






Proceedings of the
Global Conference on Aquaculture 2010

Farming the Waters for People and Food

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Food and Agriculture Organization of the United Nations
Rome, Italy 2012

Network of Aquaculture Centres in Asia-Pacific
Bangkok, Thailand 2012

From the Editors

We, the editors of *Farming the Waters for People and Food*, the Proceedings of the Global Conference on Aquaculture 2010, are delighted to acknowledge the completion of such a massive undertaking involved in compiling this volume. We thank the authors for their patience, continued support and assistance towards making this volume a success. We are grateful to the following FAO staff who assisted us in revising the manuscripts: Jose Aguillar-Manjarrez, Junning Cai, Alessandro Lovatelli, Melba Reantaso, Doris Soto and Koji Yamamoto. We sincerely thank Jose Luis Castilla Civit for his untiring efforts in layout design and page formatting.

Our challenge is to present to you an appealing, peer-reviewed, comprehensive scientific and technical document. We hope you will find that we have achieved this goal.

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Sustaining aquaculture by developing human capacity and enhancing opportunities for women

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Abstract

People are at the heart of sustaining aquaculture. Development of human capacity and gender, therefore, is an important human dimension. Human capacity development (HCD) was a major thrust of the 2000 Bangkok Declaration and Strategy, but gender was not addressed. The Food and Agriculture Organization of the United Nation's (FAO) Strategic Framework for Human Capacity Development (HCD) emphasized building human capacity in a coherent fashion at four levels – in individuals, organizations, sectors/networks and in the overall enabling environment. Although strategic HCD in aquaculture has not received attention, substantial HCD has occurred in aquaculture education and training. Aquaculture departments in universities, aquaculture research institutes, networks and professional societies all include training as central activities.

Women are active participants in aquaculture supply chains, but a dearth of gender-disaggregated information hampers accurate understanding of their contribution. Research results and FAO National Aquaculture Sector Overview (NASO) fact sheets show that female participation rates vary by type and scale of enterprise and country. Women are frequently active in hatcheries and dominate fish processing plant labourers. Women's work in small-scale aquaculture frequently is unrecognized, under or unpaid. Most aquaculture development projects are not gender sensitive, and aquaculture success stories often do not report gender dimensions; projects can fail if their designs do not include gender.

Lacking gender-disaggregated data on participation rates and trends in education, we conducted a preliminary survey of aquaculture tertiary institutes in Africa, Asia, Europe and North America. The percentage of female graduates in aquaculture increased considerably over the last four decades, from zero or low numbers in the 1970s to recent rates of around 30–60 percent; rates vary both by country and within countries. No data are available to track whether female graduates are entering successful careers in aquaculture.
To accelerate HCD to meet the needs of aquaculture growth, commodity and theme priorities for HCD must be established. Educational institutions should cooperate and harmonize work programmes and overcome language barriers. Aquaculture education needs the best students and should help prepare them for rewarding careers. More social science content is needed in aquaculture curricula to groom graduates for management and leadership roles. The gender balance in aquaculture faculty could be improved by recruiting and retaining more women.

Gender should be put firmly on the policy agenda and built into normative instruments, old and new, complemented by the collection of gender-disaggregated data for aquaculture supply chains. Women should be empowered through gender equity in access to financial, natural, training and market resources.

Women in aquaculture should not be stereotyped as "small-scale" and poor. Women are often hampered by systemic barriers such as lack of legal rights. Women should be encouraged to build their management, leadership and entrepreneural skills. In circumstances where rural men have migrated for work, small-scale aquaculture has proven a suitable livelihood option to reduce the pressure on women. Because postharvest processing and fish trade are feminized occupations, gender equity deserves special attention in fair trade and fish certification schemes. HCD and gender are receiving more attention in rehabilitation efforts to assist survivors from disease and natural disasters.

KEY WORDS: *Aquaculture, Gender, Human capacity development.*

Introduction

People are at the heart of sustaining aquaculture. Human capacity and gender, each in its own right and in combination, are important human dimensions. For human capacity development (HCD), gender is an issue; women and men both need education and training on aquaculture to provide them with the knowledge to contribute to greater national and household food supply, security and income. A key message from the Food and Agriculture Organization of the United Nations' report *The State of Food and Agriculture 2010–11. Women in Agriculture – Closing the Gender Gap for Development* (FAO, 2011) was that women's relative lack of access to education and extension services contributed to the "gender gap" in agriculture (including aquaculture) productivity.

HCD is a cross-cutting issue. In the 2000 Bangkok Declaration and Strategy (NACA/FAO 2000), Key Element 3.1 *Investing in people through education and training* recommended five action points to build the knowledge, skills and attitude of people involved in the sector. Capacity building, both institutional and human, was also highlighted in other key elements of the Bangkok Declaration (e.g. 3.3. *Improving information flow and communication*, 3.8 *Strengthening institutional support* and 3.11 *Managing aquatic animal health*). In this paper, we review progress in implementing the Bangkok Strategy and recommend a more comprehensive approach to give HCD in aquaculture new impetus. The FAO's Strategic Framework on Human Capacity Development in Fisheries (FAO, 2005) was used for its definition of HCD and as a key entry point.

The 2000 Bangkok Declaration did not include gender elements, and thus we proposed new gender strategies to the 2010 Global Conference on Aquaculture (GCA). We addressed gender throughout fish supply chains. We also addressed the goal of creating a productive and fair sector through gender-equitable practices and policies, using global terms as defined by FAO and other United Nations agencies.

Definitions for some key HCD and gender terms are presented in Box 1.

BOX 1. Some Key HCD and gender terms.

Human capacity development – the process by which individuals, groups, organizations, institutions, and societies develop their abilities, both individually and collectively, to set and achieve objectives, perform functions, solve problems and to develop the means and conditions required to enable this process (FAO, 2005).

Gender – the qualitative and interdependent character of women's and men's position in society (FAO Aquaculture glossary, www.fao.org/fi/glossary/aquaculture/default.asp). Gender roles vary across time, place and region according to changing values, practices and technologies. Gender roles and responsibilities are largely socially constructed and are the basis for the structure and organization of women's and men's differential relationships with their environments, the economy, their resource utilization patterns and strategies (Williams, Hochet-Kinbongui and Nauen, 2005).

Gender relations – the relations of power and dominance that structure the life chances of women and men (www.fao.org/fi/glossary/aquaculture/default.asp).

Gender equality – equality between men and women. Gender equality entails the concept that all human beings, both men and women, are free to develop their personal abilities and make choices without the limitations set by stereotypes, rigid gender roles and prejudices. Gender equality means that the different behaviour, aspirations and needs of women and men are considered, valued and favoured equally. It does not mean that women and men have to become the same, but that their rights, responsibilities and opportunities will not depend on whether they are born male or female. Gender equity means fairness of treatment for women and men, according to their respective needs. This may include equal treatment or treatment that is different but which is considered equivalent in terms of rights, benefits, obligations and opportunities (ILO, 2000).

Knowledge, practice and trends in the 2000s

Human capacity development

In the early years of the last decade, fisheries and aquaculture HCD was addressed by the Asia-Pacific Expert Consultation on Aquaculture Education (De Silva, Sim and Phillips, 2000) and the 2002 meeting of the FAO Advisory Committee on Fisheries Research (ACFR) that identified "Building human capacity" as a "mega priority cross-cutting issue" (FAO, 2003). The latter recommended that the FAO Fisheries Department (now the Fisheries and Aquaculture Department) should address capacity building with a more strategic approach to complement its valuable ongoing work. FAO subsequently commissioned work that led the ACFR, in 2004, to approve the Strategic Framework on Human Capacity Development (FAO, 2004, 2005). However, although many individual HCD activities were conducted, no concerted global programme or strategy was eventuated. HCD was not on the agenda of the FAO Committee on Fisheries and Aquaculture (COFI). Complacency by aquaculture policy-makers may have been partly because aquaculture production continued to expand despite the lack of attention to HCD strategies.

