

RECENT DEVELOPMENTS IN AQUACULTURE STATISTICS

by

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1. INTRODUCTION

The Fisheries Information, Data and Statistics Unit (FIDI) of the Food and Agricultural Organization of the United Nations (FAO) has been systematically collecting and disseminating global aquaculture production by weight and value (US\$) since 1984. During this period the capacity of many countries, particularly in Asia to collect and process aquaculture information has, greatly improved. The mechanisms for collecting data and the coverage and quality of data on production from aquaculture provided by countries to FAO have been constantly under review with the aim of improving their quality and relevance to future national and global needs. The aim of this paper is to identify these future needs and to discuss how some of these are being currently addressed.

2. COVERAGE OF AQUACULTURE STATISTICS

Based on national priorities, FAO Fisheries Department has adopted three principal interrelated initiatives geared towards promoting:

- a) at global, regional and national levels, the responsible fisheries management;
- b) the outcome of the Kyoto Conference to reduce waste and increase fish production; and
- c) the enhanced global monitoring and strategic analysis.

For aquaculture, the implementation, verification and evolution of practices of the first two initiatives are underpinned by the third. At the national and global levels, such monitoring is increasingly required for developing policies, managing natural resources and monitoring the efficiency of aquatic production and utilization of resources. The FAO database on aquaculture is a key vehicle for monitoring global, regional and national developments in aquaculture.

Unlike the monitoring of capture fisheries, the monitoring of aquaculture needs to encompass the various facets of culture from seed production to harvest. Even though some structural information on culture systems and production from hatcheries is collected at present, FAO has so far disseminated end-product weight and value of cultured aquatic organisms. The need to broaden the coverage for collecting and disseminating information on aquaculture for management and strategic planning purposes, is acknowledged within the structure and activities of the Fisheries Department of FAO

This requires that FIDI ensures the collection of “quantitative data required for developing and managing fisheries and on preserving the aquatic environment” (FAO, 1992). Such expansion, however, should consider the country’s capacity to routinely provide such information and this is probably best done on two phases: firstly, to consider indicators on aquaculture currently collected by countries but not requested by FAO, or reported to FAO but not utilized; and secondly, to develop with countries, the capacity to widen the coverage in order to meet their future needs.

In addition to coverage, other issues which are likely to impede monitoring, need to be re-addressed. These include:

- a) harmonization of terminology, there is the difficulty of national authorities to classify fishery production as “aquaculture” or “capture fisheries”;
- b) aggregated reporting of unclassified or incompletely identified aquatic organisms; and
- c) inappropriate methodologies for collecting information on aquaculture and institutional limitations.

Progress on initiatives to address some of these issues on aquaculture are considered below. Irrespective of the range of constraints, however, the quality of national statistical and non-statistical information on aquaculture is unlikely to improve if its development is conceived in isolation of national technical developments in aquaculture, and if the need for national monitoring is not given due priority.

3. AQUACULTURE AS AN ECONOMIC ACTIVITY

Unlike many other economic activities, aquaculture is currently not recognized or defined under the International Standard Industrial Classification of All Economic Activities (ISIC) as a separate economic activity. Instead, elements of aquaculture are categorized under “Fishing” (division 05, 005) which covers “fishing, operations of fish hatcheries and farming, and service activities incidental to fishing”. Moreover, this category specifically excludes activities such as frog culture, and is clearly unsuitable for defining aquaculture practices. In order to rectify this omission, FIDI is examining the possibility of including aquaculture in ISIC as an economic activity in its own right.

4. DEFINITION OF AQUACULTURE

Based on the definition developed by the Southeast Asian Fisheries Development Center (SEAFDEC) in the early 1970s, FAO has formulated its own working definition of aquaculture for statistical purposes. This definition is itself undergoing modification to accommodate recent changes in the culture practices within fisheries. At present, the FAO definition read as follows:

Aquaculture is the farming of aquatic organisms including fish, mollusc, 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 harvest fisheries.

Despite widespread discussion and acceptance of the above definition by international fora and organizations such as the Coordinating Working Party on Fishery Statistics (CWP), the European Union (EU), International Council on the Exploration of the Seas (ICES) and SEAFDEC, limitations of the above definition are increasingly apparent (Beveridge, 1990, etc., Floyd et al. 1991, New & Crispoldi-Hotta 1992, Csavas & New 1994, Kara 1994, SEAFDEC 1994, CWP 1995a, 1995b, FIRI 1995, Garibaldi 1995).

