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CWP Handbook on Aquaculture Statistics

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PREFACE

Aquaculture, the farming of aquatic organisms, is the fastest growing food producing sector in the world, since 1990s. Aquaculture now accounts for nearly half of the world's food fish production to meet the growing global demand for nutritious food fish and to contribute to the growth of national economies, while supporting to sustainable livelihoods of many communities.

The need for aquaculture data and information collection is embedded in the Code of Conduct for Responsible Fisheries (FAO 1995). Reliable and timely data is fundamental requirements to support sustainable aquaculture development. However, due to its rapid growth, many countries have yet struggled in establishing adequate institutional mechanisms to meet the information demands for sustainable management of the sector. There is an urgent need for many countries to adjust the current systems to meet the changing demand for data and information and improve national aquaculture statistics accordingly. At the same time, clear guideline of data collection and monitoring methodologies for aquaculture sector has to been established.

As a response, FAO developed the Strategy and Outline Plan for Improving Information on Status and Trends of Aquaculture (Strategy-STA) through the Expert Consultation on Improving Information on Status and Trends of Aquaculture in 2004, which was endorsed by the third session of the FAO Committee on Fisheries (COFI) Sub-Committee on Aquaculture (New-Delhi, 2006) and subsequently the twenty-seventh session of COFI (Rome, March 2007). The Strategy is a voluntary instrument, global in scope, and applies to all types of aquacultures. The overall objective of the Strategy is to provide a framework for the improvement of knowledge and understanding of aquaculture status and trends as a basis for policy-making and management, and to ensure development that is compatible with good stewardship of resources and the environment. One of main component of the Strategy is to establish global methodologies and standards for aquaculture statistics.

The Expert Workshop held in Halong City, Viet Nam, November 2009 initiated a development of this Handbook with participation of five CWP member organizations (FAO, NACA, SEAFDEC, SPC and EuroStat) and additional 11 invited experts. The task was passed to the Coordinating Working Party on Fishery Statistics (CWP) after the establishment of Aquaculture Specialized Group (CWP-AS) at its 23rd session held in Hobart, Australia, 22-26 February 2010.

The Handbook intends to cover a range of basic concepts, definitions, standard classifications and corresponding codes, as applied to aquaculture data collection and statistics. It was developed to provide the principles at international level. Authorities considering national statistical system are requested to ensure that the system developed incorporates a high degree of compatibility with the standards described here.

The CWP is consistently keeping these standards under review and welcomes the feedbacks and comments of the national authorities on their application at national level. Comments should be addressed to CWP Secretariat.

1. DEFINITION AND CHARACTERISTICS OF AQUACULTURE

1. 1-1. Definition of Aquaculture

UN ISIC Rev. 4 indicates aquaculture as "*the production process involving the culturing or farming (including harvesting) of aquatic organisms (fish, molluscs, crustaceans, plants, crocodiles, alligators and amphibians) using techniques designed to increase the production of the organisms in question beyond the natural capacity of the environment (for example regular stocking, feeding and protection from predators)*", where "*culturing/farming refers to the rearing up to their juvenile and/or adult phase under captive conditions of the above organisms. In addition, aquaculture also encompasses individual, corporate or state ownership of the individual organisms throughout the rearing or culture stage, up to and including harvesting*".

The FAO definition of aquaculture is:

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 licences, are the harvest of fisheries.*

Here, the key important points are

1. Aquaculture include production of all aquatic organisms, regardless its taxonomic classifications (e.g. fish, molluscs, crustaceans, other invertebrate, reptiles, amphibians, mammals and algae who inhabited in or at water bodies) as well as regardless its final utilization (e.g. food, non-food such as pharmaceuticals and nutrition supplements, ornamental, seed, feeds, other industrial uses)
2. Definition of "aquaculture" includes two main criteria, i.e. i) intervention in the rearing process and ii) ownership of cultivated organisms.

2. 1-2. Stages in Aquaculture

Aquaculture entails whole life stages of cultivated organisms, as the case of livestock production. The life stages of aquaculture are schematically summarized in Figure 1-1 (De Silva, et. al. 2008).

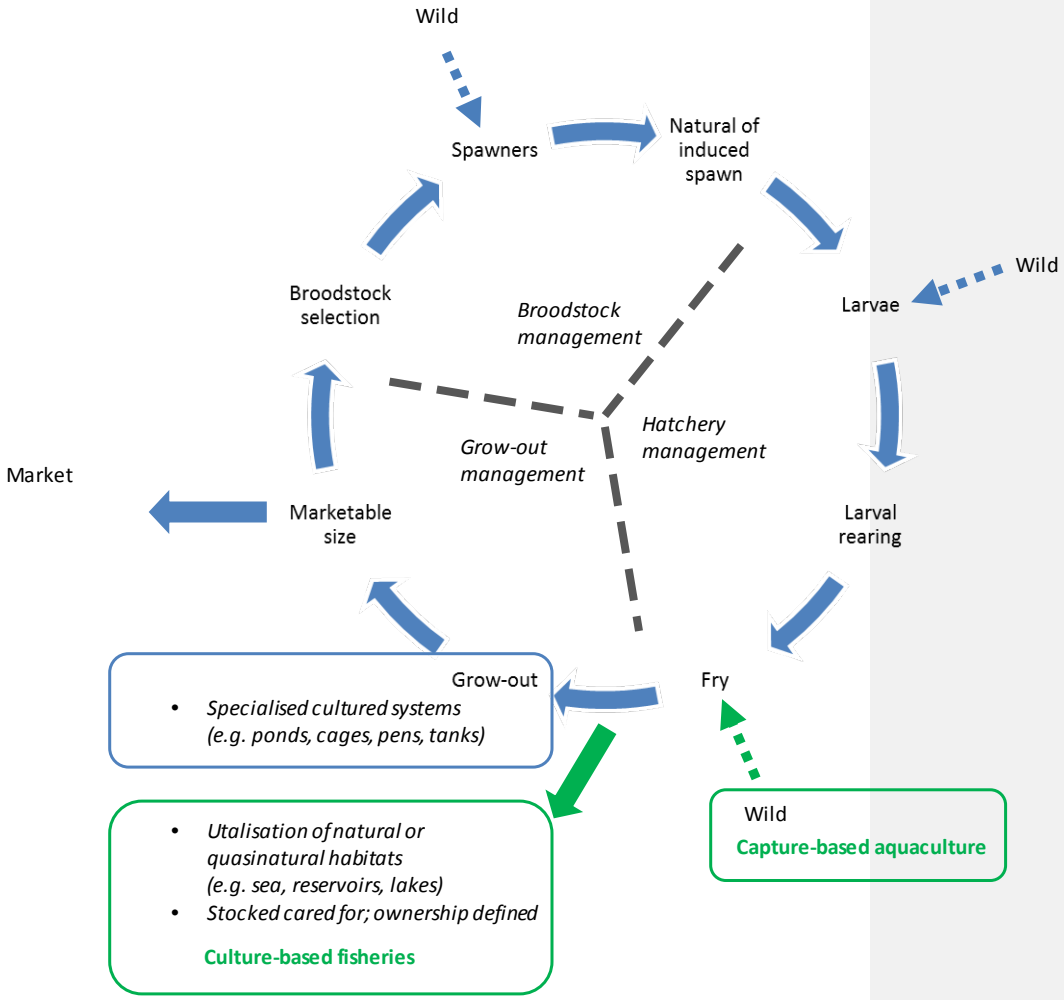


Figure-1-1 Schematic representation of the forms of aquaculture using different life cycles of species (modified after De Silva et al, 2008)

Seed production is *a multi-phased process to produce various life stages of organisms (egg, larvae, fry, post larvae, fingerling, juveniles, yearlings) for use in grow-out phase or as seed for stocking of natural resources, involving broodstock management, hatchery, and nursery operations*. Here, **broodstock management** refers to *maintaining matured animals of both sexes in captivity for the purpose of controlled reproduction (independent of whether a first or subsequent generation is produced) as well as keeping young animals destined for the same purpose*. According to species, nursery operations may include multiple phases of production, e.g. fry, fingerling, yearling etc.

Grow-out is *the phase where cultivated organisms raised up to a marketable size for food and other commercial purposes (i.e., ornamental, pearls, etc.).* In some cases, seed from hatcheries may be directly stocked into grow-out facilities.

Total period that organisms are kept in seed production phase and grow-out stage varies widely depending on species.

3. 1-3. Classifications of aquaculture

Aquaculture constitutes a complex production system and practice. It ranges from small-scale back-yard ponds to highly sophisticated industrial production units. Here a range of different classifications of aquaculture is shown.

The aquaculture can be classified based on the number of species cultured in a production system, i.e. monoculture and polyculture. **Monoculture** refers to "*the cultivation or culture of a single crop or one species*", while **polyculture** refers "*the rearing of two or more non-competitive species in the same culture unit*".

Aquaculture is often practiced in association with other agricultural crops or livestock. This type of practice is called **integrated aquaculture**. Integrated aquaculture is a very old traditional, rural farming activity that has evolved to generate synergies between aquaculture and other farming activities such as animal husbandry, crop farming, horticulture and sericulture. These include different types and degrees of integration in which wastes from different farming activities are utilized to enhance the effective utilization of resources, ecological benefits and economic returns to the farmer. **Rice-fish farming** is a unique traditional integrated aquaculture system characterized by concurrent or rotating culture of aquatic animals and rice (paddy) in the same field.

i. 1-3-1. Intensity of culture practices:

Aquaculture systems range from an intensive indoor system monitored with equipment to the simple release of fry and fingerling to aquaculture facilities. Some of the simplest production systems are the small family ponds in tropical countries for domestic consumption. At the other end of the scale are high technology systems, such as the intensive indoor closed units or the sea cages for growing a variety of species. The stocking density can also vary from few individuals per m^2 (2-5 inds/m^2) to many individuals per m^2 (150 – 200 inds/m^2) and from completely unfed to fully fed systems.

Since this is in continuum, it is difficult to explicitly define categorization to demarcate one from the other. The followings are indicative definition of **extensive**, **semi-intensive** and **intensive** aquaculture.

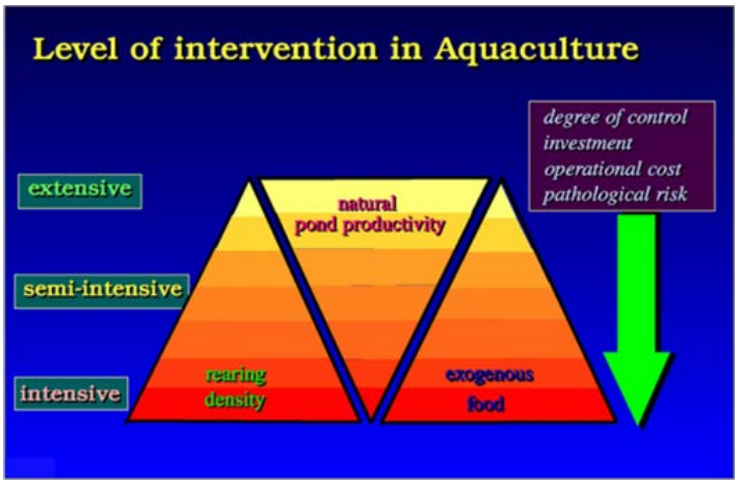
- **Extensive culture**: *the cultured stock obtains all the nutrition required from the natural food produced in the containment where it is reared and/or through the water supplied to the containment,*

- **Semi-intensive culture**: *the cultured stock is provided a part of nutrition required externally, mostly through supplementary feeding*, (The culture where only the

chemical to enhance production including fertilizers and pesticides are provided is considered as “Extensive culture”, and

- **Intensive culture**: *all the nutrition that the culture stock requires is provided externally*.