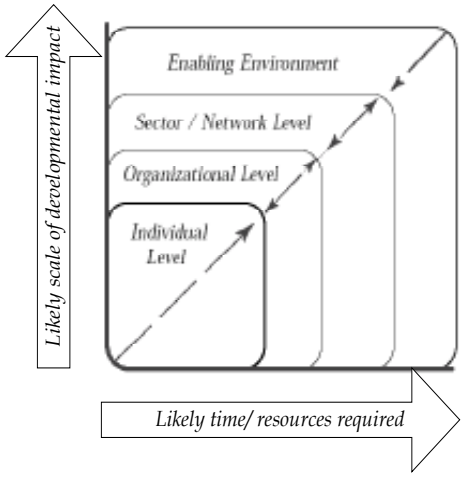
The FAO strategic framework still remains relevant. One of its key features was to emphasize that human capacity needs to be built at four levels (see Figure 1),

namely in individuals, organizations/institutions, sectors and networks, and the overall enabling environment. For aquaculture, the levels of the scheme can be interpreted as follows:

- The *individual* could be a student, trainee, farmer, worker or official whose capacity is being specifically developed through training, education or some less formal process.
- Depending on who is the individual, the *organization* (or institution) could be the household, farm, factory, employing firm, government agency, university or research institute within which the individual does or will undertake aquaculture-related activities.
- The *sector/network* could be the commodity production system or specialist thematic field (e.g. fish disease diagnostics) within which the individual and her/his organization operates.
- The *enabling environment* could be the society, policy, laws, markets, environment and their combinations that create the operational support and regulatory systems within which the three above levels operate.

For an HCD strategy to succeed, action must be aligned across the levels. This bottom-to-top coherence from individuals to purpose and environment was illustrated in CARE Bangladesh's Agriculture and Natural Resources Programme when the organization realized that it could not achieve all the benefits it wished for women unless the CARE Bangladesh organization had appropriate internal HCD, staffing and attitudes (Debashish *et al*., 2001). Gender equity had to be established first at the level of individuals, e.g. by employing female staff, and inside the organization, by the way staff were treated and behaved.

FIGURE 1
The four levels of capacity development: capacity development conceptual framework



Source: FAO (2005, Appendix 1), adapted from Bolger (2000).

The FAO strategic framework also recommended integrating efforts for three knowledge and skill areas that, applied to aquaculture, would be: (i) aquaculture science and research, (ii) aquaculture sector management, and (iii) societal skills and knowledge focused on aquaculture-specific issues. All are still highly relevant.

Although global attention to HCD was lacking, some regions and most countries did progress aquaculture capacity development, especially in tertiary education.

For example, European countries and the European Union (EU) supported the AQUA-TNET (EU Thematic Network for Aquaculture, Fisheries and Aquatic Resources Management); China, India and many other Asian countries upgraded their aquaculture education programmes, creating many new postgraduate programmes, more comprehensive undergraduate programmes and broadening the scope of tertiary aquaculture education to meet social as well as industry needs (ISAFE, 2009). Capacity building also remained a vital part of the work programmes of international specialist institutes such as the Network of Aquaculture Centres in Asia-Pacific (NACA), the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) and The WorldFish Center.

Recognizing the rapid development of aquaculture, many universities and other tertiary education institutes that had not previously taught aquaculture have been attracted into offering aquaculture courses, as well as bachelor's degree and post-graduate courses. Many higher education institutes have switched most of their courses from fisheries to aquaculture or at least shifted the balance of courses to favour aquaculture. Scholarships and sponsorships in aquaculture have aided this shift.

Gender

Although reliable estimates are not available, women probably are more involved in aquaculture than in the fisheries sector (Weeratunge and Snyder, 2009). Despite this, women/gender studies are more numerous for fisheries than for aquaculture. In an FAO bibliography covering gender and fisheries/aquaculture reports published between 1990 and 2001 (Kyprianou, 2001), fewer than 10 percent of the reports were on aquaculture. More recently, between 1998 and 2007, in the four triennial symposia on women/gender in fisheries conducted by the Asian Fisheries Society (AFS), fewer than 25 percent of the papers were chiefly focused on aquaculture, more than half focused mainly on fisheries and the remainder were equally focused on aquaculture and fisheries.[1] Women in fisheries publications such as those of the Secretariat for the Pacific Community Women in Fisheries Information Bulletin (http://www.spc.int/coastfish/en/publications/bulletins/women-in-fisheries.html and Yemaya published by the International Collective in Support of Fishworkers (ICSF) (http://wif.icsf.net/icsf2006/jspFiles/wif/index.jsp) mainly focus on fisheries. The lesser attention to gender in aquaculture versus fisheries may be due to the more recent history of aquaculture and academic interest in the complex sociology and anthropology of fishing communities and practices.

Over the last ten years, gender issues in aquaculture received little global attention. The period started promisingly with several key studies, such as

[1] Based on analysis of the published original papers in Williams *et al*. (2001, 2002), Choo, Hall and Williams (2006) and, as only selected papers were published, from the programme of the 2007 symposium (http://groups.google.com/group/GAF2).

those in the Asia Pacific Economic Cooperation (APEC) project led by the Asian Institute of Technology (AIT) and University of Stirling (Brugere *et al.*, 1999; AIT, 2000; Kelkar, 2001; Kusakabe and Kelkar 2001; Kusakabe, 2003). Subsequently, research became more dispersed and much was carried out in separate projects.

FAO has not addressed gender and aquaculture in a comprehensive way since 1987 (Nash, Engle and Crosetti, 1987), although many local and regional activities have been undertaken (e.g. Nandeesha, 2007) and FAO National Aquaculture Sector Overview (NASO) fact sheets (www.fao.org/fishery/naso/search/en) (Table 1) show that women and children, as well as men make important contributions. In addition, towards the end of the last decade, the lessons learned from aquaculture (and fisheries) studies were codified under the theme "Gender in Fisheries and Aquaculture" in the *Gender in Agriculture Sourcebook* (World Bank, FAO and IFAD, 2008) and in FAO (2007). Under social capital, women's involvement in major decision-making roles in small-scale aquaculture has been identified as one of 14 indicators for assessing the contribution of small-scale aquaculture to sustainable rural development (Bondad-Reantaso *et al*., 2009).

The FAO report, *State of World Aquaculture 2006* (FAO, 2006) collated available information on employment in aquaculture, where possible disaggregated by gender. Unfortunately, data for Asian countries, the dominant aquaculture region, were largely lacking. In Africa, FAO reported that women own or manage 16 percent of farms and play only a minor role in fish production, although they make large but unquantifiable contributions in fish processing and marketing. Women's roles in managing aquaculture production differ greatly depending on commodity and country. For example, in Madagascar, Mozambique and Tanzania, women own and/or manage more than 80 percent of the seaweed farms. In South America, women's participation in aquaculture, except in processing plants and subsistence aquaculture, is estimated at only 5 percent of workers. Across most Eastern European countries, women's fish farming participation is as low as 5–10 percent, but rises to 20 percent in Ukraine, 50 percent in Estonia and up to 70 percent for some fish breeding farms in Russia. In 2004, in Canada, the female workforce was about 28 percent.

Despite its limitations, available information indicates that aquaculture labour, roles and responsibilities are not gender-determined but that a considerable degree of gender differentiation occurs in practice, conditioned by many social, economic and personal factors. The roles also depend on the type of aquaculture. For example, in some countries such as Mexico, in intensive or semi intensive commercial aquaculture, professional female and male staff perform the same kind of activities, whereas, in sub-Saharan Africa, rural people with low educational levels tend to assign traditional roles to women. Thus, gender roles and contributions need to be understood within their context and characterized

with respect to economic, social and individual assets and people's needs. Characterization may present special methodological challenges, especially if the contribution is made by unpaid and/or unrecognized labour. A further challenge comes from the rapid development of aquaculture that is accompanied by rapid changes in supply chains and hence in labour, roles and contributions.

Educational level is a particularly potent determinant of who does what and therefore, the contribution made. Compared to illiterate women, those with schooling tend to be more active in small-scale operations such as wild fry collection, hatchery and fish nursery phases, feeding and other husbandry tasks, postharvest processing and marketing and can even dominate these stages of the supply chains. For example, women high school graduates dominate factory floor jobs in export prawn processing plants in Sri Lanka because they can comprehend the quality control procedures (De Silva and Yamao, 2006). However, although education can give women access to a greater range of aquaculture activities, their control over resources and decision making is not only linked to their knowledge and know-how but is also affected by household, community, social and economic settings. Men tend to be responsible for pond and cage construction and maintenance, stocking and harvesting (e.g. see Kibria and Mowla (2006) for an example of labour division).

Despite their participation, many women receive low economic returns from aquaculture and experience poor working and social conditions. Yet, women and poverty should not be conflated in aquaculture development, or indeed in development more generally (Jackson, 1996). Some women do or could populate the more entrepreneurial segments of the supply chains, particularly in value-addition jobs and marketing in East and Southeast Asia. Much of the discrimination that may constrain women's aquaculture progress is driven by other factors such as legal rights to assets and cultural mores and is not due to poverty.

Despite many development organizations having gender policies and strategic plans to mainstream gender, most aquaculture projects and programmes are not gender sensitive. For example, a review of five projects in one fisheries development programme in Bangladesh showed that women's roles were minor or largely overlooked, including in the four aquaculture projects (Halim and Ahmed, 2006). Where the Bangladeshi women worked in the aquaculture enterprises, their work contributed to the household finances but did not necessarily give them more decision-making power. Gender is overlooked in developing many pond/fish farming activities and is rarely addressed in education and training.