In recent years it has been realized that, for capture fisheries in inland waters, the exploitable fish biomass and consequent catches can be increased through varying forms of intervention such as stocking of fingerlings, fertilization, environmental engineering, etc. (Welcomme, 1996). Therefore, under the current FAO definition of aquaculture, capture fisheries in which restocking is practiced and in some situations, recreational fisheries can, with only minimal inputs be considered as aquaculture (Welcomme, 1996). The current FAO definition of aquaculture has therefore raised questions on what form and degree of intervention in aquatic production constitutes "aquaculture" and which practices and products should be regarded as aquaculture. It also leaves the difficult question of the implications of ownership of the cultured aquatic organism open to interpretation. To accommodate these changes FAO is continuing to refine and standardize the definition of aquaculture. Recent changes proposed include that the definition should limit aquaculture to "rearing for most of the life-cycle" (Welcomme, 1996), is still unsatisfactory as it excludes aquatic seed production as an aquacultural activity.

To overcome these ambiguities, a revised and hopefully clearer working definition for aquaculture is proposed as follows:

"Aquaculture is the farming of aquatic organisms including crocodiles, alligators, amphibians, finfish, molluscs, crustaceans and plants where farming refers to their rearing up to their juvenile and/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 source, irrespective of whether harvest is undertaken with or without exploitation rights."

The above definition encompasses three components which must be fulfilled for an activity to be classified as aquaculture. These are: **the cultured organisms, the activity, and ownership of the reared organism.**

To assist in the designation of production to aquaculture and culture-based capture fisheries, the following working definition has been proposed for the latter and included in the FAO Technical Guidelines for Responsible Fisheries:

"Activities aimed at supplementing or sustaining the recruitment of one or more aquatic species and raising the total production or the production of selected elements of a fishery beyond a level which is sustainable through natural processes. In this sense culture-based fisheries include enhancement measures which may take the form of introduction of new species; stocking natural and artificial water bodies;

fertilisation; environmental engineering including habitat improvements and modification of water bodies; altering species composition including elimination of undesirable species, or constituting an artificial fauna of selected species; genetic modification of introduced species."

A proposed classification of various fishery practices is given in Table 1.

5. UNIDENTIFIED AQUATIC ORGANISMS

In both capture fisheries and aquaculture, aquatic organisms which are not identified to the species level may be aggregated and reported as "miscellaneous freshwater fishes" or reported to the family or genus level. This aggregation is potentially a serious constraint for monitoring changes in fish assemblages and the legally binding Convention on Biodiversity. The chronological changes in reporting incompletely identified aquatic organisms from inland and marine waters are considered elsewhere. This paper considers only the reporting of unidentified aquatic organisms from inland waters.

Although an increase in both the number and volume of unidentified aquatic species reported to FAO is evident in aquaculture and capture fisheries, over 68% of the total volume from inland waters in Asia originates from inland capture fisheries. On the other hand, for inland capture fisheries the greatest problem for improving the resolution of unidentified aquatic species reported to FAO is the high tonnage of "freshwater fishes *nei*". By 1995, this group totaled 2.6 million mt and accounted for 69% of the total volume of unidentified aquatic species from inland capture (Figure 1).

Identifying the various species items originating from aquaculture and inland capture may help to focus assistance for species identification. Inland capture fisheries accounts for 68% of the "freshwater fishes *nei*" and almost all of freshwater crustaceans and mussel *nei* groupings. For cyprinid *nei*, however, aquaculture accounts for 78% of the total (Figure 2).

Although the quantities of reported unidentified aquatic organisms have increased, the ranking of major countries reporting unidentified species as freshwater fishes *nei* has remained the same in the last five years. In 1995, China reported around 734,000 and 895,000 mt as freshwater fishes *nei* from aquaculture and inland capture fisheries, respectively, followed by Bangladesh with 287,00 and 437,500 mt and India with 0 and 471,000 mt, respectively (Figure 3). In the case of India, it reported that most of its unidentified finfish as cyprinid *nei*. In 1995, India accounted for 87% of this group (Figures 2 and 4). Thus, overall attention to species identification should focus on the freshwater fishes, molluscs and crustaceans and cyprinid *nei* as in China, Bangladesh, India, Viet Nam, Indonesia and Myanmar.