General relationship among rearing densities, reliance on natural productivities and reliance on exogenous food corresponding to the different level of intensity of culture practices can be illustrated below:



ii. 1-3-2. Scale of aquaculture operations

Aquaculture practices are a continuum to small-scale, medium and large to very large. Small-scale may be considered as farmer family owned/leased, operated and managed farming systems, as opposed to others which may be defined as systems singly and or corporately owned but operated through a permanent labour force. However, there is no explicit and agreed definition.

4. 1-4. Interaction between aquaculture and capture fisheries

Aquaculture and capture fisheries interact each other often by sharing common water resources. Aquaculture and capture fisheries are inter-dependant when hatchery seeds are used in stock enhancement (i.e. culture-based fisheries) and as well as when wild-caught seeds are used in aquaculture production (i.e. capture-based aquaculture). Capture fisheries often provide sources of feed used in aquaculture production.

Culture-based fisheries are 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 in natural and artificial

water bodies including rice fields or constituting an artificial fauna of selected species, and genetic modification of introduced species. It should be noted that those activities do not necessarily result in an increase of production of targeted segment.

Commented [ST1]: Remaining issue: the range of "culture-based fisheries", whether modifications and improvement of ambiences should be included.

Here, restocking, stock enhancement, and sea ranching are defined as follows:

Restocking - the release of cultured or wild caught aquatic species (usually juveniles) into the wild to restore the spawning biomass of severely overfished stocks to levels at which they can once again provide sustainable yields

Stock enhancement - process by which the numbers of wild stocks of a particular species in a particular body of water are boosted by releasing large numbers of hatchery raised organisms

Ranching - commercial raising of animals, mainly for human consumption, under extensive production systems, within controlled boundaries and paddocks (e.g. in agriculture), or in open space (oceans, lakes) where they grow using natural food supplies. In fisheries: stocking usually of juvenile finfish, crustaceans or molluscs from culture facilities for growth to market size or to maturity in the natural environment. Species usually used are migratory and return close to the point of release (e.g. salmon) or non-migratory and remain for at least a substantial portion of the life-cycle in restricted areas where they enter the local fishery (e.g. red sea bream, *Penaeus japonicus*, etc.).

Capture-based aquaculture is defined as *aquaculture practiced with seed collected from the wild*. Capture-based aquaculture includes aquaculture practices based on wild caught seed of crustaceans, molluscs, echinoderms, other invertebrates, finfishes and macro algae (Lovatelli and Holthus, 2008).

For statistical purpose, wild-caught seeds used in aquaculture (capture-based aquaculture) are considered as a product of capture fisheries that is reclassified from natural fish resource to cultivated resources, an input from wild to aquaculture environment. Similarly, seed output from a hatchery when used for restocking, stock enhancement and ranching open space, is considered as an aquaculture production and reclassification from cultivated to natural resources. (See section 2-1 for further details)

The rough concept on how to allocate production to aquaculture and capture fisheries is illustrated in Figure 1-2, with selected examples shown in Table 1-1.

Figure 1-2. Illustration of the inter-dependency between aquaculture and capture fisheries together with input and output of seed and allocation of production either to aquaculture or capture fishery components.

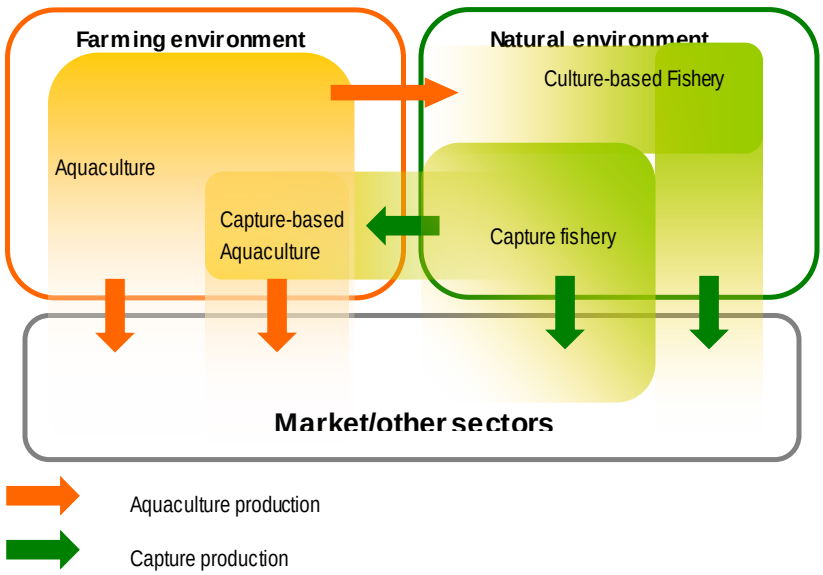


Table 1-1. Selected examples of activities to be designated either to capture fishery or aquaculture.

PRODUCTION FROM	DESIGNATION	
	Aquaculture	Capture
Hatcheries	*	
Ponds (including inter-tidal ponds)	*	
Tanks	*	
Raceways	*	
Cages	*	
Pens	*	
Integrated culture production	*	
Stocked lakes, reservoirs, barrages and rivers		
- with other enhancement (predator control and/or fertilization		*
- modification with "exploitation rights"		*
- no other intervention without "exploitation rights"		*
- quantities of released seeds	*	
Lakes, reservoirs and rivers without stocking		
- with enhancement (fertilization and/or predator control, habitat modification), with "exploitation rights"		*
Rice-fish culture	*	
Finfish and other animals harvested from brush parks:		
- managed over time and with other enhancement rights		*
- harvested on an install and harvest basis		*
Finfish and other animals harvested from fish aggregating devices and/or artificial reefs		*
Finfish and other animals harvested from aquaculture using wild captured seeds, including post larvae capture and culture (PCC):		
- quantities of wild seeds captured		*
- the remaining quantity of harvest	*	
Molluscs:		
- from managed grow-out site (e.g. poles, ropes, net bags)	*	
- from areas not managed but sown with cultured seeds		*
- subject to harvest with "exploitation rights"		*
- subject to open fisheries		*
Aquatic plants:		
- harvest of planted and suspended aquatic plants	*	
- from enhanced areas (implanting, predator control, and/or habitat modifications		*
- harvest of natural aquatic plants		*
Aquatic organisms caught in open waters		*

2. AQUACULTURE LIVING RESOURCES AND THEIR ATTRIBUTES

5. 2-1. General concept on aquaculture living resources

In the aquaculture, similar to livestock, the target organisms are kept within aquaculture facilities during the substantive period before obtaining social and economic values, either through sending out to market, domestic and international trade, consumed as local food supply, or released as seed for stocking. The total period that organisms are kept in aquaculture varies widely depending on species. While a broodstock is a critical component to support aquaculture production, it usually does not directly produce any social and economic value.

In order to fully understand the status and flow of aquatic organisms under aquaculture as well as the deficit and contribution of the aquaculture sector to social, economic and food consumption aspects, it is important to continuously monitor production in a sense of final outputs of seed, food, non-food products together with status and flow of all organisms under cultivation.

For this purpose, the concept of accounting, especially the flow and status of cultivated fish resources as "environment assets[1]" that was developed under the United Nations System of Environmental and Economic Account (SEEA), is considered to be useful and most suitable as standard to monitor aquaculture sector. The SEEA aims to improve the management of environmental assets and to ensure long sustainability of natural resources and environments. Applying the concept of the SEEA for monitoring aquaculture sector will have additional advantage to make the indicators and collected data to be comparable with those in the other sectors, e.g. crop production livestock and processing. The natural resource management including land and water access increasingly requires an integrated holistic approach. Maintaining comparable indicators with other sector would be essential for future development of aquaculture.

Fish resources (aquatic living resources) contain two components, i.e. cultivated aquatic resources and natural aquatic resources. The resource is considered as **cultivated aquatic resources** when *growth and regeneration of biological resource is under direct control, responsibility and management of an institutional unit (e.g. farmers).*

Cultivated resources are further divided into inventories, the component destined for commercial products and **fixed assets**, the rest, i.e. not directly destined for final commercial products, such as breeding stock.

i. 2-1-1. Account table for aquaculture:

[1] Environmental assets are defined as *items of value inherent in the environment and their input that the environment provides to society.*

Table 2-1 presents a basic component to be fulfilled in accounting fish resources within aquaculture that is modified from the SEEA environmental asset account table. Items shown within square brackets are indicative examples for the use in aquaculture

Table 2.1 Account table for aquaculture resources (tonnes/numbers)

		Cultivated resources – fixed assets	**Cultivated resources - inventories**
Opening stock		[Quantity of resources at the beginning of a time period]	[Quantity of resources at the beginning of a time period]
Additions to stock			
	Entry to stock	[Introduction from other monitoring unit(s)]	[Introduction from other monitoring unit(s)]
	Growth in stock	[Overall growth in quantity during a time period]	[Overall growth in quantity during a time period]
	Reclassifications	[Seed of wild origins]	[Introduction from wild]
Reductions in stock			
	Gross harvest	[Quantity harvested during a time period]	Not applicable
	Catastrophic losses and uncompensated seizure	[Loss in quantity due to extreme events, diseases]	[Loss in quantity due to extreme events, diseases]
	Reclassifications	[Released seed for stocking, escapement etc]	[Export of breeding stock to other monitoring unit(s)]
Closing stock of aquatic resources		[Opening stock] + [total additions] – [total reductions]	[Opening stock] + [total additions] – [total reductions]

This table should only cover the organisms of interest in aquaculture production, including seeds and broodstocks. The flow of feeds should monitor in the separate table (see also section ***).

Increases mainly come from entry (of seed) from other farms or other countries, growth in stock (in both size and numbers) and introduction of wild caught seed recorded as reclassification. In this table, growth includes natural loss for convenience of monitoring. Therefore, when natural loss, e.g. mortality during cultivation in generally expected level, exceeds increase in size and number of cultivated organisms, the growth during a given period can be negative. Where it possible, it is appropriate to record growth (i.e. natural addition) and natural loss (i.e. natural reduction) separately.

When wild caught organisms are introduced either as seeds or breeding stock, this should be recorded as a 'reclassification' from natural to cultivated resources (i.e. addition to aquaculture stock). In the case of ranching, stocking and enhancement of natural resources, cultured seeds released into the wild should be recorded as a 'reclassification' from cultivated to natural resources (i.e. reduction from aquaculture stock). Fish that escape into external environment should also be considered a 'reclassification' from cultivated to natural aquatic resources. Unexpectedly large losses due to disease or natural catastrophic events should be considered 'catastrophic losses'.