Development projects also rarely address whether the benefits of aquaculture are really obtained by women and children. Although women may generate income through aquaculture, this may be at the expense of increasing their overall workloads.

TABLE 1
Examples of women's involvement in the aquaculture workforce from the FAO National Aquaculture Sector Overview (NASO) Fact Sheets

ASIA	
Bangladesh	Motivated by women's non-governmental organizations (NGOs) and other entrepreneurs, women have been encouraged to participate in aquaculture activities.
China	Women's participation is higher in small-scale and family-run aquaculture systems than in other enterprises.
Japan	In 2003, there were 23 068 enterprises engaged in marine aquaculture, employing 69 645 workers in the high season, of whom 51 percent were women. About 4 495 enterprises were engaged in freshwater aquaculture, employing 11 558 people, of whom 31 percent were women. However, the number of enterprises and workers has been declining in recent years.
Malaysia	Women, who account for about 10 percent of the total aquaculture workforce, are mostly involved in freshwater aquaculture, particularly cement tank culture and hatchery operations for marine fish, shrimp and freshwater fish.
Philippines	Women are an integral part of production and postharvest activities.
Sri Lanka	Five percent of the workforce in shrimp aquaculture are women, whereas 30 percent engaged in the production and breeding of ornamental fish are women.
Thailand	Women participate particularly in activities related to feed preparation, feeding, harvesting, processing, accounting and marketing.
SOUTH AMERICA AND THE CARIBBEAN	
Belize	Most of the workers involved in processing are women from rural communities with high levels of unemployment and poverty.
Cuba	About 27 percent of the aquaculture workforce are female (19 percent are technicians with intermediate and higher education compared to 11 percent of all workers).
Guatemala	Women work mainly in shrimp processing plants.
Guyana	Women are mostly involved in brackishwater aquaculture.
Jamaica	Women own and operate 8–11 percent of the fish farms; in processing plants, women dominate the workforce.
Panama	Women make up 80 percent of the workforce in processing plants but in the production sector, only 7 percent are women.
EUROPE	
Estonia	The gender ratio in the aquaculture workforce is 1:1.
WEST ASIA AND NORTH AFRICA	
Israel	The aquaculture workforce has high skill levels because of the advanced technical nature of Israeli aquaculture. Most, if not all workers, have at least a high school diploma, and a high percentage have a degree (B.Sc. or M.Sc.). Women make up about 95 percent of the workforce.

Source: www.fao.org/fishery/naso/search/en (accessed 25 June 2011).

In aquaculture development, ignoring gender can harm social relationships and undermine the potential for aquaculture progress. In Tabasco, Mexico, men and women were found to have different motivations for aquaculture, and ignoring these led to the introduction of inappropriate technologies and extension methods and the ultimate failure of some projects (Galmiche-Tejeda and Townsend, 2006). Given the range of skills and knowledge needed for such work, most successful examples of incorporating gender, all from small-scale aquaculture, have involved partnerships among different types of complementary

agencies. These linkages aid the effective exchange of information, pooling of skills and lessons on gender issues.

Starting in 1995, the Asian Fisheries Society (AFS) began highlighting the role of women in fisheries, stimulated by initial linkages with the PADEK-Cambodia fish culture programme (Nandeesha and Tech, 2002). Over the last ten years, further progress in raising awareness has been made (e.g. the 2001, 2004 and 2007 AFS symposia on women/gender and fisheries), plus other efforts (Williams, Hochet-Kinbongui and Nauen, 2005). The AFS, FAO and others continue to highlight gender issues through triennial women/gender symposia (e.g., through the 2011 3rd Global Symposium on Gender in Aquaculture and Fisheries and Website http://genderaquafish.org/). In recent years, the World Aquaculture Society (WAS) began holding sessions on women in aquaculture at their annual conferences. The 2005 World Food Prize was awarded to Dr M.V. Gupta for disseminating low-input freshwater fish farming to, among others, poor women and landless farmers.

Despite the growing knowledge and rising awareness on gender, little progress has been achieved in collecting gender-disaggregated statistics and in incorporating gender in aquaculture and fisheries normative instruments. The low participation of women in the more lucrative aquaculture activities, such as carp, salmon and shrimp farming, is often taken by development planners as a sign that there are no gender issues to be addressed, whereas the dearth of women may instead be interpreted as an opportunity for more women to become involved.

The slow progress on gender information is a major constraint to progress on gender issues. When addressing gender issues, gender-disaggregated data and information are essential (Razavi and Miller, 1995) to understand their importance in productive enterprises such as aquaculture or to promote equity and women's rights. Whereas manuals and expert guidance have now been developed for collecting gender-disaggregated information in other rural sectors such as water, household energy and to some extent agriculture, the aquaculture and fisheries sectors have not developed guides to collecting gender-disaggregated information and deriving indicators (Williams, 2010). In science and technology (S&T), some gender-disaggregated statistics relevant to aquaculture are collected by the Agricultural Science and Technology Indicators Programme (http://www.asti.cgiar.org/gender-capacity). Beintema and Marcantonio (2010) found that gender-disaggregated data on S&T focus more generally on S&T rather than on agriculture, as a whole, or aquaculture specifically. Also, data are not always comparable across countries because different methodologies and coverage are used.

In the absence of sufficient data, progress towards gender equity and equality in aquaculture is difficult to assess because data are not available. For example,

in a review of successful Asian fisheries aquaculture development (De Silva and Davy, 2009), only two of eight case studies substantively addressed gender issues. Often, studies, such as most of those on aquaculture in the AFS symposia on women/gender, focus mainly on projects with positive gender interventions, rather than studies on current realities.

HCD and gender

Gender-disaggregated participation rates and their trends are not readily available for aquaculture education and training. Hence, we conducted a preliminary survey of institutes to better understand the rates and trends.[2] Over the last 40 years, female participation moved from negligible to sizeable levels, approaching and occasionally exceeding male rates.

Tertiary education

Data were obtained from 18 institutions and programmes, nine from Asia, four from Europe, three from Africa and two from the United States of America. These data were from the larger and more long-term providers of aquaculture specialist education, but we recognized that major gaps exist (e.g. South America, China). The data sets were of varying length and detail, the earliest from 1970 (France) and 1972 (Bangladesh), and therefore, time series comparisons are difficult. Although the statistics refer to aquaculture and fisheries graduates in some universities, in more recent years, the graduates were predominately from aquaculture.

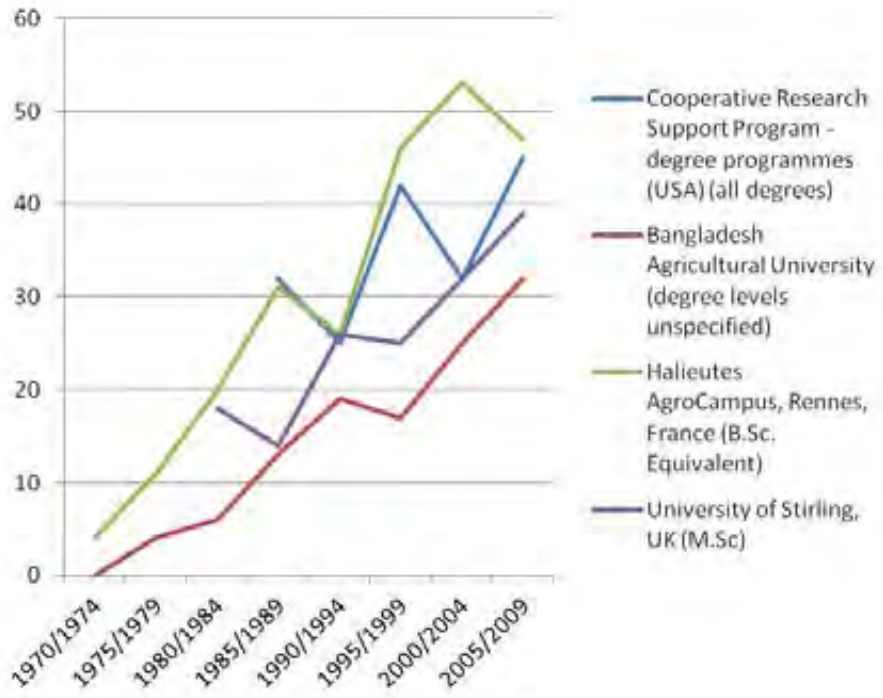
Regional and international degrees and higher education programmes have been important in the early and continuing development of aquaculture. Few countries offered specialist aquaculture degrees until the sector's recently achieved greater economic prominence.