6. PROPOSED CHANGES FOR REPORTING GLOBAL PRODUCTION FROM FISHERIES

The aquaculture questionnaire (FISHSTAT AQ) was introduced in 1984 and the data are published in Aquaculture Production Statistics (FAO Fisheries Circular No. 815). At present, nominal catches for marine and inland capture fisheries are inferred by subtracting the country returns from FISHSTAT AQ from the national summary (FISHSTAT NS1).

This procedure for estimating catches is currently under review and FIDI intends to develop two separate databases, one on capture fisheries to include marine and inland capture fisheries and the other on aquaculture. The separation process is planned in two phases: establishment of these databases at FAO (already complete for 1984-1995), and the reporting by countries of separate statistics for both these databases from 1998.

At present, FIDI, is estimating national production from aquaculture for the period 1950-1984. The completion of this exercise will facilitate the total separation of the FAO aquaculture and capture fisheries databases. Whilst these changes will ease access to marine and inland capture fisheries data in the *Catches and Landings* Yearbook, it does not change the current procedure used by FAO for estimating production for inland and marine capture and aquaculture or influence the quality and detail of the data. The quality of these data are likely to improve with the implementation of separate questionnaires for aquaculture and capture.

7. QUANTITATIVE STRUCTURAL INFORMATION ON AQUACULTURE

Despite the significant contribution of cultured fish to national security, particularly in rural areas, structural information on aquaculture is virtually non-existent. This is being increasingly recognized by policy makers, aquaculturists and agriculturists. Following continued requests to agricultural statisticians at a national level, and given the close association of aquaculture with other farming activities, the Fifteenth Session of the Asia and Pacific Commission on Agricultural Statistics (APCAS), recommended that "FAO should give consideration to include aquacultural activities in the World Census of Agriculture Programme (WCA 2000) either in the global program or as a regional addendum for the Asia and Pacific Region" in order to take advantage of the large scale agricultural census in the collection of more and useful data on aquaculture.

To meet the repeated requests, various options were explored by FIDI in collaboration with other relevant FAO divisions such as the Statistical Development Service (ESS) and the Inland Water Resources and Aquaculture Service (FIRI). Countries may choose to conduct an independent aquaculture census, or as in the case of some countries, include it with their fisheries census. Alternatively, countries may wish to collect such information as part of their agricultural census program. In this initial consideration, the feasibility of the third option was explored by FIDI and ESS at two regional consultations. The option that countries eventually choose may depend on the national priority given to this sector, the state of national aquaculture development, and the coverage expected from such an exercise.

Expert Consultations

To consider this option, draft guidelines for the collection of quantitative structural data on aquaculture (hereafter referred to as the Supplement) were prepared by FIDI/FAO in collaboration with ESS/FAO, from a working document prepared by Mrs. Virgilia T. Sulit (SEAFDEC Aquaculture Department, Iloilo, Philippines). The purpose of the Supplement is to provide guidelines for countries who would like to expand the scope and coverage of their Census of Agriculture to include the collection of structural information on aquaculture.

Such guidelines would also provide harmonized definitions and methodologies for countries which already collect such information as part of their fisheries census and form the basis for improved and appropriate sampling frames and methodologies for use during inter-census aquaculture surveys. These outputs should eventually result in improved national and FAO statistics. These guidelines were reviewed in two recent consultations organized by FAO at the Regional Office for Asia and the Pacific (RAP), namely the:

- a) Round Table Discussion on Aquaculture Statistics, November 1996 (predominately with aquaculturists to provide feedback on the items covered in the proposed Supplement, and establish the suitability of the scope and coverage of the Supplement to meet country needs), and
- b) Technical Evaluation of the Supplement, April 1997 (predominately with agricultural statisticians to establish the need, implication and logistics of including aquaculture in the agricultural census).

Participation of Countries and Regional Organizations

The above mentioned meetings were attended by 40 participants representing eight countries, and eight regional and global institutions which are closely associated with the monitoring and development of the aquaculture sector. The meetings were attended by participants from Cambodia, China, India, Indonesia, Japan, Philippines, Thailand, and Vietnam as well as representatives from the Asian Institute of Technology (AIT), the Bay of Bengal Programme (BOBP), the International Center for Living Aquatic Resources Management (ICLARM), the Mekong River Commission (MRC), the Network of Aquaculture Centres in Asia-Pacific (NACA), SEAFDEC, Stirling Aquaculture - Asia, and FAO.

