*

Statistical systems

- Priority should be given to strengthening national systems for collection of statistics
- The purpose of data collection and the expected output from analysis should be clearly defined.
- Closer connection between development and monitoring should be promoted.
- An internationally comparable data system should be developed on basis of good national model systems

Harmonization of terms and variables

- Harmonization of terms and variables is needed to ensure information submitted to regional and international bodies are comparable.
- A regional working group should be established to evaluate and assist countries to develop their capacity in data collection and collation and to help standardise and harmonize methodologies, terms and definitions.

Definition of aquaculture

[40] SEAFDEC-FAO. 1999. Report of the SEAFDEC-FAO Ad Hoc Expert Consultation on Variables and Terminology for Aquaculture Monitoring in Asia, 13-16 September 1999, Bangkok, Thailand. 32p.

- FAO should revise the definition of aquaculture to take into considerations concerns raised by the countries. It should contain the three concepts of the original definition– the organisms and their farming environment, aquaculture practice, and the ownership of the organism. Clear guidelines should be established to differentiate aquaculture from capture fisheries. The revised definition should be widely circulated.
- To avoid problems in the interpretation of "brackishwater environments", aquaculture could be classified as marine, coastal and inland.. guidelines should be prepared for the disaggregation of coastal and marine data to coastal and marine data.

Glossary of aquaculture terminology

- The outline glossary of aquaculture terminology was approved by the countries and its expansion recommended
- A glossary of terms should be compiled and compared at the international level by FAO for dissemination to all types of users. The assistance of member countries in providing national glossary of terms used in aquaculture and aquaculture monitoring is needed for this purpose.

Other suggestions

- Add ornamental fish to aquaculture definition.
- Hatchery production Broodstock rearing should be an aquaculture activity.
- Add farmed edible aquatic plants to definition & statistics.

First Session of the APFIC Joint Working Party (JWP) on Fishery Statistics, 1997[41]

Recommendations for National Action

- *In order to make capture fisheries and aquaculture statistics available to users in a timelier manner, there is a need to automate data processing to speed their collation and dissemination. Software packages (e.g. ARTFISH) are required in conjunction with training of staff (e.g. enumerators) at the local and national levels*
- *There is need to improve national inter-agency communications and coordination so that the best use can be made of all data collection schemes (e.g. population, labour, or food surveys) to obtain fisheries data. This could be accomplished by establishing national working group(s) comprising fisheries and other statisticians, as well as technical specialists.*
- *There is an urgent need to improve species details in statistics collected for capture fisheries and aquaculture production, particularly for the commercially important species. …… countries are encouraged to prepare local taxonomic field guides for enumerators so that at least the main commercial species landings can be quantified.*
- *To respond to the need for harmonized aquaculture statistics, countries are urged to collect structural data for aquaculture using censuses and surveys utilizing as far as possible definitions, standards and methodologies provided in the Supplement on Aquaculture to the WCA 2000 Programme.*

Recommendations for Regional and Global Action

- *FAO should review and revise, where appropriate, its FISHSTAT AQ questionnaire to include necessary information such as specifications of the life stages in hatchery outputs.*

[41] APFIC. 1997. Status of Fishery Statistics in Asia. Report of the first session of the APFIC Joint Working Party on Fishery Statistics and Economics. Bangkok, Thailand, 19-23 August 1997. *RAP Publication* 1997/43. 24p.

- *In order to improve the quality and utilization of fishery statistics in the region ... special attention should be focused on development of software for compilation, processing and analysis of aquaculture statistics*

The JWP placed top priority (for follow up) on the development of guidelines on definitions, standards and methodologies, to improve consistency of national statistics with international standards. This included the preparation and distribution of the Aquaculture Supplement to WCA 2000.

Recommendations to APFIC and FAO

- *The JWP should ascertain the current and likely use for fisheries and aquaculture performance indicators for fisheries and aquaculture within APFIC countries and this information should be collated and distributed to all members by the Technical Secretariat.*

ANNEX II

THE FAO DEFINITION OF AQUACULTURE

1. The current FAO definition:

"Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries."