The same concept is used in monetary term to monitor economic status changes.

ii. 2-1-2. Monitoring units

While account tables can be compiled in any level of details for any of dimensions, it is preferable to compile them in the least aggregated level as possible, e.g. separate table for each species cultivated by individual farm and type of facility, for allowing full flexibility and utility at analysis and later compilation. In such case, output from individual farm, regardless the stage and destination of product should be considered as harvest. Similarly the fry, fingerling, yearlings and broodstock introduced from other monitoring units should be recorded as entry to stock.

In all cases a consistent way of counting and common unit of measurement should be used within one account table although the suitable unit of measurement may vary by type of aquatic resource and type of aquaculture. For example, in the case of seeds and ornamental products, numbers could be more readily available and suitable measurements.

At the time of compilation into national and sub-national statistics, it may be necessary to convert estimates of the biomass into number and vice versa. It is strongly encouraged to collect conversion factors for this purpose.

iii. *2-1-3. Aquaculture production*

In the compilation of national and sub-national statistics from account tables, the aquaculture production is considered as sum of harvest and overall balance due to reclassification with wild resource (i.e. difference between wild caught seed and seed utilized for stocking).

The products that are transferred from one monitoring unit to others within an aggregated framework (e.g. sub-national area, countries, etc) will be cancelled out by having matching figure between harvesting unit(s) and receiving unit(s). When account tables are only available for a part of units within an aggregated framework, the relevant account tables should be raised prior to compilation. For example, when 70% of hatchery production and 90% of grow-out production complete individual account tables, prior to combine two tables, each table should be raised to 100% production.

In fishery and aquaculture statistics, the production is converted into live-equivalent weight, in order to ensure compatibility among different type of processed commodities (e.g. simply gutted, gutted and headed, filleted, frozen). Direct measurement of harvest in live-weight equivalent at the time of harvest is ideal. When measurement is only possible

on processed products, the supplementary survey to determine conversion factor from processed weight to live-equivalent weight would be useful. General conversion factors of typical product weight to live-weight equivalent for major fishery commodities are available in Table XXX.

When multiple products are produced from one animal (e.g. pearls and shell meat, caviar and sturgeon meat), it must be careful to only include quantity converted from one of the products, in order to avoid double-count of production by applying.

6. 2-2. Attribute of aquaculture production

i.

ii. 2-2-1. Ownership/ nationality of production

For statistical purpose, the aquaculture production is attributed to the nations within whose territories including Exclusive Economic Zones where the farming facilities are located, regardless of the nationalities of owners of facilities. It should be noted that this is not exactly comparable with the attribute of capture production, where the United Nations Statistical Commission decided in 1954 that the fish catches should be assigned to the country of the flag flown by the fishing vessel, regardless the location of catch, which the CWP is in principle in support.

Although aquaculture operations are currently not undertaken in the high seas area the development of such operations in time to come cannot be excluded. Appropriate criteria to indicate attribute production in such cases needs to be established.

iii. 2-2-2. Time unit

Aquaculture production can be measured either based on a life cycle of cultured organisms or based on a certain time period, e.g. year, quarter, months etc. While the former is useful for monitoring and control at a farm level, the production statistics generally uses a fixed time period.

For compilation of national aquaculture production, total production as a sum of harvest and overall balance due to reclassification with wild resource (i.e. difference between wild caught seed and seed utilized for stocking) in annual term should be recorded as a minimum.

The calendar year, i.e. the period between 1 January and 31 December (according to the Gregorian calendar) is the most commonly used time unit in fishery and aquaculture statistics. When other definition is used for compilation of statistics, the definition of time unit used should be clearly defined and described.

iv. 2-2-3. Culture environments

Culture environments are defined according to the salinity of water that is mainly utilized at the farming facilities, noting that a utilization of multiple types of water within a single farming unit is not unusual.

Freshwater Culture - Freshwater culture refers to the cultivation of aquatic organisms where the end product is raised in freshwater, such as ponds, reservoirs, rivers, lakes, canals etc., which has a constant negligible salinity. Earlier stages of the life cycle of these aquatic organisms may be spent in brackish or marine waters.

Brackishwater Culture - Brackishwater culture refers to the cultivation of aquatic organisms where the end product is raised in waters of fluctuating salinity in a range between 0.5 ‰ and full strength seawater. Culture utilizing relatively high salinity water originated from inland water bodies should be considered as brackishwater culture. If these conditions do not exist or have no effect on cultural practices, production should be recorded under either "Freshwater culture" or "Mariculture". Earlier stages of the life cycle of these aquatic organisms may be spent in fresh or marine waters.

Mariculture - Mariculture refers to the cultivation of the end product in seawater, such as fjords, inshore and open waters and inland seas where salinity is generally high and is not subject to significant daily or seasonal variations. Earlier stages in the life cycle of these aquatic organisms may be spent in brackishwater or freshwater.

The breakdown in culture environment (freshwater, brackishwater and marine water) is not simple and is often left to the subjective judgment of reporters. Many farming located in the inland have high salinity even exceeding 20 ‰, while some farming located in coastal areas and internal waters are actually using freshwater. There are many areas where the salinity levels fluctuate over the year.

v. 2-2-4. Location of production

FAO asked countries to report the fishery and aquaculture products according to their location of harvest using FAO Major Areas for Statistical Purposes. FAO Major Areas was established to describe global distribution of fishery and aquaculture production, with eight inland areas corresponding to the inland waters of the continents and nineteen marine areas covering the waters of the Atlantic, Indian, Pacific and Southern Oceans with their respective adjacent seas. This information is especially important when a given countries facing to the multiple FAO Major Areas to understand geographic distribution of harvest correctly (e.g. Pacific and Atlantic side of production for the USA, Canada, and Mexico).

In a case of aquaculture production, the FAO Major Areas should be determined based on location of farming facilities, regardless the type of waters utilized. When on-land farming facilities are located close to the coast and mainly rely on water supply directly pumped from the marine area, their production should be allocated to the relevant marine areas. Otherwise, production of on-land facilities should be allocated to the relevant inland area. However, when a given country is surrounded by only one marine Area, it is possible to assign all mariculture production to the relevant to marine Major Area and the rest to inland Major Area.

7.

8. 2-3. Farming systems/ culture methods

A farming system in aquaculture means any form of improvise or devise that is utilized to contain the cultured organisms, irrespective of the stage of its life cycle, in a given space. Very diverse containments are used in aquaculture operations depending on types of aquatic organisms cultured and the stage of its life cycle. Size of containments implies indicator of holding capacity and is to be used to standardize production efficiency and utilization of waters, fertilizers, feeds and other resources. This information when utilizing together with production will also provide an indicator on culturing intensities.

There is no consensus view on which of surface area under culture or water mass within containment would be more appropriate standard measure of farming capacity. Due to easiness to collect information, majority of existing data collection adopt surface area under culture as a standard measurement. The area under culture can change considerably during the year and it is recommended to measure the area at their final production phase.

i. 2-3-1. Classification of farming systems

Ponds
Ponds are natural and/or artificial structures, on land, that are capable of retaining water for rearing of stock. Ponds often consist of some form of banks or dykes. Under this category ditches, flood plain depressions, derelict mining pools and similar structures are included. Pond culture is usually carried out in stagnant waters with periodic water exchange or water flushing that is done through the pond inlets and outlets. Some pond culture, e.g. trout pond, may have a high water refreshment rate.

The measurement unit should refer to number of ponds, water surface area and water volume.

Tanks
Tanks are artificial units of structure capable of holding and interchanging water which are generally built above ground level and can be made of various materials (e.g. bricks, cement, concrete, fibreglass, plastics, wood, asbestos, metal, etc.), in various shapes and sizes. They are used in hatchery, nursery and grow-out operations.

The measurement unit should refer to surface area and water volume, and water turnover rate is important parameter to collect.

Pens
Pens refer to areas of a water body (e.g. in shallow lagoons, but also inland e.g. in lakes, reservoirs) that is fenced using structures (nets, wooden bamboo) fixed to the bottom permitting free water exchange. A pen generally encloses a large volume of water.

The measurement should refer to surface areas and information on setting environments (whether in flowing water, still water, or marine water) may be important.

Cages
Cages refer to open or covered enclosed structured with net, mesh or any porous material which allows natural water interchange. These structures may be floating, suspended, or fixed to the substrate but still permitting free water interchange. Cages are either supported by frameworks made of metal, plastic, bamboo or wood, or are suspended by

stakes at its four concerns in open water bodies or in ponds. Cages use both for seed and grow-out production.

The measurement unit should refer to surface area and volume, and information on setting environments (whether in flowing water, still water, or marine water) may be important.

Raceways
Raceways are long and narrow rectangular tanks usually constructed with bricks and concrete and artificial material above ground, that permits a rapid flow of water. To water turnover rate is generally in excess of 20 changes per day.

The measurement unit should refer to surface area and water turnover rate is important parameter to collect.

Enclosures
Enclosures refer to natural water areas (e.g. natural bay), where the shoreline forms all but one side, confined by a net mesh and other barriers allowing free water interchange and distinguished by the fact that enclosures occupy the full water column between substrate and surface.

The measurement unit should refer to surface areas and information on setting environments (whether in flowing water, still water, or marine water) may be important.

Lakes, Reservoirs, Dams
Lakes, reservoirs and flood plains where stocking of aquatic animals are conducted on the regular basis, the stocked animals are confined in the stocked water bodies with management interventions; the products are harvested exclusively within the people with entitled ownership of the stocked material. Stocked material should compose the significant proportion of the total fish production from the water body.

The measurement unit is the water surface area.

Flood plains

Commented [ST2]: Remaining issues: no text for this category

Barrages
Barrages are semi-permanent or seasonal enclosures formed by impervious man-made barriers and appropriate natural features.

The measurement unit should refer to surface areas and information on setting environments (whether in flowing water, still water, or marine water) may be important.

Irrigation systems (channels and ditches)
Irrigation channels and ditches refers to water bodies that are used for fish aquaculture but their primary function was for converting water for irrigation purpose such as channels and ditches excavated or constructed with concrete in the ground.

The measurement unit should refer to surface area.

Rice-fish paddies

Rice-fish paddies refer to paddy fields used for culture of fish and other aquatic animals, including both concurrent culture of aquatic animals with rice plantation and seasonal rotation of fish and rice crop farming in the same paddy field.

The measurement unit should refer to surface area.

Suspended/hanging systems

Suspended/hanging systems are floating structures as rafts built of wood, bamboo and long lines with seaweed nets or hanging lantern nets, growth ropes, pearl nets, net bags or trays, normally equipped with floats and safely anchored in a sheltered coastal area. This system may be used for the suspended culture of seaweed, molluscs and other animals such as sea cucumbers.

The measurement unit should refer to the number of farming structures, surface areas and length of lines or ropes.