The preliminary assessment of female graduate rates undertaken indicated that few women were enrolled in the 1970s, but rates rose in subsequent decades (Figure 2 and Table 2). Except in parts of India, most graduate rates (B.Sc., M.Sc. and Ph.D.) are over 30 percent and often closer to parity.

We also found little concordance between the current rates of female graduates and the 2009 national Global Gender Gap rankings (Hausmann, Tyson and Zahidi, 2009). With respect to female aquaculture graduate rates, relatively highly ranked countries such as the UK and the United States of America differed little from countries with much lower gender gap rankings (e.g. Bangladesh, Cambodia and India). Thus, national gender gap rankings do not explain all differences in female rates of aquaculture education, although they may relate to gender differences in later career progress (no data available).

[2] All those who kindly responded to the survey are mentioned in the Acknowledgements.

FIGURE 2
Selected time series of female graduates in aquaculture programmes



In summary, these data indicate that, in all countries (i) the percentage of female graduates in aquaculture increased considerably over the last four decades from zero or low numbers in the 1970s, and (ii) gender ratios of graduates vary by country and even within countries, particularly in heterogeneous countries such as India.

In the case of five institutes, some data were provided on gender ratios among faculty. These indicated that the number of males exceed those of females in four institutes (6 to 40 percent women) but not in one institution in France (Cnam/Intechmer (DESTA) – 66 percent female).

On graduation, women's and men's career prospects, including salary rates, may differ. Studies are needed to verify the anecdotal information on how gender affects the career paths of graduates. For example, in Asia, women often avoid work involving entering ponds and other physical work during education, preventing them from gaining the full range of practical skills and knowledge needed for career progression. Employers often do not want to put women in the field for safety reasons, also impeding their career paths. In Mexico, field work and gender issues play out in a different way. Working in the field is used by both women and men as a way to gain experience so that they can access better

TABLE 2
Female aquaculture graduate rates in regional, international and country educational institutes. Statistics are given for females as a percentage of total graduates. B.Sc. = bachelor of science and course equivalents in aquaculture; M.Sc. = master of science and course equivalents in aquaculture; Ph.D. = doctor of philosophy and course equivalents in aquaculture. Note that some statistics also include fisheries graduates due to the nature of courses. Where time series were available, the oldest and the most recent rates are given

Institute and programme	Period	Women's graduation rates (N=total number of graduates)
Regional and international institutes and programmes, countries		
Asian Institute of Technology (AIT), Aquaculture and Aquatic Resources Management Programme (AARM)	2003–2008	M.Sc. and Ph.D.: 42% (N=116) Differs by country of origin, e.g. 85% Thailand (N=27); 0% Cambodia (N=9), Indonesia (N=5)
Aquaculture and Aquafish Cooperative Research Support Program (United States of America)	1996–2009	B.Sc.: 44% (N=411) M.Sc.: 37% (N=374) Ph.D.: 34% (N=102)
Countries		
ASIA		
Bangladesh: Bangladesh Agriculture University, Faculty of Fisheries, Mymensingh	1972-2008	Graduates (Unspecified): 32% (2005–2008, N=233); 0% (1972–1974, N=70) (see Figure 2)
Cambodia, Faculty of Fisheries, Royal University of Agriculture	1990-2009	B.Sc.: 20% (2005–2009, N=96); 29% (1990–1994, N=137)
India, Karnataka, College of Fisheries, Mangalore	1980-2009	B.Sc.: 18% (2005–2008, N=156); 6% (1990–1994, N=142) M.Sc.: 19% (2005–2008, N=70); 1% (1980–1984, N=88) Ph.D.: 4% (2005–2008, N=26); 9% (1986–1989, N=11)
India, Kerala, College of Fisheries, Pananagad, Kochi	2004-2009	B.Sc.: 58% (N=223) M.Sc.: 67% (N=27)
India, Tripura, College of Fisheries, Central Agricultural University, Lembuchera	2005-2009	B.Sc.: 29% (N=78)
Thailand, Kasesart University, Faculty of Fisheries	1990-1998	Students: 39% (aquaculture students, N=unknown) (Suwangransi, 2001)
Viet Nam, Nha Trang University	2005-2009	M.Sc.: 40% (N=83)
EUROPE AND NORTH AMERICA		
Belgium, University of Liège	2000-2009	M.Sc.: Belgian graduates, 26% (N= 27); foreign graduates, 16% (N= 113)
France, Halieutes AgroCampus, Rennes	1970-2009	B.Sc.: 46% (2005–2009, N=129); 0% (1970–1974, N=48) (see Figure 2) (French and francophone countries, especially in Africa)
France, Cnam/Intechmer (DESTA)	1991-2010	M.Sc.: 25% (N=191)
United Kingdom, University of Stirling, Institute of Aquaculture	1980-2009	M.Sc. and Ph.D.: 39% (2005–2009, N=unknown); 18% (1980–1984) (see Figure 2)
United States of America, Auburn University, Department of Fisheries and Allied Aquacultures	2000-2010	M.Sc. and Ph.D.: ~40% (N=70–75 graduate students per year)
AFRICA		
Benin, Lycée Agricole Médji de Sékou	2008-2010	Graduates (unspecified): 18% (N=unknown)
Cameroon (no institute specified)	2007-2010	B.Sc.: 80% (N=5)

jobs. Field extension jobs are the main way of gaining field experience. However, field extension jobs are among the worst paid jobs, and this can be a source of corruption, especially when financial support is being given to fish farmers. Also, it means that the extension staff are always young and inexperienced, and thus many are of limited use in helping farmers.

Training and vocational institutions

Gender-disaggregated data on short training courses and vocational programmes are even more dispersed and difficult to access than data for higher education. These data would indicate how practical skills that are of direct relevance to aquaculture are being developed. Some studies have indicated that women's training generally lags behind that of men, partly from low targeting of women for aquaculture technology transfer (extension and adoption) (Nandeesha, 2001) and also from real or perceived lack of job opportunities. Women may be reluctant to attend training programmes due to their heavy responsibilities at home, but this and other constraints such as low literacy levels in some developing countries need to be better understood.

We obtained training and vocational data from one regional institution (the Southeast Asian Fisheries Development Center, Aquaculture Department, SEAFDEC/AQD), one international agency (The WorldFish Center) and several French secondary and postsecondary school vocational institutes.

Since 1990, in the Philippines, SEAFDEC/AQD has achieved about 30 percent female participation in its technical training programmes and 40 percent in its field outreach training programmes that take practical courses to villages. Of particular note, in certain training courses for fishers, such as mud crab culture, the majority of participants were females, whereas male participants were more numerous in training on grouper culture.

At The WorldFish Center's regional aquaculture research facility in Abbassa, Egypt, a marked shift towards greater female participation occurred between 2000–2004 (9 percent) and 2005–2009 (21 percent).

In the French national school system, at the upper and postsecondary school levels, students have a number of options for aquaculture vocational training. The most advanced of these, the BTS (Brevet de technicien supérieur) is for students aged 18–20 years.

Although the data from the French vocational training institutes are not comparable to those for tertiary education graduates, such as Halieutes AgroCampus, Rennes, they show much lower levels of female graduates. Typically, the courses have fewer than 10 percent female participants. Perhaps these levels are closer to those for skilled workers likely to be employed in the private sector than are the present higher levels of women tertiary graduates

(e.g. 46 percent for Halieutes AgroCampus, Rennes). To attract more women to the courses may require more marketing to women and prospective employers of the opportunities for them to work in aquaculture.

Governments are also using training to encourage more people into the aquaculture sector. For example, the state of South Australia, wishing to create local job opportunities and improve local aquaculture performance, offers short-term modular training programmes that are delivered at existing institutions such as selected high schools, vocational colleges, universities and research centers; a range of courses is offered (www.pir.sa.gov.au/aquaculture/products__and__services/training).

Despite statistics showing greater participation by women in aquaculture training, we do not know how many of the women trained actually get involved in aquaculture production. Research would be needed to see if a difference exists.

Other forms of HCD

We have focused on formal education and training, but other forms of (indirect) HCD such as self-help groups (e.g. in India) have proven effective in introducing aquaculture techniques and discussions (Kripa and Surendranathan, 2008). In large aquaculture companies, training is a business imperative, directed at helping employees meet the companies' needs for work safety, product quality, as well as meeting environmental standards. Local and often informal associations and more formalized institutional structures (e.g. producer or marketing cooperativess), when available, would serve as an important vehicle for transferring productivity-enhancing knowledge and techniques in the sector.