2. The revised working definition adopted for the collection of aquaculture structural statistics in the context of the World census for Agriculture 2000 and published in "Guidelines on the collection of structural aquaculture statistics":

"Aquaculture is the farming of aquatic organisms including crocodiles, alligators, turtles, amphibians, finfish, molluscs, crustaceans and plants where farming refers to their rearing up to their juvenile or adult phase under captive conditions. Aquaculture also encompasses individual, corporate or state ownership of the organism being reared and harvested in contrast to capture fisheries in which aquatic organisms are exploited as a common property resource, irrespective of whether harvest is undertaken with or without exploitation rights."[42]

[42] Rana, K.J. 1997. Guidelines on the collection of structural aquaculture statistics. Supplement to the programme for the World census of Agriculture 2000. *FAO Statistical development Series*No. 5b. Rome,FAO. 1997. 56p.

Classification proposed for various aquaculture and capture fisheries practices *(Modified from CWP 1992)*

PRODUCTION FROM	DESIGNATION		
	AQUACULTURE	CAPTURE FISHERIES	
		Enhanced	Traditional
Hatcheries	*		
Ponds	*		
Tanks	*		
Raceways	*		
Cages	*		
Pens	*		
Barrages	*		
Integrated vallicoltura production	*		
Private, tidal ponds (tambaks)	*		
Stocked lakes, reservoirs and rivers			
- with other enhancement (predator control and/or fertilisation)		*	
- modification with " exploitation rights"		*	
- no other intervention without " exploitation rights"			*
Unstocked lakes, reservoirs and rivers			
- with enhancement (fertilization and/or predator control habitat modification), with " exploitation rights "		*	
Rice-fish culture:			
- from stocked rice-paddy	*		
- from unstocked rice-paddy			*
Finfish and other animals harvested from brush parks:			
- managed over time and with other enhancement rights		*	
- harvested on an install and harvest basis			*
Fish and other animals harvested from:			
- fish aggregating devices			*
Molluscs			
- from managed grow-out site (e.g. poles, ropes, net bags)	*		
- subject to open fisheries			*
Aquatic plants			
- harvest of planted and suspended seaweed	*		
- harvest of natural seaweed beds			*
Aquatic organisms caught in open waters			*
Privately owned recreational fisheries			*
Ranching		*	
Fish and other animals harvested from artificial reefs "with exploitation rights"		*	

ANNEX III

FAO GUIDELINES AND OTHER STANDARDS FOR RESPONSIBLE FISHERIES RELEVANT TO AQUACULTURE

The technical guidelines described below are preliminary and will be evaluated and revised as information accumulates through their implementation. The guidelines have no formal legal status.

1. Aquaculture development [43]

This document provides annotations to the Principles of Article 9 of the Code of Conduct for Responsible Fisheries. These annotations are meant to serve as general guidance, and should be taken as suggestions or observations intended to assist those interested in identifying their own criteria and options for actions, as well as partners for collaboration, in support of sustainable aquaculture development.

2. Guidelines on the collection of structural aquaculture statistics [44]

The guidelines are intended to assist countries to improve their current surveys of aquaculture and to provide a framework for those countries intending to develop databases on aquaculture information. The document provides definitions, concepts, standards and guidelines for collecting internationally comparable data on aspects such as location and size of the farms, types of aquaculture activity, employment structure, use of resources and aquaculture inputs. The items proposed for collection address issues related to natural resources and utilization and sustainable aquaculture developmental issues. The document also provides examples of summary tables that could be used to develop a questionnaire.

3. Good aquaculture feed manufacture practice [45]

The guidelines were compiled for FAO in support of Article 9 of the Code of Conduct for Responsible Fisheries (CCRF) concerning Aquaculture development, and in particular in support of Article 9.4.3 of the CCRF concerning the selection and use of feeds and additives. They cover a number of issues, ranging from ingredient purchasing, processing, bulk storage, handling, monitoring, and documentation, to issues such as employee training and safety, customer relations, and the delivery of finished goods to the farmer.

4. Integration of fisheries into coastal areas [46]

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[43] FAO Fisheries Department. Aquaculture development. *FAO Technical Guidelines for Responsible Fisheries.* No. 5. Rome, FAO. 1997. 40p.