Off-bottom systems

Off-bottom systems are structures like trestles and long lines installed on stakes impaled in the seabed or inter-tidal zone. Culture nets, lantern nets, growth ropes, pearl nets, net bags or trays are usually used in these structures to farm seaweed and molluscs.

The measurement unit should refer to the number of farming structures, surface areas and the length of lines or ropes.

Commented [ST3]: Remaining issues: there is an opinion that suspended/hanging systems are a part of off-bottom systems

On-bottom systems

On-bottom systems refer to the farming of molluscs such as clams and oysters, and sea weeds, and holothurians directly seeded on muddy or sandy areas in the inter-tidal zone or on the seabed.

The measurement unit should refer to farming surface area.

ii. 2-3-2. Classification for statistical purpose

For statistical purpose, the farming facilities can be aggregated into the following groups:

- Ponds
- Cages, raceways, tanks, enclosures, pens,
- Lake, reservoirs, dams, barrages, flood plains, irrigation systems
- Rice-fish paddies (rice fields used for aquaculture)
- Suspended/hanging systems, on-bottom systems, off-bottom systems

The measurement unit in principle should refer to farming surface area that means whole area occupied by farming facility system. Where appropriate, measurement unit in volume and length should also be used in addition.

3. ADDITION AND REDUCTION OF AQUACULTURE FISH RESOURCES

Aquaculture contributes to food security, poverty alleviation, economic development and social wellbeing of many people in the world. For effective management of aquaculture within national policy, it is necessary to monitor a full spectrum of such contribution. The following three sections describe types of information needed to monitor aquaculture sector. This section describes what information and data are relevant to be considered and collected for statistical purposes, in order to monitor change of aquaculture fish resources, both fixed asset and inventories. Final harvest, i.e. output products, from aquaculture can be either as food or for non-food use.

9. 3-1. Aquaculture output products – Gross harvest

This handbook considers three general categories of aquaculture output products – namely, production for food, production for non-food uses, and production of seed for further aquaculture practices or for release to the wild environment. This section mainly describes the necessary statistics to quantify the gross harvest, i.e. production, in each category.

i. 3-1-1. Output products for food

The vast majority of aquaculture production is destined for human consumption. Statistics quantifying aquaculture production for food is in principle quantity in biomass by species, in terms of live weight equivalent. Thus, for molluscs and crustaceans, the weight of the shell should be included in the production weight. Suitable conversion factors can be used to convert meat weight to live weight equivalent and vice versa. Aquatic plant production should be reported as wet weight. [List of indicative conversion factors]

The final food product as output from aquaculture often comes in form of processed food, where the value of products is generally linked to the volume. More accurate statistics can be obtained on the quantity of processed weight by commodities or by species. [International Standard Statistical Classification of Fishery Commodities]

All statistics of quantity of products should be reported together with farm-gate value. This indicates the amount that the farmer would expect to receive for the harvest before any transportation costs are included. This concept is widely accepted but often quite difficult to collect in actual situation. Thus, it is useful to maintain and report brief explanation on what is exactly measured by the farm-gate value.

All statistics of quantity and value of products should be stratified by species, environment, farming systems and destinations. Here, the destination could be two fold; i) for domestic markets (local use) and ii) for international markets (exports).

ii. 3-1-2. Output products for non-food use

Non food aquaculture products can further be classified as follows:

1. Ornamental (or aquaria) organisms. This can be finfish, other aquatic animals such as molluscs (giant clams, trochus, etc), crustaceans (lobsters and shrimp of genus like *Lysmata* sp., etc), live rock and corals or aquatic plant. Usually these are reported in numbers but live rocks and some live corals occasionally may be reported as weight.
2. Raw materials for jewellery, apparel, handicraft etc. This would include cultured pearls, shells, corals, skins etc, reported in either pieces or numbers.
3. Industrial use. This includes raw material intended for further processing, whether for pharmaceutical, food processing, or production of chemicals that are usually reported in product weight.
4. Others. This includes production of fingerlings as feed for feeding carnivorous fish.

In principle, the same standard statistics as food product should be collected for the products for non-food use, though quantifying non-food aquaculture production presents some special circumstances. In particular, ornamental fish and pearls are traded and reported by numbers and not by weight.

Statistics to be collected include quantity in either number or products weight, and the farm-gate value. Where applicable, WCO standard unit of quantity should be referred. [WCO HS 2012 for fishery and aquaculture commodities] All statistics should refer to stratifications by commodity, species, environment, farming system and by destination (i.e. local use or for export), in the same way as those for food-use.

Commented [ST4]: Need update with HS2012, also need better search system

iii. 3-1-3. Output of seed product

Seed production includes eggs, larvae, post larvae, fry, fingerling, juveniles, yearlings spats, seedlings, propagules and broodstock. Seed production is often measured by numbers, although both may be applicable for broodstock.

Seed is used both for aquaculture and stock enhancement. In the other words, seed production as output can be either harvest that would be utilized as inputs of aquaculture production in different unit(s), or seed to be released to wild that to be recorded as inputs to wild resources. Therefore, it is important to collect information on destination in addition to the quality and quantity of seed produced. Statistics of seed production should include all hatchery produced seed. The information on the origin and the genetic status is also important in monitoring and managing the sector.

Statistics to be collected for seed include quantity in number and farm-gate value, stratified by species, environment, farming system, and destination, and if possible with the addition on the information on life stage of juvenile form.

The destination of seed product should at least identify:

- Released to the wild for restocking and/or stock enhancement (culture-based fisheries)
- Released to a controlled environment for recreational purposes (e.g. a trout farm)
- Destined for domestic aquaculture practices (on-growing)
- Exported, with destination country where available.

Statistics to be collected for brood stock include quantity in number and biomass and farm-gate value, stratified by species, environment, farming system and by destinations, in the same way as those for food-use.

10. 3-2. Seeds and Broodstock -- Inputs to aquaculture

Seed is a major input to aquaculture fish resources. Seed represents many different early life stages of cultured organisms ranging from fertilized eggs to post-larvae (shrimp), spat (molluscs), glass eels/elvers (eels), smolts (salmon), fry and fingerling (finfish), spores/seedlings (sea weeds), etc., depending on the type of species cultured. Seed could come from either hatcheries or from the wild.

The components that are required for monitoring of the sector include not only quality and quantity of seed but also their origin and genetic status. At least for statistical purpose, the seeds and broodstock of locally produced and those of imported should be clearly separated. According to the level of management needs, the "local" can be defined in sub-national level, for example, at province level: i.e. distinguishing those originated in one province of a country and used in another province from those produced and used in the same province.

Seed and broodstock from the wild is input to aquaculture but at the same time, output from capture fishery, i.e. capture production, that should be recorded as reclassification from natural to cultivated resources in fish resource asset account. This quantity is important for both aquaculture and capture fishery sectors managements. In general seed quantity should be collected in number, since this quantity in biomass is negligible in most cases, However, when the quantity is substantial (e.g. broodstock, tunas) and/or target organisms are commercially important, concerned in their stock conditions and/or ecologically sensitive (e.g. tunas, eels, some groupers), both quantity in both number and biomass should be collected.

The data to be collected for seed input include quantity in number and purchase value by species and separated between those locally produced and those imported.

In the case of wild-caught seed, especially for tunas, eels and groupers, quantity in biomass should be collected in addition to the normal statistics described above.

Statistics of broodstock input should be collect separately from seed input. Data to be collected are quantity in number, quantity in biomass, and purchase value by species and by origin.

11.

12. 3-3. Stock of aquaculture fish resources

In the aquaculture, similar to livestock, the target organisms are kept within aquaculture facilities during the substantive period before obtaining social and economic value, either through sending out to market, domestic and international trade, consumed as local food supply, or released as seed for stocking. In order to fully understand the status of aquaculture sector, it is strongly recommended to collect the stock size of cultured fish

resources at a certain time, usually at the beginning or at the end of defined period for statistics.

The statistics to be collected should include estimated quantity in biomass that is kept at farming facility at the time of monitoring, separated by species, environment, and farming system.

13. 3-4. Losses of aquaculture fish resources and farming facilities

Aquaculture production can be lost, full or partially, due to various reasons including disease, natural disasters, and other environmental impacts. Despite the significant volume of loss in aquaculture production as per above mentioned causes, there has no statistics been collected systematically to monitor such losses.

As the first step, the countries are encourage to collect the following categories, if possible, systematically:

- Estimated quantity in biomass and value of loss of cultured organisms due to disease, separated by name of diseases, species and environment
- Estimated biomass and value of loss of cultured organisms due to natural disaster and other environmental impacts, separated by type of events, species, and environment
- Estimated value of loss in culturing facilities/equipments and number of culturing facilities/equipments affected due to natural disaster and other environmental impacts, separated by type of causes and environment

Within SEEA, the first two points of such losses should be recorded in catastrophic losses of aquaculture fish resources.

4. SOCIO-ECONOMIC ASPECTS OF AQUACULTURE

The socio-economic information on aquaculture sector is essential to measure and monitor the sector's contribution to food security and poverty alleviation, and to plan and manage the sector in long-term sustainable manner. Census and Structural Business Statistics suveys may provide an opportunity to collect such information extensively but such census/survey only occurred with a certain, rather long intervals. When relying on census and cross-sectoral surveys to obtain socio-economic information, it is necessary to establish some way to monitor changes of key indicators between census/survey years.

14. 4-1. Employment

An employee is one whose main activity during the reference year was to be in paid employment or self-employment. Currently, FAO is collecting the employment in aquaculture with the following classifications (see CWP Handbook on Fisheries):

- Full-time farmers receive at least 90% of their livelihood from farming activities (including employment at farms) or spend at least 90% of their working time in that occupation.
- Part-time farmers receive at least 30% but less than 90% of their livelihood from farming activities (including employment at farms) or spend at least 30% but less than 90% of their working time in that occupation.
- Occasional farmers receive under 30% of their livelihood from farming activities (including employment at farms), or spend under 30% of their working time in that occupation.

However, it is noted that this classification is not necessarily always suitable and/or applicable to actual employment and working situations in aquaculture sector.

Where possible, further data collection on employment, especially through full utilization of census together with follow-up surveys, will support in developing better understandings on social and economic contribution and issues of aquaculture sector.

One area of potential improvement is to incorporate additional classifications of employment as follows:

- Employee : person in paid employment,
- Own-account worker : person who is working on his/her own account, or with one or more partners, in a self-employment,
- Contributing family worker : person who is working in a self-employment in the holding operated by a member of the same household,
- Others

The data to be collected may include age, gender, average wage, and educational level, together with number of people engaged by these categories. Such information could be collected at the time of population census by separating aquaculture from agriculture as independent sector as well as other surveys including agricultural census, fishery census, and rural surveys.

15. 4-2. Structure of farming operations

Currently, most of countries require registration of aquaculture production facilities with the competent authority also providing a range of data and information including ownership, location of farming facilities, type and size of farming systems in operation, water access, etc. In order to understand the structure of farming operations and their changes according to time, the information on existing farming facilities by farming systems and type of production units is considered as useful initial step. Here, production unit will be defined according to individual national legislation relevant to registration and licensing for aquaculture activities and may not be consistent among countries.