HCD, gender and disaster risk management

In the last decade, building the capacity of children, women and men suffering the consequences of natural disasters and diseases has gained greater attention. For example, in Africa, life opportunities for children orphaned due to HIV/AIDS and other vulnerable children, are being created by labour-saving food-producing strategies such as farming fast-growing tilapia (Gordon, 2005). Good examples include the Mangulukeni Fish Farming Project, the work of the Oonte Orphans and Vulnerable Children's Organization, Namibia (M.G. Kibria, personal communication, 2010), and projects in Africa of Aquaculture Without Frontiers (www.aquaculturewithoutfrontiers.org). After the 2004 Indian Ocean tsunami, in Aceh, Indonesia, aid agencies including the Australian Centre for International Agricultural Research (ACIAR) redeveloped the Ujung Batee Regional Brackishwater Aquaculture Development Center and strengthened research management capacity to support the re-establishment of the aquaculture sector (Sammut *et al*., 2008)

Progress towards meeting the expectations and commitments of the 2000 Bangkok Declaration and strategy for aquaculture development

HCD

The first Key Element of the Bangkok Declaration was *3.1 Investing in people through education and training.* HCD was addressed also in other Key Elements. The progress of HCD in each Key Element of the 2000 Bangkok Declaration is described below.

Key Element 3.1– Investing in people through education and training

Strong progress has been made for Key Element 3.1 in many countries and in some regions, especially Asia and Europe. In this Key Element, HCD was envisaged to be more cost-effective and responsive to needs and attention directed towards participatory curriculum development, cooperation between institutions, multidisciplinary and problem-solving approaches to learning, use of information and communication technology, balancing practical and theoretical approaches.

Despite little attention at the global level, at the country and regional levels, education and training for aquaculture increased nearly everywhere, driven mainly by national economic, food production and educational goals. Although cause and effect have not been studied in the last ten years, the greater national and regional focus on HCD has likely contributed to increased aquaculture production. Evidence from rigorous cost-benefit studies in the agricultural sector has shown that returns on investments in HCD are high and of similar levels to those from research and development investments (Gordon and Chadwick, 2007). In aquaculture, the same is likely to apply.

Of all forms of HCD, education merits special attention because it is the foundation for aquaculture know-how across the spectrum from educating aquaculturists, aquaculture trainers and teachers, researchers, regulators and policy-makers. Many educational institutes are also research institutes helping to create new technologies and solve industry problems. Education helps create the professional base for the sector. Although data are not available, indications are that more M.Sc. and Ph.D. programmes in aquaculture are now offered by more institutes. In countries where aquaculture tertiary studies historically were focused in specialized colleges of fisheries, such as China, India and the Philippines, aquaculture and related courses are now also offered in comprehensive and agricultural universities.

Many higher education programmes in aquaculture are making use of modern education and communication technology, and some of these are described in the section on Future Expectations, Major Issues and Opportunities.

To complement and strengthen the role of the educational institutes, intergovernmental and professional networking has strengthened and matured through institutions and associations such as the Network of Aquaculture Centres in Asia-Pacific (NACA), AFS, WAS, SEAFDEC, and through private-sector and commodity-specific events. In Europe, aquaculture tertiary education institutions are harmonizing and networking their courses and facilities.

In the past decade, training programmes, mainly with a focus on technologies, have also grown in number. Trends in training are difficult to track because the courses are usually short and delivery is dispersed. Often, training is delivered in an integrated manner with development, research and commercial projects. Short training courses often are targeted to impart practical skills in specific aquaculture techniques to potential farmers and entrepreneurs and may be sponsored by government agencies.

Further, developing quality human resources to support aquaculture developments, including innovations made by farmers, will contribute to sustainable development of the aquaculture sector. Farmer innovations are vital but need to be greatly augmented by the farmers' adoption of technologies derived from science and business insights made accessible to capable farmers. Research, technology development, adoption and HCD go hand in hand. This was recognized in the Bangkok Declaration in parts of Key Elements 3.2, 3.3, 3.8 and 3.11 and was addressed during the Global Conference on Aquaucltur e 2010 (see Expert Panel Review VI.4).

Key Element 3.2 – Investing in research and development, especially capacity of research institutions to be more responsive to development requirement

We have little basis for objectively judging how research institutes have responded to development requirements. However, in the section on Future Directions, we provide examples of how regional organizations such as NACA and SEAFDEC/AQD set priorities and work with partners. Strong national institutes such as Viet Nam's Research Institute for Aquaculture (RIA) 1, RIA 2 and RIA 3 have contributed greatly to supporting the development of their countries in becoming leading aquaculture producers. De Silva and Davy (2009) report many small-scale aquaculture successes.

Key Element 3.3 – Improving information flow and communication, especially strengthening national capacity to determine data requirements and data selection and management

In partnership with member countries, FAO's work is among the most important in addressing this Key Element. For example, FAO has continued to improve national and global aquaculture reporting systems and to build national capacity to meet the global information requirements. The regional specialist agencies and networks such as INFOFISH, NACA, SARNISSA (Sustainable Aquaculture

Research Networks for Sub-Saharan Africa), and SEAFDEC/AQD have all capitalized on modern information technology to disseminate their knowledge over the Internet as well as in hard copy and by direct contact. National agencies such as the aquaculture institutes of the Indian Council for Agricultural Research (ICAR) have also greatly increased their information outreach via their Websites. With the increasing use of Internet technologies, national institutes are expected to accelerate information flow.

Key Element 3.8 – Strengthening institutional support, especially institutional capacity to establish and implement policy and regulatory frameworks

We note that aquaculture developments still often run ahead of policies, environmental and product quality regulations and trade requirements (e.g. the use of antibiotics and the introduction of exotic species such as *Litopenaeus vannamei* in Asia). This suggests that greater attention is needed to better develop the capacity of government aquaculture officials and policy-makers to get ahead of trade and production crises. At present, regional aquaculture agencies, development agencies, non-governmental organizations (NGOs) and the industry are more likely to initiate best practice guidelines and advocate for policy change than national agencies, as occurred in the development of shrimp farming better management practices (BMPs). We therefore conclude that national agencies need to pay greater attention to developing the capacity of their staff to meet trade and regulatory challenges.

Key Element 3.11 – Managing aquatic animal health, especially capacity building at both institutional and farmer levels through education and extension

Aquatic animal health is a particularly challenging area for capacity development, as it requires highly specialized knowledge and skills. During the last decade, HCD included areas pertaining to biosecurity governance (e.g. development of national strategies on aquatic animal health), aquatic epidemiology, surveillance, application of risk analysis and improved diagnostic capacity (both field and laboratory and high technologies, e.g. molecular biology). Developments in the veterinary curricula have also taken place, with aquatic animal health becoming more explicit, particularly at postgraduate levels. More details can be seen in the Expert Panel Review III.3 in this volume.

One of the most successful professional societies in the field of aquatic animal health is the Fish Health Section (FHS) of the AFS. The FHS, composed of aquatic animal health professionals, mainly from Asia, organizes triennial symposia, with the publication of *Diseases in Asian Aquaculture* as one of its major activities. Every Symposium on Diseases in Asian Aquaculture is complemented by offering to participants a continuing professional educational programme on various aspects of aquatic animal health management, taking advantage of the experts attending the symposium. The FHS is the longest-running section of the

AFS, demonstrating its great relevance. The FHS is now in its 24th year, with the 8th Symposium on Diseases in Asian Aquaculture being organized in India, in November 2011.

Gender

Concerning gender, no expectations were expressed in the Bangkok Declaration, although the keynote presentation by Professor T.V.R. Pillay did stress the need to "give due respect" to the involvement and empowerment of women in aquaculture (Pillay, 2001).

Future expectations, major issues and opportunities

In this section, important issues affecting both HCD and gender are elaborated and opportunities to address them are presented.

HCD

Aquaculture is predicted to keep expanding, increasing the world's reliance on it for fish production. The sector will also confront new (and old) opportunities and challenges, such as production efficiency, sustainability, quality and safety. Will women and men in the sector have the necessary capacity to take the opportunities offered, meet the challenges and overcome setbacks?

At this critical stage in the formation of modern aquaculture, our expectation is that the education and research sectors will take a leading role in developing human capacity. Education and research provide the professional foundations for new, knowledge-intensive aquaculture enterprises. Educational and research institutes must determine the extent to which their aquaculture education programmes and related research focus on large, intensive farming technologies and on small-scale, less intensive technologies that are more suitable for the many poor and small-scale farmers; and on the extent to which environmental and sustainability issues are addressed, as well as achieving a balance between research addressing the present and the future problems for aquaculture.

Issue 1. Accelerated HCD is urgently needed to meet the needs of rapid aquaculture development

The rapid development of aquaculture has created an urgent and growing need to upgrade aquaculture skills and knowledge, maintain the quality of HCD and to do so in an efficient way, such as by taking advantage of new media for delivery. As outlined in Figure 1, coherent HCD across the four levels is needed. We have mainly addressed the first two levels (the individual and the organization) and focused on the educational and training institutions in this review.