Outcome of meetings

The need to collect structural information on aquaculture was reinforced by the participants in both consultations. For the consultations, the Supplement was divided into three major parts: (a) Introduction and methodological considerations, (b) Proposed census items, and (c) Tabulation program. The detailed deliberations of the participants on possible mechanisms for the collection of structural information on aquaculture will be published in the final reports of the meetings. Overall, three major aspects were discussed: the coverage of aquaculture within the WCA 2000 Programme, the range of items to be covered, and implementation of the Supplement.

The coverage of aquaculture within the agricultural census program was the key consideration of both consultations. In this context, the participants at both consultations noted that the value of the census will be limited due to the current definition of the agriculture holding, which restricts the scope of the census to those agricultural holdings on which aquafarming is practiced. Participants concluded that, to increase the probability of implementing the census on aquaculture, FAO should emphasize cost/benefit considerations of including aquaculture in the agricultural census program and provide flexible guidelines to enable countries to include the collection of structural statistics either as part of their agricultural, livestock or fisheries censuses or through an independent aquaculture census. Following the recommendations of both consultations, holdings of two types which conduct aquacultural activity, will be defined in the guidelines. These are:

a) Agri-aqua holding

An agri-aqua holding will be defined as an agricultural holding engaged in agriculture as well as aquaculture provided that the means of production (labor, equipment, buildings) on the holding is the same. Aquaculture can be conducted alongside and integrated with agriculture or on a separate site as long as both activities belong to the same economic unit. Examples are combined fish and rice, plants or livestock and fish culture.

b) Aquaculture holding

An aquaculture holding will be defined as an economic unit which is predominately or solely engaged in aquafarming. For an economic unit to be considered an aquaculture holding, the means of production (labor, equipment, buildings) on the holding must be the same. Such holdings may also be "landless": for example houseboats, in which cages are suspended from below the floor boards, may be an integral part of the dwelling, and aquaculture on water bodies such as sea, estuaries, lagoons, lakes, reservoirs, rivers, etc.

The participants in both consultations acknowledged that, given the possible financial and human resource and institutional constraints, the collection of information on all the desired items may not be feasible and therefore recommended that a reasonable limit (say 10) be placed on the number of questions asked. Nevertheless, the number of items and their definitions provided by FAO in their guidelines will be sufficiently broad so that even though countries may limit the number of questions or items based on their national priority, the definitions of selected items will be harmonized between countries to permit international comparison. It was also recommended that items should be prioritized as "essential" and "recommended", based on the comments by agricultural statisticians and should provide examples of tabulation tables.

Given the current debate on the aquaculture sector as a net user of natural resources and on the possible impact of aquaculture on the environment, participants discussed the merits of classifying farms as extensive, semi-intensive and intensive. The participants acknowledged that such demarcations were arbitrary and subjective and, as such, difficult to define. The participants concluded that the level of intensification of culture systems can best be addressed by ensuring that the key features of intensification (capital energy, feed and fertilizer inputs, and stocking density) are included in the questionnaire.

In view of recent concerns on the possible negative impact of aquaculture on the environment, the regional experts supported the importance of collecting key environmental indicators in the WCA 2000 Programme. For aquaculture, participants mentioned that they would like to see more emphasis on the indicators of sustainable development. They suggested that the section on aquaculture, production facilities be regrouped according to environments, e.g. land-based facilities, lakes, marine etc. They were informed on the sensitivity of such grouping and of the willingness of respondents to answer such questions, particularly if they felt that by doing so their future activities will be compromised. It was therefore suggested that a preferable approach would be to augment the questionnaire with additional information on culture practices, such as water treatment plants, use of special feeds, etc. It is envisaged that the Aquaculture Supplement to the WCA 2000 Programme will be published at the end of 1997.

8. CURRENT STATUS AND CONSTRAINTS OF COLLECTING AQUACULTURE STATISTICS

Current procedures used to collate aquaculture statistics and status of current aquaculture listing and other sampling frames in selected countries, were considered at the Round Table Discussion. A preliminary effort was made to:

- a) establish current practices and constraints of collecting aquaculture statistics in selected countries,
- b) ascertain the potential role of regional bodies in data collection; and
- c) inform participants on fisheries census conducted to date.

This process was initiated for Malaysia through direct contact with the Department of Fisheries and through several country papers presented at this discussion. Representatives from China, India, Japan, Cambodia, Vietnam and Philippines and representatives from ICLARM, NACA, SEAFDEC, MRC, and BOBP presented papers giving carrying levels of detail on the above three aspects.

The participants noted that among the main objectives of a census program is the development of appropriate sample frames. Given that sample frames are likely to form the basis for annual inter-census surveys, participants emphasized the need for, and FAO, assistance in, developing and/or improving sample frames and listings to foster international comparability.