The information that is considered to be useful to collect includes:

- total numbers and areas of production units, separated by household units and non-household units,
- gender, age and national/ethnic group of the production unit owner,
- tenure type of production unit,
- types and surface areas of farming systems within the production unit,
- species cultivated,
- water sources, main water type and annual average volume in use, and
- number of employees by gender

It would be also useful to collect information separately according to the status of aquaculture commercial activity and/or their organizational status defined under national legislation, e.g. farm holding; business enterprise; large corporate farms; franchise operation (i.e. small farmers operating units within a corporate large farm); part of a cooperative/ producer group; etc.

16. 4-3. Investment

The information on investment is essential for sustainable development and effective management of aquaculture sector, especially for small scale holdings. Such information could be available within the government. Although no standard concepts and procedure exist for aquaculture sector, the CWP strongly encourages countries to make efforts to collate and maintain the information on investment relevant to aquaculture sector in a systematic way, where applicable.

5. OTHER KEY FACTORS AFFECTING AQUACULTURE PRODUCTION SYSTEMS

Better monitoring, management, development and planning of the aquaculture sector largely depend on the availability of accurate information on the input requirements for practicing aquaculture. Although there is an array of inputs is used in aquaculture, the section quickly touches on need of data for monitoring the sector performance, with several key inputs including (i) seed and broodstock, (ii) water (iii) feed and fertilizer, (iv) antibacterials and (v) energy. Although labour is an important input to aquaculture, all human aspects are discussed under Section 7.

17. 5-2. Water

Water is an essential requirement to aquaculture production. In many areas of the world, there is a limited, and potentially expensive, supply of fresh water. Therefore there will be the possibility of resource competition among various food-producing sectors as well as other users of water. It will become increasingly important for aquaculture to be able to quantify its use of water resources in order to justify its use relative to other potential uses.

The data elements necessary to measure this use remain to be developed but it is expected that this will be an issue of increasing importance in the future. Furthermore, the environmental impacts of the use of water for aquaculture through the discharge of effluents into common waters might also need to be considered. However, collecting such data and information will be difficult and may not be realistic and practical in many places, conditions and occasions.

At this moment, there are no internationally agreed standard how to measure the utilization of water by aquaculture. FAO is currently working on defining a set of indicators of water use and benefits obtained from such water use for inland fishery and aquaculture.

For farming facilities including ponds, tanks, and raceways, the standing stock of water in use at farming facilities, turn-over rate, specification of inlets and outlets (e.g. directly from and to wild water body, irrigated waters etc), and physical, chemical and biological water quality of discharged waters (e.g. COD, BOD, concentration of N and P etc) should be monitored. In the case of farming facilities which rely on uncontrolled water exchange including enclosures, pens, cages, rafts, ropes, stakes and bags, it would be more appropriate to establish regular monitoring and assessment systems of ambient waters with a specific focus on gross effects on nutrients and their potential impacts on surrounding environments and ecosystems. However, collecting such information may not be practical for many reasons, including the inability to quantify information and the cost.

18. 5-3. Feeds and Fertilizers

Feed is also a primary requirement to aquaculture. Feed could be natural and in some extensive aquaculture practices there is no supplementary feeding is practiced. Aquaculture feeding practices range from non-fed extensive practices to nutritionally wholesome feeds used for intensive practices. They range from live feed (Artemia, rotifers, algae, etc.), fresh plant material (grass, macro algae, etc.), simple supplementary feeding material (kitchen waste, various agricultural by-products such as livestock waste, poultry waste, etc.), fresh fish material, farm made feeds, and commercial feeds. Both farm-made feeds and commercial feeds are formulated, using different combinations of ingredients (maize, corn, fishmeal, fish oil, soya bean, etc.), offering a range of compositions of nutrients to satisfy the nutritional requirements of the species under culture.

When a culture practice relies on natural food, either fully or partially, fertilizers may be used to enhance productivity in ponds. Globally a large quantity of fertilizer is used in aquaculture production.

Although the information on the origin and utilization of feeds are extremely important for aquaculture development and planning, particularly in the view of strategic planning of effective utilization and distribution of locally available ingredients, the current level of knowledge is not adequate to establish standard procedure of monitoring of this component. In the interim, further enhancement of the regional and national knowledge of actual practice through occasional surveys, censuses, and case studies would be strongly encouraged.

For statistical data collection and information requirements on feeds and fertilizers, for the purpose of monitoring the sector, considering the complexity of feeds and fertilizers used in aquaculture, the following categorization is considered to be important:

- Farm-made feeds (volume and value)
- Commercial feeds (volume and value)
- Aquatic animals from the wild (volume and value)
- Terrestrial plants
- Terrestrial animals
- Animal and vegetable wastes
- Animal and vegetable sub products and by-products
- Aquatic animals from culture (volume and value)
- Aquatic plants from the wild (volume and value)
- Aquatic plants from culture (volume and value)
- Fertilizers (volume and value)

19. 5-4. Antibacterials

As modern intensive aquaculture practices are generally prone to disease outbreaks many farmers opt to use antibacterials as treatments. Inappropriate use of antibacterials often lead to problems related to increased frequency of bacterial resistance as well as not producing any results. Injudicious use of antibacterials has also resulted in the occurrence of their residues in aquaculture products, resulting to commodity bans by importing countries and associated economic impacts, including market loss. Considering the increasing usage of antibacterials in aquaculture, the potential implication of environmental and human health and food safety of irresponsible usage, and the

increasing regulatory requirements of controlled antibacterial usage at national levels for international trade in aquatic animal and animal products, monitoring the use of antibacterials is considered important.

As a regulatory procedure, countries are expected to maintain a list of antibacterials banned in using in aquaculture. These are banned for using in aquaculture and should not be sold for aquaculture use and should not be used in aquaculture.

There are antibacterials which are allowed to use in aquaculture under certain conditions. They should be used for a specific purpose under instructions by a registered veterinarian or a person having authority to prescribe.

It is important to monitor the use of antibacterials in aquaculture and the unit for monitoring use should be kilograms or tonnes.

20. 5-5. Energy

The energy required for aquaculture operations is another important input and will need to be quantified so that the use of energy can be justified relative to other food producing and non-food producing sectors. The data elements for this exercise remain to be developed. However, studies should be initiated to study the energy requirements of various production systems with the hope of identifying more energy efficient methods of fish production. Environmental impacts of energy use will need to be considered.

6. MINIMUM REPORTING REQUIREMENTS FOR NATIONAL STATISTICS ON AQUACULTURE

The following are the minimum data and information essential to monitor aquaculture sector at country level. These should be considered as minimum reporting requirement to ensure consistency and comparability among different national aquaculture statistics and to enable regional and global analysis. Countries should enhance their monitoring capabilities by broadening scope and increasing level of details of data collected according to their own needs.

Category	Reference	Criteria	Unit
Aquaculture outputs	3-1-1	Food products	Quantity in live weight equivalent, and farm-gate value stratified by species, environment, farming system, and destination
	3-1-2	Non-food products	Quantity of products either in number or product weight, and farm-gate value, stratified by commodity, species, environment, farming system, and destination
	3-1-3	Seed products	Quantity in number and farm-gate value stratified by species, environment, farming system, and destination
	3-1-3	Broodstock	Quantity in number and biomass, farm-gate value stratified by species, environment, farming system, and destination
Aquaculture inputs	3-2	Seed	Quantity in number and value of seeds, stratified by species, numbers and origins.
Employment	4-1		Number of people engaged in the aquaculture sector, by gender and classification whether full-time, part-time, or occasional
Structure of framing operation	4-2		Number of production units registered and/or licensed, number of hatcheries and number of grow-out facilities, and if possible, number of households involved, stratified by type of facilities and water environments.

7. DATA COLLECTION AND PLANNING AND IMPLEMENTING SURVEYS

With the rapid growth of aquaculture and its interaction with global markets and economies, there is urgent need to establish data collection system for timely and reliable aquaculture information to support sector management and decision making at international, regional and national levels.

Due to similarity of nature of activities between aquaculture and agriculture, especially for livestock, and close link between them, it would be beneficial to establish aquaculture data collection and monitoring systems in a harmonization with those already established in agriculture. In this section, the general principles applied in agricultural surveys and censuses are presented with minor modifications to accommodate aquaculture needs.

The similarities between aquaculture and agriculture include i) involving the raising of animals in captivity or cultivation of plants; ii) activities locations being bound with specific geographical areas; iii) often sharing the same inputs, such as fertilizers, chemicals, machinery and labour; and iv) two activities often being integrated together, e.g. in rice-cum-fish culture. Utilizing the same set of general concepts, principles and core items to be collected, it would become possible to carry out joint surveys and census which would result in reducing overall cost, enhancing a link and compatibility between aquaculture and agriculture data and enabling more holistic analysis on food security and management and planning of agriculture sector as a whole, including aquaculture, fishery, and forestry.

Statistical needs for aquaculture management, planning and policy-making are very broad. The primary needs are statistics produced on a regular basis, such as production, annual inputs and outputs, and damages through extreme events and diseases, to monitor current conditions and to provide information to help governments and others in short-term decision-making. Such information is usually collected through administrative reporting systems and/or through sample surveys. Periodic survey should cover the minimum data requirement indicated in Section 8.

In addition to periodic surveys, an in-depth survey could also be conducted to further explore the topics, including more information on operational details, water turnover rates, waste water treatment, type and source of feeds as well as fertilizers, biocides and other chemicals, cost of production, and more information on the integration between agriculture and aquaculture, such as sharing inputs and the use of agricultural products as inputs to aquaculture.

On the other hand, censuses have three characteristics i) collecting data on the structure of individual farms including farm size, land use, land tenure, quantities of stocks in holdings; ii) total enumeration where small and subsistent producers would be also covered; iii) less frequency – usually taken every ten years or even less. Census would provide a benchmark for regularly collected data and provide a frame survey information to assist in developing proper sampling and compilation methodologies, specifically in order to produce statistics with less biases and fair representation of small scale producers' contribution.

21. 7-1. Global Strategy of Improving Agricultural and Rural Statistics

The Global Strategy of Improving Agricultural and Rural Statistics adopted by UNSC in 2010 provides a conceptual framework of developing integrated data and statistics collection covering whole aspects of agriculture including aquaculture and fisheries under National statistics system.

The following main problems are common to many developing countries:

- limited staff and capacity responsible for collection, compilation, analysis, and dissemination of agricultural statistics;
- lack of adequate technical tools, statistical methodology and survey framework to support data production efforts;
- insufficient funding allocated for agricultural statistics from development partners and national budgets;
- lack of institutional coordination which results in the lack of harmonized and integrated data sources;
- lack of capacity to analyse data in a policy perspective which results in a significant waste of resources as large amounts of raw data are not properly used;
- difficult for data users to access existing data with no metadata and indication of quality.

As the first step, the Strategy determined a set of core data that all countries should collect as shown in Table 9-1, where those relevant to aquaculture are marked in the last column.