Opportunity 1.1 Establish priorities for HCD

More efficient, sustainable and safe aquaculture is also more knowledge intensive, so that the aquaculture sector must simultaneously meet the growing

need for HCD to be delivered more broadly to more people and at a more advanced level to key subsectors. How can the HCD demand for this be met? How can the quality of training and education be maintained and how can such impediments as language be addressed in building human capacity?

How can targeted training and technology dissemination make aquaculture knowledge more relevant and accessible and aquaculture more efficient, sustainable and profitable? New technologies must be relevant to future sector needs and be accessible. How can the needs of aquaculture operators be recognized and addressed in research systems and how will the results of new technologies reach farmers and others in the supply chain faster?

The above concerns create a potentially huge agenda for HCD. They are already the core concerns of government policy and extension agencies and research institutes, and these present hard choices among competing priorities. How agencies set aquaculture programme priorities can provide guidance to setting HCD priorities. Research and development planning and technology dissemination approaches have been codified in priority-setting and technology demonstration and dissemination activities of specialist aquaculture agencies such SEAFDEC/AQD and NACA and its partner centers of excellence. These agencies begin with aquaculture commodities and aquatic ecosystems as their base unit for planning (. They chart the technology transfer, adoption pathways and client needs for different types of product, and seek feedback. This commodity approach, plus the “farm to fork” and “fork to farm” tracking of needs and solutions are tailored to success at all stages of the value chain. Training needs assessments could be conducted for commodity and production systems and also more broadly for the environment, social, food and market needs. Dissemination methods for new technologies in areas such as fish breeding and farming systems are tailored to different client segments (e.g. hatcheries and farmers). Results are conveyed through a wide range of customized publications that are now widely disseminated on the Internet, as well as at commodity-specific and general conferences and training sessions with accompanying trade exhibitions. Although these dissemination methods may not directly reach many farmers and workers in the supply chain, they do reach those who support and supply them. Specialist agencies such as NACA, SEAFDEC and INFOFISH report that their products are reaching one or two orders of magnitude more users than when they were available only in hard copy, thus also accelerating HCD.

Opportunity 1.2. Cooperate and harmonize work among institutions to address the priorities

The rapid development of aquaculture depends on innovation and access to collective practical and theoretical knowledge. Aquaculture training and education need to achieve a balance between multidisciplinarity and specialization and between basic and cutting-edge knowledge. As the technological complexity

of aquaculture increases, the organization of a comprehensive aquaculture curricula requires the combining of transnational or transregional expertise. This has been recognized in Europe through such initiatives as the AQUA-TNET network and by FAO and China with a focus on developing countries through the new unilateral trust-funded training center on aquaculture in China. However, even more cooperation is desirable, not least because, due to unequal growth of aquaculture sectors across regions and countries, friction grows between the need for well-trained workers and highly qualified staff in one place and the dwindling student numbers in another. Transnational knowledge and skilled worker needs have contributed to the growing trend of aquaculture education programmes to rely on student and teaching staff mobility as a means to tap into the required expertise that can no longer be generated entirely in-house. However, before unlimited mobility can be deployed for the benefit of transparent and accessible education, two major challenges need to be resolved: discrepancies in educational systems and language barriers.

Discrepancies in educational systems are tackled on two fronts: harmonization and accreditation. Harmonization is the process whereby educational systems converge towards a common structure that allows seamless exchange of whole or partial educational programmes. Harmonization does not equal uniformity; on the contrary, harmonization fosters the diversity of educational programmes but strives to remove the obstacles that allow learners to access diverse transnational programmes. Accreditation is the second pillar of transparency and accessibility across various educational programmes. Accreditation is the process whereby an independent agency, governmental or non-governmental, carries out the quality insurance and certification – in this case, of educational programmes – according to collectively accepted procedures. Without accreditation, universities and other institutes of higher education will not or cannot grant a diploma based on a curriculum that is partially or entirely pursued elsewhere. Accreditation of educational programmes is an intricate task involving the detailed description of the programme (i.e. coherence, structure, level, objectives, outcomes and assessment), the institute (i.e. staff, infrastructure, facilities) and student-related issues (e.g. selection, admission, tutoring, social and housing services).[3] In engineering and medicine, global as well as national accreditation systems apply, helping these sectors to have acceptable common standards across the profession. Such quality standards also facilitate networking courses across and within countries for mobility and wider applicability.

A key challenge is the status of unaccredited short-term sectoral and professional training courses. The European Commission-funded VALLA project (Validation of

[3] For example, see European Consortium for Accreditation in higher education (ECA, www.ecaconsortium.net). In the Philippines, for example, an agency called the Professional Regulations Commission is responsible for regulating and supervising the practice of professionals who constitute the highly skilled manpower of the country. They provide certification exams for a wide range of courses, including fishery technology.

All Lifelong Learning in Aquaculture: www.vallaproject.com) tested how some types of lifelong learning fitted into the European Qualifications Framework (EQF) (EQF: http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm), targeting the aquaculture sector as a pilot case study. The project developed and piloted methods of recognizing and accrediting lifelong learning in the aquaculture sector via the EQF.

Specialist HCD conferences such as the AFS International Symposium on Aquaculture and Fisheries Education (ISAFE, 2009) can help networking among professionals. Professional association conferences such as those of the AFS, WAS, Aquavision and major commodity networks such as the International Symposia for Tilapia in Aquaculture and the INFOFISH commodity conferences could host sessions to identify HCD needs. The FAO Committee on Fisheries Sub-Committee on Aquaculture (COFI/AQ) could take a lead in encouraging global HCD actions. HCD plans must be forward looking so that they help position the sector for future challenges, risks and possible shocks. Risk mitigation strategies must include HCD components, regardless of whether the risk is related to the environment, fish disease, food safety, climate variability and change, or natural and human disasters such as war and economic collapse.

Opportunity 1.3. Address the communication challenges

Language barriers are a major hurdle, as they can make access to materials difficult unless they are translated and can touch sensitive matters involving cultural identity. No simple and global approach exists to solve language barriers. Solutions lie in locally determined tailor-made combinations of (i) the adoption of a "lingua franca" (will this be English and/or Chinese for aquaculture?) and (ii) the inclusion of language training in the curricula. Language issues are most acute in higher education and less so for vocational and professional education and informal learning, as these tend to target the local job market and therefore usually operate in the local language.

Issue 2. Aquaculture education needs to attract the best students and help prepare them for rewarding careers

Over the last decade, as the global economy has boomed, aquaculture faculties have reported difficulties in attracting students, especially the brightest, and even where numbers have grown sharply, such as in China, graduates often prefer jobs outside aquaculture or cannot break into the sector without substantial capital. Some of the course accreditation and mobility solutions discussed above would help attract and retain students, but much more still needs to be done to design the educational systems that are appropriate to the social needs and aspirations of today's best students against stiff competition from other attractive economic sectors, and to help improve graduates' employment prospects. Two suggestions are to attune courses to rural settings in which aquaculture operates and to pro-actively market the benefits to high-school students.

Opportunity 2.1. Take aquaculture education and training to rural areas

Aquaculture is typically carried out in rural areas, yet many of the institutes of higher education are located in large cities, giving the students a taste for city life and occupations. Other fields of education grappling with similar challenges, such as attracting sufficient qualified doctors and other professionals to service rural areas, have found that students educated at provincial universities are much more likely to go on to work in rural areas than their counterparts educated in cities.

Opportunity 2.2. Build and project a positive image for aquaculture

The image and prospects for work in the aquaculture sector need substantial improvement. In many countries, the general public hears more in the media about the negative aspects of aquaculture than its positive ones. The sector needs to develop savvy media outreach to overcome this problem, and the aquaculture education institutes should be actively engaged in this process. Aquaculture does attract public interest, as shown by the social networking through electronic outreach by the SARNISSA project (www.sarnissa.org). SARNISSA's Facebook page has 921 followers from among the general public, and the number is growing by the day. About one third of these were women (accessed 26 June 2011).

Opportunity 2.3. Create schemes to develop young aquaculture researchers

In most countries, competition for young professionals is intense among the different economic sectors. Aquaculture research institutes should develop attractive programmes to attract and retain high-quality young researchers for the long term, through scholarships, research awards, mentoring and development.

Issue 3. Aquaculture education urgently needs more social science content

Students in tertiary aquaculture courses do not get exposure to the social sciences, including gender analysis methods and management skills, thus limiting their ability to understand the holistic nature of issues affecting aquaculture development. Core curricula are urgently needed that impart a range of the necessary social science skills and knowledge to all students.