[44] Rana, K.J. 1997. Guidelines on the collection of structural aquaculture statistics. Supplement to the Programme for the World Census of Agriculture 2000, *FAO Statistical Development Series*. No. 5b. Rome, FAO. 1997. 56p.

[45] FAO Fisheries Department. 2001. Aquaculture development. 1. Good aquaculture feed manufacture practice. *FAO Technical Guidelines for responsible Fisheries* No. 5, Suppl. 1,Rome, FAO. 2001.47p.

[46] FAO Fishery Development Planning Service, Fisheries Department. 1996. Integration of fisheries into coastal area management. *FAO Technical Guidelines for Responsible Fisheries.* No. 3. Rome, FAO. 1996. 17p.

These Guidelines are provided as explanatory material to Article 10 in the CCRF, concerning the Integration of Fisheries into Coastal Management in order to assist in achieving the rational use of scarce coastal resources. In particular, they address the issue of how the fisheries sector can be integrated into coastal management planning so that interactions between the fisheries sector and other sectors can be taken into account in the establishment of management policy and practice with regard to coastal resources. The fisheries sector is taken, in the Code and these Guidelines, to refer to both capture fisheries and aquaculture, unless one or other sector is specifically mentioned.

5. Precautionary approach to capture fisheries and species introductions [47]

Guidelines for the application of the Precautionary Approach to capture fisheries and the introduction of species, presented in this publication, were developed by the Technical Consultation on the Precautionary Approach to Capture Fisheries (Lysekil, June 1995), for the governments, fisheries authorities, the fishing industry, regional fishery management bodies, NGOs, and others interested in fisheries, in order to: (a) raise their awareness about the need for precaution in fisheries, by providing them with background information on the main issues and implications, and (b) provide them with practical guidance on how to apply such precaution.

6. Policies for sustainable shrimp culture [48]

The Consultation recommended a range of desirable principles to be followed in the establishment of legal, institutional and consultative frameworks and government policies for sustainable coastal aquaculture, including shrimp culture. These are intended as guidelines to assist in the establishment or amendment of national legislation. The Consultation also recommended a number of specific areas for future research including on economic incentives and on carrying capacity of coastal ecosystems for shrimp culture. Further, it recommended that FAO convene expert meetings to elaborate best practices for shrimp culture, desirable elements of the legal and regulatory frameworks for coastal aquaculture and the criteria and indicators for monitoring sustainability of shrimp culture.

7. Indicators and criteria of sustainable shrimp culture [49]

The meeting prioritized and prepared a recommended short-list of the criteria and indicators of sustainable shrimp fisheries which should form the basis for regular reporting by countries to the FAO Committee on Fisheries (COFI). The meeting stressed that these criteria and indicators related to the national level and did not encompass farm-level and local-level indicators. It noted that the regular collation of these indicators would greatly benefit the planning and management of shrimp culture development in the countries. The meeting elaborated a questionnaire to allow governments to review and comment on the recommended indicators and on their present and future ability to acquire the related data and information.

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[47] FAO Fisheries Department. 1996. *FAO Technical Guidelines for Responsible Fisheries.* No. 2. Rome, FAO. 1996. 54p

[48] Bangkok FAO Technical Consultation on policies for sustainable shrimp culture. Bangkok, Thailand, 8-11 December 1997. *FAO Fisheries Report*. No. 572. Rome, FAO. 1998.

[49] Report of the Ad-hoc Expert Meeting on Indicators and Criteria of Sustainable Shrimp Culture Rome, Italy, 28-30 April 1998. *FAO Fisheries Report* No. 582, Rome, 1998

8. Indicators of sustainable aquaculture development (in preparation), 2001[50]

The principal objective of the Consultation was to contribute to the preparation of technical guidelines for the selection and use of indicators of sustainable aquaculture development. These guidelines are intended to facilitate the process of developing indicators of sustainable aquaculture development, at farm, local, national and international levels. They will be published in the FAO series of technical guidelines in support of the implementation of the Code of Conduct for Responsible Fisheries. A related objective of the Consultation was to identify general and specific sustainable development indicators which can measure performance and progress of various types of aquaculture systems and practices. Such indicators would be expected to apply across a range of themes, including technical specifications, performance ratios, measures of social and economic benefit, and various descriptions of natural resource and environmental quality. This would link with broader concepts of sustainability, and could potentially form part of a framework applicable to the aquaculture sector. In view of increasing information demanded by consumers of aquaculture products, the Consultation also addressed the possible use of aquaculture sustainability indicators for purposes of developing effective and equitable certification/labelling schemes and standards. The report of the Consultation is currently under preparation.