Table 9-1 Minimum set of core data

Group of Variables	Key Variables	Core data items	Frequency	
Economic				
- Output	Production	Core crops (e.g wheat, rice, etc.) Core livestock (e.g. cattle, sheep, pigs, etc.), Core forestry products, Core fishery and aquaculture products	Annual	**
	Area harvested and planted	Core crops (e.g wheat, rice, etc.)	Annual	**
	Yield / Productivity	Core crops, core livestock, core forestry, core fishery	Annual	**
- Trade	Exports in quantity and value	Core crops, core livestock, core forestry, core fishery	Annual	**
	imports in quantity and value	Core crops, core livestock, core forestry, core fishery	Annual	**
- Stock of Resources	Land cover and use	Land area (including water area)		*
	Economically active population	Number of people in working age by sex		*
	Livestock	Number of live animals in stock		**
	Machinery	e.g. Number of Tractors, harvesters, seeders etc.		*
- Inputs	Water	Quantity of water withdrawn		*
	Fertilizers in quantity and value	Core Fertilizers by core crops		*
	Pesticides in quantity and value	Core Pesticides (e.g. fungicides herbicides, insecticides, disinfectants)		*

		by core crops		
	Seeds in quantity and value	by core crops		**
	Feed in quantity and value	by core crops		*
Agro processing	Volume of core crops/livestock /fishery used in processing food	By industry		**
	Value of output of processed food	By industry		**
	Other uses (e.g. biofuels)			*
Prices	Producer prices	Core crops, core livestock, core forestry, core fishery		**
	Consumer prices	Core crops, core livestock, core forestry, core fishery		*
Final expenditure	Government expenditure on agriculture and rural development	Public investments, Subsidies, etc.		**
	Private Investments	Investment in machinery, in research and development, in infrastructure		*
	Household consumption	Consumption of core crops/livestock /etc. in quantity and value		*
Rural Infrastructure (Capital stock)	Irrigation/roads/railways/ communications	Area equipped for Irrigation /roads in km / railways in km /communications		
International transfer	ODA for agriculture and rural development			
Social				
Demographics of urban and rural population	Sex			
	Age in completed years	By sex		
	Country of birth	By sex		
	Highest level of education completed	1 digit ISCED by sex		
	Labor status	Employed, unemployed, inactive by sex		
	Status in employment	Self Employment and employee by sex		
	Economic sector in employment	ISICs by sex		**
	Occupation in employment	International Standard Classification of Occupations by sex		
	Total income of the household			
	Household composition	By sex		
	Number of family/hired workers on the holding	By sex		
	Housing conditions	Type of building, building character, main material, etc.		
Environmental				
Land	Soil degradation	Variables will be based on above core items on land cover and use, water use, and other inputs to production.		
Water	Pollution due to agriculture			*
Air	Emissions due to agriculture			
Geographic location				
GIS coordinates	location of the statistical unit	Parcel, Province, Region, Country		*
Degree of urbanization	Urban/Rural area			

The next step is for each country to establish the set of core items they will include in their national system, add other items relevant to their economy, determine the frequency in which data will be provided, and the scope of the national coverage. Each country should consider how these should be included in the national system. The goal should be to provide annual data for those items that combined account for over three fourths of the country's value of production and coverage of land, productions that can vary significantly from year to year, impact the majority of the households, and have short term affects on land use and the environment. Then, for each item, it is needed to

determine the desired level of detail, and indicate the frequency that data will be provided.

One of the shortcomings of current statistical systems in both developed and developing countries is that data collections across sectors are often done independently using different sampling frames. The results generated from these surveys could not be integrated into a common data base for analyses and access by data users. The Global Strategy proposed in order to overcome this problem to establish master sampling frame by combining individual population with physical land mass, i.e. geo-location and the measure of statistical units. The measure of statistical units could be the farm or agricultural holding, the household, and land parcels. Geo reference would provide a link of the statistical units defined by surveys to the economic, environmental, and social dimensions.

The integration of agriculture into the national statistical system will begin with the development of a master sample frame which will be the foundation for all data collections based on sample surveys or censuses. The master sample frame is to built on the requirements to include both households and farms as statistical units and provides a linkage between the census framework and land use. An integrated survey framework will be established to provide data measured consistently across time and comparable across countries using an annual survey of selected core items and rotating panels covering economic and environmental issues. The concept of a master sample frame will be extended to include a data management system for all official statistics related to agriculture. Population and agricultural censuses, administrative information and registers are key sources of information to establish master sample frame together with satellite imagery. Through this master sample frame, it becomes possible to integrate data collected by individual survey frames. In the case of aquaculture NASO maps would provide a good basis in consolidating information for master sample frame.

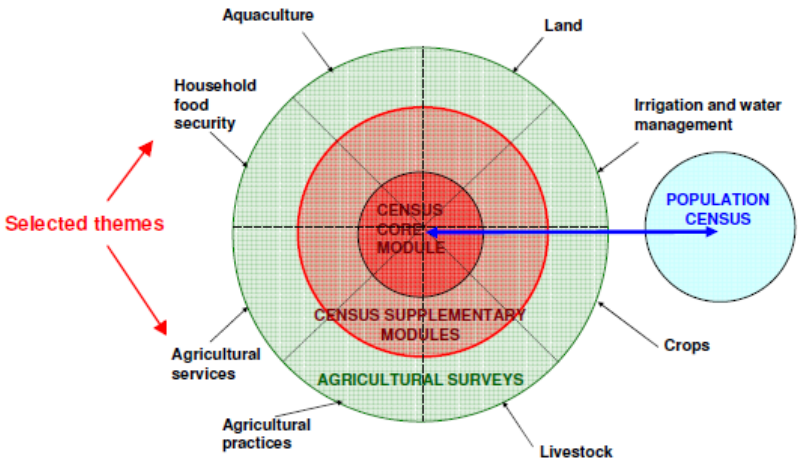
At the same time, the master sample frame enables the use of a rich assortment of sample designs including single vs. multiple stage sampling and an integrated survey framework that collect multiple aspects of information within a single sample without compromising statistical representativeness.

22. 7-2. Coordination with agriculture and population census

FAO has promoted the decennial World Programme for the Census of Agriculture (WCA) since 1945. Following the recommendation by the Fifteenth Session of the Asia and Pacific Commission on Agricultural Statistics (APCAS), the 2000 round of WCA incorporated "Supplement on aquaculture" in order to collect quantitative structural and other information on the aquaculture sector, specifically for agricultural holdings that also engage in aquaculture activities (Rana, 1997).

The 2010 round of WCA enhanced further the integration of a range of data collection needs especially monitoring and policy making in support of food security and provided options to conduct aquaculture census survey in conjunction with agriculture census. The 2010 WCA has two elements: (i) the agricultural census, which would works as frame survey to be a basis in designing sample survey; and (ii) the sample surveys, including those for aquaculture.

Figure 7-2 The framework of the 2010 WCA system of integrated agricultural censuses and surveys



WCA 2010, like the previous programmes, covers only agricultural production units, with aquaculture data limited to activities associated with agriculture. However, for the first time, WCA2010 provides the option to carry out an aquaculture census in conjunction with the census of agriculture, based on the modular approach.

The statistical unit for the aquaculture census is the aquaculture holding, defined in a similar way to an agricultural holding as follows:

> "An aquaculture holding is an economic unit of aquaculture production under single management, comprising all aquaculture facilities without regard to title, legal form, or size. Single management may be exercised by an individual or household, jointly by two or more individuals or households, by a clan or tribe, or by a juridical person such as a corporation, cooperative or government agency. The aquaculture holding's aquaculture facilities are located in one or more separate areas or in one or more territorial or administrative divisions, providing the facilities share the same production means, such as labour, buildings and machinery."

WCA 2010 recommends that aquaculture censuses use the same modular approach as for agricultural censuses, with the core module providing a limited set of key data on the structure of aquaculture holdings and a sample-based supplementary module providing more detailed structural data.

The agricultural census core items relate to basic structural data, such as household size and land use, and these should also be included in the aquaculture census. The use of a

common set of core items for the agricultural and aquaculture censuses may make it possible to conduct the core modules of the two censuses using the same questionnaire.

The sample-based supplementary module should include the same aquaculture items as under Theme 10 of the agricultural census. Below presents a broad outline of the methodology for the joint census of agriculture and aquaculture and discusses the implications for the item definitions of combining the two census operations.

Core module

The frame for the core modules of the census of agriculture and aquaculture can be created in various ways, including i) use of a frame of households from the population census to provide the basis for identifying aquaculture holdings; ii) including additional questions in the population census to identify households engaged in own-account aquaculture production; and iii) use of administrative sources, such as business registrations and aquaculture licensing.

An important element in integrating the agricultural and aquaculture censuses is the use of common items, concepts and definitions for the two censuses. The definition of Item 0007 (area of holding according to land use types) should be modified to include water area, defined as the surface area of the water body. Also, bodies of water should be separately identified under "Other land" in the land use classification. WCA2010 recommends including one additional aquaculture-related item in the core module of the aquaculture. The items for the core module relevant to aquaculture census are as follows:

Items recommended for the core module relevant to aquaculture

0001 Identification and location of holding
0002+ Legal status of holder
0003 Sex of holder
0004 Age of holder
0005 Household size
0006 Main purpose of production of the holding
0007 Area of holding according to land use types including water bodies
0008 Total area of holding
0009 Land tenure types on the holding
0010 Presence of irrigation on the holding
0011 Types of temporary crops on the holding
0012 Types of permanent crops on the holding and whether in compact plantations
0013 Number of animals on the holding for each livestock type
0014 Presence of aquaculture on the holding
0015+ Presence of forest and other wooded land on the
0016 Other economic production activities of the holding's enterprise
0017 *AREA OF AQUACULTURE BY TYPE OF SITE (for the holding)*
- Land-based
  - Arable land
  - Non-arable land
- Inland open water
- Coastal and sea water

Supplementary modules

WCA 2010 recommends the following items to be collected specifically for aquaculture

holdings. At this moment, the classifications and definitions used here are not exactly the same as those defined in the previous sections. Those discrepancies should be resolved in WCA 2020

Items for consideration for the supplementary aquaculture module
Theme 10 – Aquaculture
(Reference group: holdings with aquaculture in Item 0014)

For the holding

1001 Area of aquaculture according to type of site

– Land-based
- Arable land
- Non-arable land

– Inland open water
– Coastal and marine waters

Area of aquaculture refers to the area of land under water used for aquaculture. This means the surface area of the pond, paddy field, lagoon, estuary, irrigation canal, or the sea used for aquaculture. The area figure should include supporting structures such as pond banks and floating structures of cages. The area of land-based aquaculture-related facilities such as hatcheries, storage buildings, fish processing facilities, laboratories and offices, should not be included. The area should include land owned by the holding as well as bodies of water rented from others for use for aquaculture purposes. Such bodies of water could include parts of rivers, lakes, reservoirs, dams, canals, lagoons/estuaries, bays/coves, or the open sea. The aquaculture area should refer to the area of the aquaculture facility on the body of water – for example, the total area of the pen or cage network in the water. Some holdings may have very small area of aquaculture.