Opportunity 3.1. Increase the social science content of aquaculture courses

The FAO HCD Strategic Framework particularly stresses the importance of social science knowledge and devotes one of the three knowledge and skills groupings to it – societal skills and knowledge. Since the HCD Strategic Framework also stresses the importance of integration of the different knowledge and skills groupings, students not educated in the social sciences are at a disadvantage in functioning well at higher levels in the sector, as these require integrating

skills and knowledge from the three groupings. For aquaculture, these social science skills and knowledge would entail: community mobilization and participation, management and administration (including economics, finance and corporate social responsibility), conflict management and problem solving, good governance, environmental awareness, sustainable trade, information and communications and social literacy, including gender (FAO, 2005).

Gender

Our expectation is that gender equity and equality issues will be placed firmly on the aquaculture policy agenda at all geographical and institutional scales. Attention to gender is needed to help improve women's aquaculture productivity and for human justice. Placing gender on the aquaculture agenda requires a coalition of gender champions, informed researchers, expert networks and policy advocates. Just being aware of the gender dimensions and being gender sensitive are no longer adequate. In society at large, efforts over decades to get more balanced representation/numbers of women and men in the professions, companies and in board rooms have often failed or only marginally succeeded. We expect similar challenges in the aquaculture sector. Already, the fish processing sector has the typical inequity patterns of other sectors. In numbers, women dominate the factory floors all around the world, but few women are in managerial positions, including in countries such as Norway (Husmo, 2005) and New Zealand (Lambeth *et al*., 2002), despite being the countries with the 3rd and 5th lowest national gender gap, respectively (Hausmann *et al*., 2009). The aquaculture sector will have to redesign and intensify gender equity and equality programmes, as well as set targets in some institutions to help achieve gender equity.

Issue 1. Gender is ignored in aquaculture

Gender is almost totally overlooked in the global, regional and national aquaculture policy agendas, and little gender-disaggregated information is collected to illuminate the respective contributions of women and men. Commonly, gender is not recognized in sector objectives, plans and private-sector investments, nor in aquaculture and anti-aquaculture advocacy programmes. Activists have focused their attention on the environmental side of aquaculture and paid relatively little attention to the human side, including gender, with the exception of some shrimp farming critiques. Gender is not covered in the FAO *Code of Conduct for Responsible Fisheries* (FAO, 1995), and despite the fact that Goal 3 of the United Nation's 2000 Millennium Development Goals is to "Promote gender equality and empower women", little has been done to translate this in aquaculture. To place gender on the aquaculture agenda, much more knowledge of gender issues is needed. Most policy-makers, researchers and extension officers do not have adequate knowledge of gender issues and the possibilities to improve gender equity and, as a consequence, they are reluctant or simply forget to address gender in their work. They are often not aware of the impact of aquaculture projects on household equity relationships. Private companies in

the supply chain often do not take a proactive approach to the social equity side of the business, seeking least-cost labour solutions for their needs, although they are responsive to product quality and sustainable production issues.

For all the generalizations made above, notable exceptions exist. One comes from the Department of Fisheries, Thailand, which was awarded the 2008 Thailand "Best Practice Award on Gender Mainstreaming". As Dr D. Prakoboon, then the Director of Fisheries, noted in the 1998 AFS Symposium on Women in Fisheries, 33 percent of the 3 000 officials in the Department of Fisheries were women, including many in high places (Prakoboon, 2001).

Opportunity 1.1. Put gender on the aquaculture policy agendas and include it in normative instruments, starting with a gender stock-take of instruments

All institutions dealing with aquaculture should examine their gender policies and practices and resolve to tackle the dearth of gender-disaggregated data. Although aquaculture alone cannot change deep societal norms of gender inequity and inequality, as a new and growing sector, it has the potential to shake up the societal norms.

With the help of gender experts, FAO and partner aquaculture development agencies should perform a gender stock-take of their aquaculture related normative instruments, policies, programmes and projects and revise their practices to achieve greater gender equity. New policies and standards create the opportunity to incorporate gender awareness from the start. For example, gender should certainly be included in the new FAO certification guidelines under the heading "Minimum substantive criteria for addressing social responsibility in aquaculture certification schemes". Gender sensitivity in the production of aquaculture commodities could be used as a marketing advantage (selling point) in the future.

Best practice guides and codes of conduct should explicitly address how to achieve gender-equitable social and economic returns in households, communities and companies. These normative instruments could address, among others:

- improved working and social conditions for all people in the industrial aquaculture sector as a normal part of corporate social responsibility;
- equitable access to land/water resources and tenure over these resources by women;
- innovative extension approaches to ensure access to technology and adoption by women as well as men; and
- equitable access to credit, entrepreneurship and management training and business development services by men and women.

Opportunity 1.2. Aquaculture agencies should collect relevant and focused gender-disaggregated information across the range of activities in the sector/value chain, from production to marketing

Gender-disaggregated data are essential to guide and measure the effectiveness of gender policies and actions. FAO should commission a group of experts to draw up guidelines for collecting gender-disaggregated data in aquaculture, drawing on existing work from the agriculture, water, sanitation and household energy sectors. The group of experts should be charged to advise on suitable gender participation and equity indicators that are feasible and cost effective to collect and use at different scales. Indices should be developed for use throughout the supply chain. The expert group should advise on data requirements on the basis of an understanding of gendered structures and needs in the sector, should distinguish data requirements at different scales from global to household and should suggest priorities rather than develop "wish lists" of all possible data. The group should work closely with FAO's own data collection experts in fisheries and gender. Qualitative as well as quantitative data should be considered. The users of the data should be kept in mind. For example, policy-makers will need different information than those delivering local projects. Different types of data will be collected in different ways, from national statistics to household surveys.

Whereas collecting comprehensive and informative gender-disaggregated data sounds straightforward, experience shows that it entails fundamental reform in the thinking and organization of the agencies involved. In particular, data collection forms will need to be redesigned/modified to make them gender sensitive (with questions such as "how many women" as a minimum). More women will be needed as data collectors/enumerators as, in some contexts, it may be difficult for male enumerators to reach women to ask questions or check information. Government statistics and fisheries/aquaculture departments will need to be more gender aware.

Issue 2. With more women and men in a wider range of aquaculture jobs, the challenge is to create greater gender equity and promote the potential of aquaculture to empower rather than exploit people

Women's, especially poor women's, aquaculture roles and responsibilities are often overlooked and considered more menial than those of men, even though they are essential to household food security and industry prosperity. New jobs are often created using substandard employment practices. For example, women in export prawn processing plants in India often work under difficult labour conditions and with few benefits (Nishchith, 2002). In professional jobs (e.g. research, education, regulation), women could offer different insights and perspectives to help research institutes to more fully address the unique and pressing challenges of both female and male farmers (Beintema and Marcantonio, 2010). We are aware, however, that women in power positions often reproduce androcentric views, and their participation does not always

translate into a better understanding of women's problems, unless they are gender aware.

Opportunity 2.1. Address gender equity and equality in aquaculture workplaces

The work conditions for many women, but also many men employed under similar conditions, need attention by employers and labour organizations, just as the International Labour Organization (ILO) has started to address labour conditions in fisheries through the 2007 Work in Fishing Convention.

Many women and women's groups have found aquaculture to be empowering because they have been able to earn decent wages from it and improve their social status in the community and household. How can aquaculture be more empowering for those women already involved and be used to empower those entering the profession? Critical issues to resolve include women's access to resources (e.g. financial, natural, training and market), their mobility and how they are perceived. In Thailand, cage culture was chosen as the income-generating activity for a group of women, and its success raised the recognition that women now enjoy in the village (Sullivan, 2006). In Lao PDR, backyard pond aquaculture was considered more empowering for women than communal waterbody management, because while women were ensured of their access to resources with the private pond, the communal pond gave them little decision-making power (Saphakdy *et al*., 2009). Experience in Mexico has shown that the participation of men in groups led by women can become a learning experience for equity. It has helped the men recognize the women's contributions from fish farming when, typically, men and children have only recognized women's contributions to the household (i.e. domestic work).

Making women equal partners to men will enable them to improve their families' nutritional and living standards through multifunctional roles, increasing aquaculture productivity and self-reliance. But empowering women can also raise the stress levels within families and in the short-term, work-family conflicts will need to be addressed. However, women will be in a better position to contribute to society's welfare if their needs for adequate skills, knowledge and technologies are met. The objective should be to harness and maximize the respective skills of women and men to work together in harmony for a productive contribution.

The greater involvement of women in aquaculture may raise legal issues such as the need to strengthen the legal framework to provide women access to land, rights to own businesses, and access to education and health and childcare services.