The common constraints faced by most countries were shortage of manpower, limited funding and inadequate equipment. Despite these constraints many countries collect and report national aquaculture statistics to FAO. The sampling methodology, quantity, and quality of aquaculture data collected, however, are still not considered suitable. Inadequately qualified staff for data collection, coupled with staff turnover and minimal motivation and understanding the methods and purposes of collecting data, often reduce the accuracy of collected data. In Malaysia for example, aquaculture data are collected by extension officers who have 11 years of school education. The range of items covered major aquaculture producing countries, such as the Philippines, were not considered to be adequate. Whilst countries collect information on the output of aquaculture products for final consumption and processing information on operational hatcheries and seed production by species are however lacking. The assistance of FAO and other agencies to evaluate and improve the current practices of data collection was requested.

9. SUGGESTED ACTION

The participants of the Workshop were invited to comment upon the developments of norms and standards (e.g. definition of aquaculture and culture-based capture fisheries) reported in this paper, and the proposed inclusion of aquaculture in the WCA 2000 Programme as well as how aquaculture statistics in particular species identification, can be improved.

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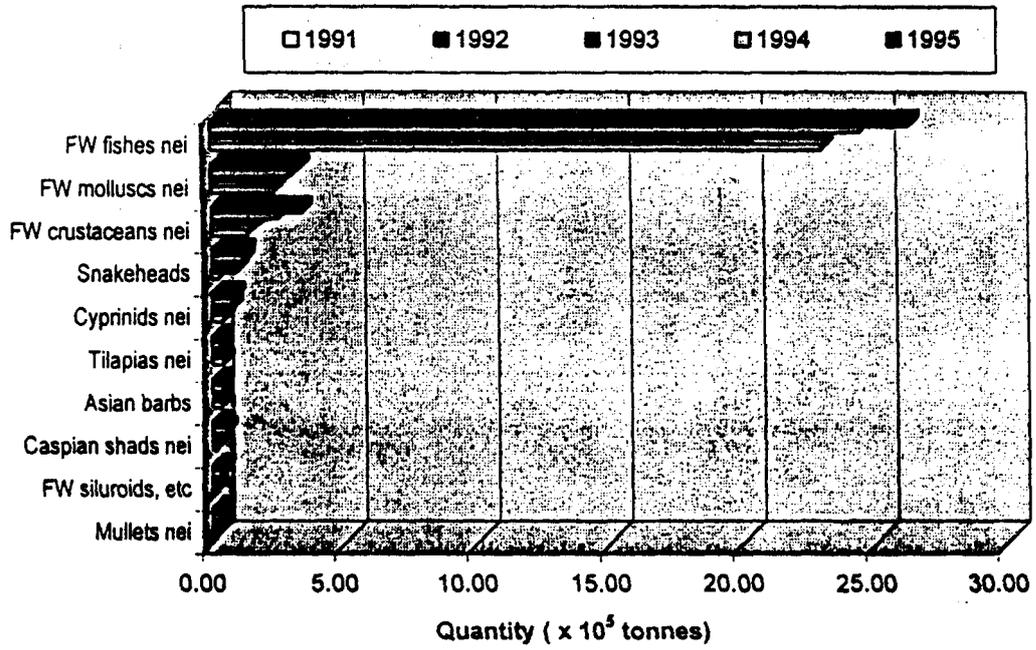


Figure 1. Tonnage of Unidentified Species Items Reported for Inland Capture Fisheries in Asia for 1995 (top 10 reports)