Land-based aquaculture is aquaculture practised in rice fields, ponds, tanks, raceways and other land areas on the holding. Countries may need to develop procedures to distinguish between land-based and open water aquaculture for some water bodies such as ponds. The split into arable and non-arable land is intended to determine what part of the land-based aquaculture is practised on land that is also used for crop production. Examples of non-arable land are saline-alkaline lands and wetlands.

Inland open water includes dams, reservoirs, lakes and rivers. Coastal and marine waters include lagoons, estuaries, shallow and open seas, bays and coves, including inter-tidal mudflats.

The reference period for data on area of aquaculture is the census reference year.

1002 Area of aquaculture according to type of production facility

– Rice-cum-fish culture
– Ponds
– Pens, cages and hapas
– Tanks and raceways
– Floating rafts, lines, ropes, bags and stakes

Rice-cum-fish culture is the use of land for the culture of both rice and aquatic organisms. One form of rice-cum-fish culture is the introduction of brood-stock or seed into flooded paddy fields, often modified for aquacultural purposes. Another form of rice-cum-fish culture is where rice and fish are raised on the same land in different seasons. Fishing associated with fish from the wild that enter paddy fields during flooding is not included.

Pond culture is the breeding or rearing of aquatic plants or animals in natural or artificial enclosures. Pond culture is usually carried out in stagnant waters with periodic water exchange or water flushing through inlets and outlets. Sometimes, large ponds are used in association with cages or hapas. Often there is some integration between crops, livestock and pond culture, as in fish-cum-vegetable culture or fish-cum-animal husbandry.

Pens, cages and hapas are net enclosures used for rearing aquatic animals or plants in lakes, rivers, reservoirs or the open sea. Pens are fixed by frameworks made of metal, plastic, bamboo or wood. Cages are held in place by floating structures. Hapas are simple net enclosures suspended by stakes in the four corners in open water bodies.

Tanks and raceways are fixed structures used for raising aquatic animals or plants. They are normally built above ground and can be made of bricks, concrete or plastic. Tanks are small round or rectangular structures, whereas raceways are long, narrow structures.

Floating rafts, lines, ropes, bags and stakes refer to the aquacultural practice based on these facilities, commonly used for the cultivation of shellfish and seaweed.

The reference period for data on area of aquaculture is the census reference year.

1003 Type of water

– Freshwater
– Brackish water
– Saltwater

This item refers to whether aquaculture on the holding was carried out during the reference year using water of the above types. There may be more than one type of water used on a holding. The type of water is usually closely related to the type of site in Item 1001.

Freshwater refers to reservoirs, rivers, lakes and canals, with consistently negligible salinity. Brackish water refers to waters with appreciable salinity but not to a constant high level. It is characterized by fluctuations in salinity due to regular influxes of freshwater and seawater, such as in estuaries, coves, bays and fjords. Enclosed water bodies in which salinity is greater than freshwater but less than seawater are also regarded as brackish. Saltwater (or marine water) refers to coastal and offshore waters where salinity is high and is not subject to significant daily or seasonal variation.

1004 Sources of water for aquaculture

– Rain-fed
– Groundwater
– Rivers/canals
– Lakes/reservoirs
– Dams
– Estuaries/lagoons
– Coves/bays/sea

This item refers to whether water for aquaculture production on the holding during the census reference year was obtained from the above sources. There may be more than one source of water used for aquaculture on a holding. The source of water is usually closely related to the type of site in Item 1001. Countries may wish to adapt these categories to suit local conditions.

1005 Type of aquacultural organism cultivated
– Freshwater fish
– Diadromous fish
– Marine fish
– Crustaceans
– Molluscs
– Other aquatic animals
– Aquatic plants

This item refers to which of the above types of aquatic organisms were cultivated on the holding during the census reference year. More than one type of organism may be cultivated on a holding. The classification refers to the type of aquatic animal or plant cultivated, not the type of aquaculture product generated. Thus, pearl production is shown under "Molluscs".

The main types of freshwater fish are carps and tilapias. Diadromous fish are fish that can live in both fresh and seawater, such as trout, salmon, eels and sturgeon. Marine fish include flounder, cod and tuna. Crustaceans are aquatic animals with hard shells, such as crabs, lobsters and shrimps. Molluscs are animals belonging to the phylum Mollusca, including abalones, oysters, mussels, scallops, clams and squids. Other aquatic animals include frogs, crocodiles, alligators, turtles, sea-squirts and sea urchins. Aquatic plants include seaweed and lotus.

i.

23. 7-3. Use of spatial information technology

The Spatial Information Technology is now well developed and provides powerful tool in aquaculture statistics and data collection with relatively low cost compared to field surveys through:

- Mapping of farming facilities,
- Measurement of number and size of farming systems,
- Monitoring of farming activities over time such as land use change, crop cycle monitoring e.g. stages in shrimp ponds, and abandoned or active ponds identification of coastal shrimp ponds, and

- Estimating and/or predicting production through analyses and modelling of GIS data.

The recent technology allows for mapping even individual aerators in pond by water circulation, indicating that pond is in use. The technology is especially effective for data collection in the area where the farming facilities are scattered and/or those hard to access.

Spatial information obtained through the technology provides full enumeration of the area of target and can be used as a master sample frame. Use of mobile GIS at the sample survey on ground survey, e.g. collecting socio-economic data, greatly enhances the utility, accuracy and cost efficiency of statistical data collection. Even that high spatial resolution imagery is still expensive and the methodology is based on spatial information technology can be practical and realistic and is in fact already operational in some countries (Reference).

Currently, major limitation is availability of resources with appropriate skill, i.e. those have the background on the technology, aquaculture and statisticians, to maximize the use of technology.

An attempt should be made to harness the available resources and bring about higher efficacies to the data gathering which include the agricultural developments. This will lead to a more holistic, integrated and a much needed statistics gathering that the Global Strategy to Improve Agriculture Statistics (Reference) is pursuing for.

All applications relevant to aquaculture using GIS, Remote Sensing and GPS are available at http://www.fao.org/fishery/gisfish/index.jsp

24. 7-4. Administrative data

Currently, some countries require registration and/or licensing of all aquaculture holdings with required provision of a broad range of data including ownership, location of farming facilities, type and size of farming systems in operation, water access, etc. This provides data to monitor an operational structure of the sector. Such administrative data can also be used to design sampling scheme on operational aspects including water use and other inputs/outputs information.

8. COMMON CONCEPTS AND CODES TO BE USED

Below is a text extracted from the current draft of overall handbook. Please comments on necessary amendment, revision and/or missing component, to fulfill the need for aquaculture monitoring. If necessary, it is also possible to set separate section especially for aquaculture.

25. 8-1. Country

All countries or areas have official and formal designations. These are often very long and not suitable for use in statistical databases and publications, particularly in tabulations and graphs. These designations are therefore often simplified. For example:

United Kingdom (or UK) refers to The United Kingdom of Great Britain and Northern Ireland.

Comoros refers to The Islamic Federal Republic of the Comoros.

The designations employed and the presentation of material in publications are used simply for practical reasons, and are usually accompanied by a note that they do not imply the expression of any opinion whatsoever on the part of the publishing agency concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Certain other terms used in statistical publications (for example, "developed" and "developing" economies) are based on standard UN definitions in this respect, and frequently bear relationship to the stage of economic development, and no relationship to the level of catch of the country concerned. The same applies to the now widely-used term "low-income food-deficit country" - LIFDC. The LIFDC classification is established by the World Bank as low-income in terms of Gross National Product (GNP) per caput, and by FAO as having a trade deficit for food in terms of calorie content.

In many tables, country or area entities are identified by alpha (or alphabetic) and/or numeric codes and this practice is frequently used in multilingual tables where the use of formal names, or even their common abbreviations is impossible because of space considerations. Such alpha and numeric codes have been developed by the UN Statistical Office, FAO, ILO, EU, ISO, etc. In the two annexes to this section are to be found lists of the more commonly used codes in fishery statistics.

The two annexes include:

a) FAO multilingual country or area code (maximum 12 characters) used for fishery statistical purposes.
b) ISO 3-alpha country or area code (International Organization for Standardization).
c) ISO 2-alpha country or area code (International Organization for Standardization). ISO codes relate to geographical entities (See reference below).
d) UN 3-digit country or area code (See reference below).
e) Country or area names in English (maximum 24 characters)
f) Country or area names in French (maximum 24 characters).
g) Country or area names in Spanish (maximum 24 characters).

Some countries or areas are further presented under territorial or other components used in fishery statistics, for example:

1- Continents
2- Economic class
3- Regions and sub-regions

Annex IVa: List of countries or area by multi-lingual name
Annex IVb: List of countries or area by ISO 2-alpha code

26. 8-2. Currencies and funds

The International Organization for Standardization (ISO), recognising that the need for a universally applicable code for the identification of currencies and funds had become increasingly urgent, has developed international standard codes for the representation of currencies and funds (ISO 4217). These codes are related to those developed by the ISO for geographical entities (ISO 3166).

- recommend to keep local currency records,
- maybe better to incorporate into main text

In the following two annexes are to be found lists of currencies and funds by:
Annex VIa: List of Currencies sorted by Country or Area Multi-lingual Name
Annex VIb: :List of Currencies sorted by currency code and country or area multi-lingual name.

27. 8-3. FAO Major Areas for statistical purpose

For statistical purposes, 27 major areas have been internationally established to date. These comprise:

- eight major inland areas covering the inland waters of the continents,
- nineteen major marine areas covering the waters of the Atlantic, Indian, Pacific and Southern Oceans, with their adjacent seas.

The major areas, inland and marine, are identified by their names and by two-digit codes.

INLAND		MARINE	
01	Africa - inland waters	18	Arctic Sea
02	North America - inland waters	21	Northwest Atlantic
03	South America - inland waters	27	Northeast Atlantic
04	Asia - inland waters	31	Western Central Atlantic
05	Europe - inland waters	34	Eastern Central Atlantic
06	Oceania - inland waters	37	Mediterranean and Black Sea
07	Former USSR area - inland waters *	41	Southwest Atlantic
		47	Southeast Atlantic
		48	Atlantic, Antarctic
		51	Western Indian Ocean
		57	Eastern Indian Ocean
		58	Indian Ocean, Antarctic and Southern

	61	Northwest Pacific
	67	Northeast Pacific
	71	Western Central Pacific
	77	Eastern Central Pacific
	81	Southwest Pacific
	87	Southeast Pacific
	88	Pacific, Antarctic

* The area 07 ("Former USSR area - Inland waters") referred to the area that was formerly the Union of Soviet Socialist Republics. Starting with the data for 1988, information for each new independent Republic is shown separately. The new independent Republics are: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan (statistics are assigned to the fishing area "Asia - Inland waters") and Belarus, Estonia, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine (statistics are assigned to the fishing area "Europe - Inland waters").

Annex VIIIa is the world chart showing the current FAO Major Fishing Areas

28. 8-4. Identifiers for aquatic animals and plants

As part of the ASFIS[2)] Reference Series FAO has produced a "List of Species for Fishery Statistical Purposes". The complete list is downloadable from the FAO website at: ASFIS List of Species for Fishery Statistics Purposes.