9. Land and water use in aquaculture: Towards an improved information basis [51]

The broad objective of this Consultation is to generate primary baseline information and expert advice on trends, patterns, opportunities and challenges of land and water use in the various forms of aquaculture farming systems and practices. Preparatory work on FAO's aquaculture database so far has shown that there is very significant scope for enhancing, updating and organising knowledge on required and available statistical data and bibliographic reference materials on land and water use in aquaculture. The focus in this first step of analysis is primarily on data and statistics as available, and on their collection, recording, use and interpretation. The medium- and long-term perspective here is on using and interpreting such data sets with a view to enhancing resource use efficiency and environmental performance and improving sectoral management and governance efforts.

The main objectives of the consultation are therefore:

- to compile and review available data and information on land and water use in aquaculture;
- to provide advice on experiences and approaches for the collection, use and interpretation of aquaculture land and water use data and information;
- to discuss the use and interpretation of such data and information for the purposes of analysing and comparing resource use efficiencies of aquaculture practices

It is hoped that this stock-taking exercise will provide FAO, its member countries and interested partners with basic strategic advice on possible ways to improve the collection, organization, dissemination and general use of data and information on land and water use in aquaculture.

[50] FAO. 2002. (In preparation) Report of the Expert Consultation on Indicators of sustainable aquaculture development. Rome, Italy, 24 – 27 September 2001 (in preparation)

[51] FAO. 2002. Expert Consultation on Land and Water Use in Aquaculture: towards an improved information base. Rome, Italy, 7-10 October 2002.

ANNEX IV

TABLE OF CRITERIA, DEFINITIONS AND METHODS: A FRAMEWORK FOR FISHERIES SCIENCE QUALITY ASSURANCE[52]

	Definition	Methods
The PROCESS should be:		
Transparent	The process, rules and procedures are well-defined and public knowledge.	Tender rules Statutory arrangements Institutional publishing
Responsive:	Timely and flexible to changing needs, while ensuring best practice.	Tasks should be well-defined and timely Request should be appropriate, feasible and reasonable.
Independent	Scientifically objective and free from sectoral influence by government, industry, or advocacy groups.	Open access to data, methods, raw results (including measures of uncertainty and risk). Clear method demonstrable in the integration and presentation of summary advice.
Consensual	Reports on the process should include any alternate views, incorporated as additional uncertainties to the general mathematical or conceptual uncertainties.	Rules of procedure require no 'minority', externally published reports. Sufficient time given to reach consensus.
The RESULTS should be:		
Integrated	All issues are considered in or enter into the scientific procedures, including environmental, ecosystem, economic and social issues, as appropriate.	Research into and the application of holistic assessment methods. Time set aside for scientists to undertake theoretical research, in methods, in particular modelling and simulation.
Credible	Scientifically accurate within the limits of knowledge (methods and data) from respected scientists, and reflecting practical reality.	Good data, appropriate to the task. Acceptance by scientists of the socio-economic dimensions of the fishery. Training. Theoretical research.
Quality Controlled	Procedural error-detection at appropriate times/stages.	Process for quality control established externally to the 'group'.

[52] ACFR. 1999. Report of the Working Party on Status and Trends in Fisheries. (ACFR/99/2). Rome, Italy, 6-9 December 1999

The PROCESS and the RESULTS should be subject to:

Internal peer review	Method for conducting procedural quality control and first review of results.	Institutional mechanism established for formal/scheduled quality control activities by non-tasked expert and informed non-experts.
External peer review	Process and results conform to the highest international standards.	Include the best scientists, and others, as appropriate, external to the institution, state or region.