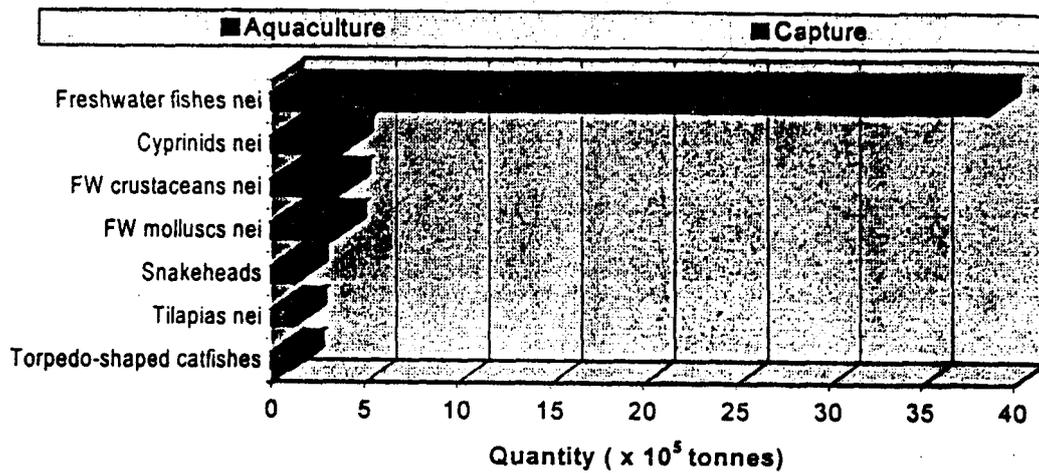


Figure 2. Contribution of Major Species Items to Inland Water Production in 1995. Note: Species items included are those with a production above 100,000 tonnes.

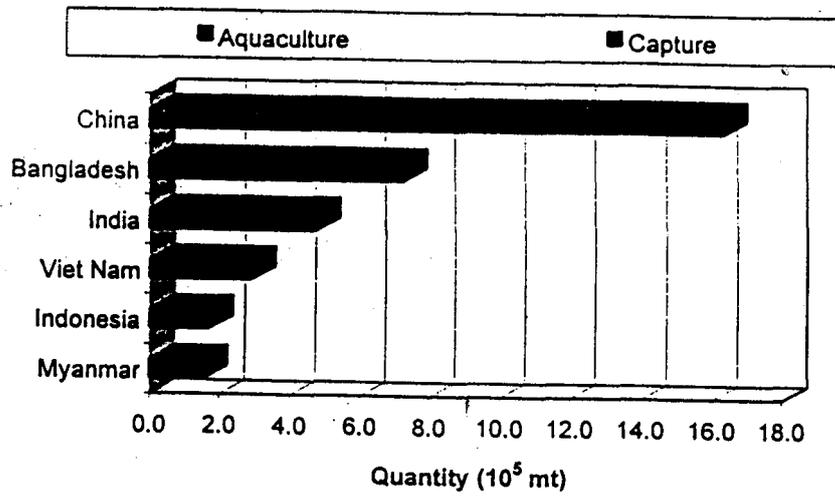


Figure 3. Contribution of Major Countries to Freshwater net grouping in Asia for 1995.

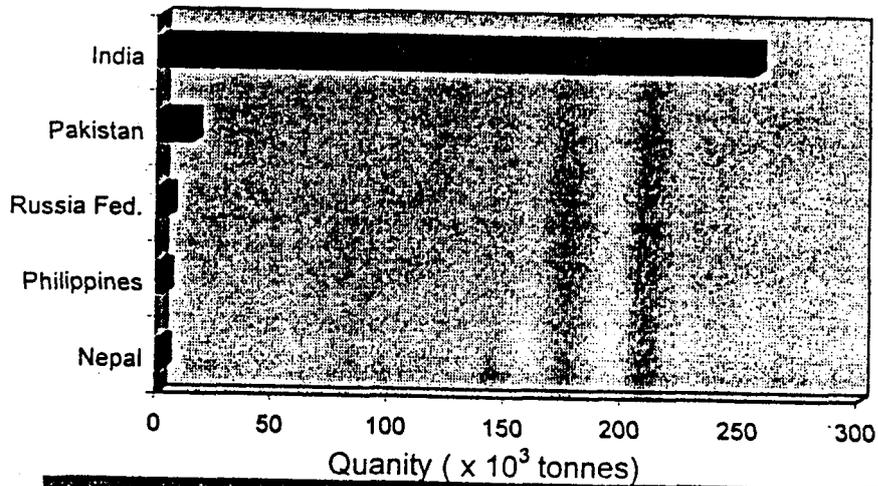


Figure 4. Aquaculture Production of Finfish Reported by Countries as Cyprinid net.

Table 1. Classification proposed for various aquaculture and capture fisheries practices. (Modified from CWP1992)

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 and reservoirs			
- with enhancement (fertilisation 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			*
Enhanced marine fisheries		*	
Aquatic organisms caught in open waters			*
Privately owned recreational fisheries			*
Ranching		*	
Fish and other animals harvested from artificial reefs		*	

PROPOSED CONTENTS

SUPPLEMENT ON AQUACULTURE*

FOREWORD

CHAPTER 1. INTRODUCTION

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* For the World Census of Agriculture Programme 2000 (WCA 2000)