This list currently comprises 10,685 species items selected according to their interest or relation to fisheries and aquaculture. As far as has been possible from statistical reports, the species items have been included down to the level of the species. However, frequently statistical reports only identify to a taxonomic position higher than the species (e.g. genus, family, order). Such items have been included in the ASFIS list. No sub-species as included in the ASFIS list.

The species of importance to fisheries and aquaculture have been mainly selected consulting the FAO Species Identification and Data Programme (SIDP) publications such as species catalogues, identification sheets and field guides. FishBase (1998) has been the main source of information on newly included fish species. For fishes, the Eschmeyer's higher classification (1998) was adopted (as in FishBase). For crustaceans the classification by Bowman and Abele (1982) was adopted and for algae that of Luning, Yarish and Kirkman (1990).

For each item the following information is recorded: For the other groups more than one source has been consulted for the higher classification. A short list of the main references used in compiling the ASFIS list of species is provided in the Bibliographical references (see below).

[2)] Aquatic Sciences and Fisheries Information System

ISSCAAP code. This code is assigned according to the FAO "International Standard Statistical Classification for Aquatic Animals and Plants" (ISSCAAP) which divides commercial species into 9 divisions and 50 groups based on their taxonomic, ecological and economic characteristics.

Commented [XZ5]: ISCAAP code for species grouping

At the 19th Session of the Coordinating Working Party of Fishery Statistics - CWP (Nouméa, New Caledonia, 10-13 July 2001), FAO-FIES presented a proposal to revise the names and composition of ISSCAAP fish groups 33, 34 and 37 with the aim of providing the users with a new useful grouping of coastal fishes and better identification of demersal and pelagic species.

The proposal was endorsed by CWP and implemented in the FAO Yearbook of Fishery Statistics starting with volumes 90/1(2001) and 90/2 (2001).

In the new classification the species items of the former group 33 "Redfishes, basses, congers" were classified as either coastal or demersal fishes and accordingly assigned to the new groups 33 "Miscellaneous coastal fishes" and 34 "Miscellaneous demersal fishes". The pelagic species, formerly included in Group 34 "Jacks, mullets, sauries", were moved to group 37, which was renamed "Miscellaneous pelagic fishes".

Taxonomic code. The taxonomic code is used by FAO for a more detailed classification of the species items and for sorting them out within each ISSCAAP group. The code consists of 10 digits followed in some cases by an additional three digits.

3-alpha identifier is a unique code composed of 3 letters developed by the CWP for the exchange of data between international agencies and with national correspondents. The identifier is also widely used in statistical publications where the use of the full species descriptor would be prohibitive and it is increasingly used in fisheries administration documents (e.g. fishing log-books). The wider use of the indicators is encouraged provided it does not affect the integrity of the system.

The 3-alpha identifiers are managed by FAO to whom all applications for new identifiers should be addressed. An essential feature of the identifier is that once it has been assigned it may not be reassigned to another item even if the species item to which it originally referred is removed from the ASFIS list of species.

Scientific name.

Recent taxonomic revisions have been consulted to use the correct scientific names and taxonomic classification. This allowed the identification of some scientific names and taxonomic codes that were no longer correct. However, this list obviously has no authority on taxonomic matters and to resolve uncertain cases specialized sources should be consulted.

A pragmatic and conservative approach has been applied for uncertain cases for scientific and FAO names. Changes of scientific names and creation of new species proposed in the scientific literature by taxonomists will be included in the ASFIS list only when such changes have been recognized by the majority of taxonomists and are well consolidated among people dealing with fishery matters and, in particular, fishery statistics. For the most controversial cases, the ASFA database

has been consulted to verify if a newly proposed scientific name has become of current use.

FAO English name.

These are the names that have been assigned to the species items by FAO as being considered to be appropriate to those species items. They are unique to that item. Member agencies of the CWP have agreed to use these standard species names in statistical publications and questionnaires.

These names may not correspond with nationally or regionally-used common names.

Where the species item refers to a single species the name is in the singular.

Where two or more species are present, the name is in the plural form.

It has been possible to assign representative English names to only 78% of the species items in the ASFIS list.

FAO French names.

The above remarks concerning the FAO English names applies to the FAO French names though only 40% of the items have been allocated appropriate names.

***FAO Spanish name*s**

The above remarks concerning the FAO English names applies to the FAO Spanish names though only 36% of the species items have been allocated appropriate names.

Family

The taxonomic family to which the species item is assigned.

Order

The taxonomic order to which the species item is assigned.

29. 8-5. Fishery Commodities Classification

Fish, as a highly perishable commodity, often undergoes treatments which prolong its shelf life and quality as food. Fish is also a very widely traded commodity. When considering statistical aspects related to fish and fish products in the fishery industry as a whole, one is faced with a wide variety of raw fishery materials, semi-processed and fully-processed commodities, crossing all the various fishery phases. The physical magnitude and value of the intake and output of the different kinds of fishery commodities can be measured in specified periods of time - days, weeks, seasons, years, etc. Statistics covering any of the above phases must be dovetailed, linked or integrated and the first indispensable step is an adequate fishery commodity classification. The classification can be used as statistical standard for more than one statistical system, e.g. the trade system, industrial censuses, censuses of commercial and service establishments, wholesale and retail price systems, etc.

The FAO International Standard Statistical Classification of Fishery Commodities (ISSCFC) has been developed for the collation of national data in its fishery commodities production and trade databases. The ISSCFC is an expansion of the United Nations Standard International Trade Classification, Revision 3 (SITC Rev.3) developed by the

United Nations' Statistical Office on the basis of earlier international work on the subject. It is linked with the Harmonized Commodity Description and Coding System (abbreviated to HS) of the World Customs Organization. The ISSCFC covers products derived from fish, crustaceans, molluscs and other aquatic animals, plants and residues caught for commercial, industrial or subsistence uses, by all types of fishing units operating in all aquatic environments, in inshore, offshore or high seas fishing. Commodities produced from the raw materials supplied by all kinds of aquaculture are also included.

The currently used classification is presented in Annex XXIb

30. 8-6. Definition of land-use and water-use

Commented [XZ6]: Not very relevant unless we really want to collect data on land use.

Land use reflects both (i) the activities undertaken and (ii) the institutional arrangements put in place; for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions. In effect, an area that is "used" implies the existence of some human intervention or management. Land in use therefore includes areas, for example protected areas that are under the active management for the purpose of excluding human activity from that area.

The SEEA land use classification is shown in Table 8-1. At its highest level, it is classified into the primary types of surfaces: land, inland waters, coastal waters, and the Exclusive Economic Zone (EEZ).

Table 8-1 Land Use Classification

Commented [HF7]: Land use and water use classification?
The table includes inland, costal and EEZ classification

LAND	
	Agriculture
	Forestry
	Land used for aquaculture
	Use of built up and related areas
	Land used for maintenance and restoration of environmental functions n.e.c.
	Other uses of land n.e.c.
	Land not in use
INLAND WATERS	
	Inland waters used for aquaculture or holding facilities
	Inland waters used for maintenance and restoration of environmental functions n.e.c.
	Other uses of inland waters n.e.c.
	Inland waters not in use
COASTAL WATERS	
	Coastal waters used for aquaculture or holding facilities
	Coastal waters used for maintenance and restoration of environmental functions n.e.c.
	Other uses of coastal waters n.e.c.
	Coastal waters not in use
EXCLUSIVE ECONOMIC ZONE	
	EEZ areas used for aquaculture or holding facilities
	EEZ areas used for maintenance and restoration of environmental functions n.e.c.
	Other uses of EEZ areas n.e.c.
	EEZ areas not in use

Category	Definition
Country area	The total of areas under "Land area" and "Inland water," excluding offshore territorial waters.
Land area	The total of areas under "Agricultural area," "Forest or other wooded land," "Land with aquaculture facilities" and "Other land."
Land with	Land used for aquaculture facilities including supporting facilities.

aquaculture facilities	Aquaculture refers to the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implying some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Aquaculture facilities include ponds and tanks (artificial units of varying sizes constructed above or below ground level capable of holding and interchanging waters), raceways and silos (artificial units constructed above or below ground level capable of high rate of water interchange in excess of 20 changes per day) and hatcheries (housing facilities for breeding, nursing and rearing seed of fish, invertebrates or aquatic plants to fry, fingerlings or juvenile stages).
Other land	Land not classified as "Agricultural land", "Forest area and other wooded land," and "Land with aquaculture facilities", including land occupied by buildings, parks and ornamental gardens, built-up areas, roads or lanes, open spaces needed for storing equipment and products, barren land, wasteland, land under permanent ice, and any other land not reported under previous classes.
Inland water areas	Area occupied by lakes, reservoirs, rivers, brooks, streams, ponds, inland canals, dams, and other land-locked (usually freshwater) waters (such as the Caspian Sea, Aral Sea, etc.)..
Marine water areas	Oceans and seas including adjacent saltwater areas including internal waters, within national exclusive economic zone. Internal waters is considered as those waters of the sea on the landward side of the baseline used by the national authorities of the coastal country to measure further seawards the width of the territorial sea and any adjacent marine waters, whether salt, brackish, or fresh in character, following the Article 8 of the Informal Composite Negotiating Text/Revision 2 (A/CONF.62/WP.10/Rev.2, 11 April 1980) of the United Nations Third Conference on the Law of the Sea.
Areas with aquaculture or holding facilities	Water surface areas above, on or below which are used for aquaculture facilities including supporting facilities. Surrounding areas that is required to keep for exclusive use of aquaculture by regulations and/or other requirement should be also included. Aquaculture refers to the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Aquaculture facilities include enclosures and pens (water areas confined by net, mesh and other barriers allowing uncontrolled water interchange), cages (open or covered enclosed structure constructed with net, mesh or any porous materials allowing natural water interchange), barrages (semi-permanent or seasonal enclosures formed by impervious man-made barriers and appropriate natural features), and rafts, ropes, stakes (raft, long lines or stakes used to culture shellfish and seaweeds).
Areas used for maintenance and restoration of environmental functions n.e.c.	Areas with enhancement including stocking, fertilization, engineering, predator control, habitat modifications, and/or access limits, including Protected Area.

Commented [HF8]: **Land used for aquaculture? (In order to keep consistency with the Table 3.1. Classification)**

Information on land use and water use in relation to aquaculture sector can be collected through administrative information including registers of aquaculture holdings, the agriculture census and aquaculture census, satellite imageries, and combination of those.

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ANNEX: LIST OF ABBREVIATION:

APCAS Asia and Pacific Commission on Agricultural Statistics
CWP Coordinating Working Party on Fisheries Statistics
EEZ Exclusive Economic Zone
Eurostat Statistical Office of the European Union,
FAO
ICES International Council for the Exploration of the Sea
ISIC International Standard Industrial Classification of All Economic Activities
SEAFDEC Southeast Asian Fisheries Development Commission
UN United Nations
UNSC United Nations Statistical Commission
WCA World Programme for the Census of Agriculture