Opportunity 2.2. Raise the technical and management levels of women's aquaculture contributions

For women in aquaculture, a continuing challenge is how to raise the technical and management levels of their contributions and make their participation more rewarding and rewarded. Increasing women's participation and rewards must somehow be achieved with such tactics as greater sharing of household responsibility so as not to increase women's overall heavy work burdens. Educating people in aquaculture technology, therefore, may also include educating women and men in gender equity.

In aquaculture projects, characterizing gender roles can help understand and target technological and other interventions. Agriculture development contains lessons for aquaculture. Reflecting on lessons from agriculture, Padmaja and Bantilan (2008) concluded that: (i) characterizing gender roles helped agriculturists to target women's activities that needed priority technology developments, (ii) women's farm management skills needed special attention, and (iii) social capital and women's access to household assets needed to be understood in addressing technology adoption opportunities and constraints.

Female extension officers and senior staff in aquaculture agencies would also help encourage a more empowered role for women in aquaculture, as they would be able to better communicate with other women. In most countries, however, there are very few female aquaculture extension agents to promote aquaculture. Programmes to attract women to serve as extension agents would serve the dual purpose of broadening the pool of extension officers and promoting gender awareness and women's empowerment at the farm level.

Opportunity 2.3. Promote the good news stories

Promoting the successes of women in aquaculture can have a positive demonstration effect on women thinking of entering the sector. To date, few efforts have been made to capitalize on these examples, learn from them and communicate them effectively to other women and to decision-makers.

Issue 3. Action is needed to enable fair fish trade in the face of rapid changes in supply chains

Regional and trade practices and policies are changing fish trade, including who can trade and who cannot. Also, the trade requirements posed by importing countries can marginalize smaller aquaculturists, especially women who have traditionally traded fish locally but who have less access to the capital, trade regulatory information and technology needed for more distant trade, e.g. in markets with strict quality requirements.

Opportunity 3.1. Foster fair trade in aquaculture products

How can trade policies be made more gender and scale neutral? To date, product accreditation schemes in the fisheries and aquaculture sector have

focused more on environment sustainability and product quality and have not addressed the full spectrum of social equity issues normally embodied in fair trade movements for other products (e.g. see fair-trade.org.uk). Small-scale women fish traders in domestic or transborder supply chains often work "under the radar" of trade promoters and regulators and can be hard hit by shifts in trade. Yet, studies on this trade provide valuable insights into their roles, needs and what actions can assist fair trade. Kusakabe *et al.* (2006), in studying the intricate Cambodia-Thai cross-border fish trade, noted the need for fair and practical fee-paying arrangements, better cold storage to lessen market risks and more fair trade policies to support the development of border regions that benefit from the fish trade.

Opportunity 3.2. Make certification more gender-sensitive

Aquaculture certification is a growing movement, and one that will affect women's roles and responsibilities in the aquaculture supply chains. In all parts of the supply chain, changes necessary to achieve certification present threats and opportunities to women. For example, on-farm procedures will become more codified and professional, so that if women in a household have been providing unskilled or semiskilled labour, they should be given the opportunity of training to undertake more skilled tasks required by certification. Some forms of certification could put value on accomplishing a minimum percentage of female staff and equity in wages between women and men.

Issue 4. Women are often incorrectly identified with poverty, small-scale farming and limited supply chain roles

The reality of aquaculture is that it can and does provide many opportunities for entrepreneurs through new business models. Women are often considered as only "small aquaculturists" and "backyard aquaculturists". While these roles for women are important, women's roles could and do go well beyond these stereotypes. Counter-examples abound. Women are often highly accomplished and have long been respected in the hatchery subsector, e.g., see example of the success of a Vietnamese woman catfish breeder (Little, Tuan and Tu, 1994), a Vietnamese ethnic minority woman awarded by the UN for her work on rural development and empowerment of women through fish farming (L.T. Luu, RIA1, personal communication), an Indonesian shrimp hatchery manager and a Malay semi-intensive grouper and snapper farmer (Brugere *et al.*, 1999). From our personal knowledge in Malaysia, the Philippines, Taiwan POC and Thailand, to name just a few countries, women often hold high positions in activities related to aquaculture, even creating and leading highly entrepreneurial, large commercial companies. For example, from a series of case studies from Taiwan POC, Chao, Chen and Chen (2006) found that the processing side of the sector seemed to provide women with more opportunities to develop artistic and healthy products. Government programmes helped women entrepreneurs, and the new Internet age assisted women to grow domestic and global businesses, starting from a low-cost base and without relocating from home districts.

Opportunity 4.1. Stop stereotyping women as only "small-scale and backyard" aquaculturists

Stereotyping women limits the HCD activities they can access. The growing number of women graduating with higher degrees in aquaculture indicate that a breakthrough is underway, at least in levels of women's education. Despite this, many women find difficulty in obtaining higher-level posts. In the industry side, Bangladesh has provided interesting insights into how mobile phones can be used to overcome many of the gendered obstacles in aquaculture (e.g. access to market information and extension services). In Viet Nam, women were able to bid for concessions for cage culture in a large community reservoir, thus showing their management capacity to organize large-scale aquaculture (Kusakabe, 2001). In Thailand, there is little restriction in women's mobility, but women generally chose not to leave their homesteads because of their responsibilities to look after the household, the fish and the livestock (Sullivan, 2006). The study of Kusakabe *et al.* (2004) showed that women used mobile phones to contact fish merchants and fisheries officers more often than men, indicating that new communication technologies can help to overcome their lack of mobility. In the household, women who had more information on aquaculture technology had more say in aquaculture production decisions compared to those who were more involved in aquaculture labour and had less access to technological information and knowledge.

Opportunity 4.2. Improve access of women to higher education in aquaculture

In higher education and research, telecommunications could be further used. Distance learning opportunities could be designed to improve access for women. The University of Stirling-Bangladesh Agricultural University postgraduate programme in aquatic resource development is using distance education to reduce the relatively high drop-out rate of high-quality women candidates.

HCD and Gender

The Expert Panel noted that the social changes affecting aquaculture often have joint HCD and gender implications. Here, we highlight two specific future expectations that affect both HCD and gender – the pressures of men working away from the home and women faculty.

Issue 1. Men's labour mobility in rural areas places increased pressure on women

Based on experience with small-scale aquaculture projects in developing countries such as Nepal and Mexico, out-migration of men from rural areas is common and women are left to take responsibility for farms and households.

Opportunity 1.1. Aquaculture can provide good livelihood opportunities for rural women

Aquaculture can provide better alternatives to livestock, vegetables and other crops, as it requires less labour. Consequently, providing training to women

in rural areas where men are absent is becoming a common need. In Nepal, women work in groups that identify their leaders. The chosen leaders will be key to the enduring success and further expansion of aquaculture. Beyond new technologies, training should include leadership skills such as group organization, effective communication, business development, accounting and financial management. In many countries, special attention should be given to indigenous women.

Issue 2. Aquaculture faculty are predominantly male

Although we were not able to obtain extensive data on current faculty composition, our observations and first-hand experience indicate a gender imbalance among teaching faculties/educators, not limited only to Asia and developing countries. For instance, when AIT gave high priority to the participation of women faculty in curriculum development and in creating a network of thematic specialists, based on the suggestion of the EU, it found very few (10 percent of 20 specialists) women available in four Asian partner universities (i.e. Royal University of Agriculture, Phnom Penh, Cambodia; RIA No. 1, Hanoi, Viet Nam; University of Aquaculture and Fisheries, Ho Chi Minh City, Viet Nam; and Institute of Aquaculture and Agriculture, Tribhuvan University, Nepal).

Opportunity 2.1. Improve the gender balance of faculty in aquaculture education institutes

Gender policies and programmes such as enriching the pool of women applicants are urgently needed to increase the ratio of female:male faculty members in academic institutions. This policy has to address the base-level faculty as well as more senior staff. Some Expert Panel members felt that women may not be attracted to aquaculture teaching positions, despite women's scholarships such as the Norwegian Agency for Development (NORAD) Scholarships at AARM/AIT. Higher education institutes should consider such affirmative action as setting minimum target numbers for women faculty or giving preference to women where other factors are equal, advertisements that target women, ensuring post-degree career opportunities/employment for women and, in aquaculture courses, promoting side disciplines such as training, extension, economics and management. In the case of the latter, these side-disciplines are less hands-on technical subjects. In subjects requiring field work, women (and indeed people) friendly field equipment should be promoted, e.g. use of water-proof trousers for entering the ponds, lighter equipment and engines.

Opportunity 2.2. Learn from initiatives in agricultural science

The aquaculture sector could learn from recent agricultural initiatives. For example, the AWARD (African Women in Agricultural Research and Development) programme, which also includes aquaculture researchers, (http://www.genderdiversity.cgiar.org/resource/award.asp) is paying renewed attention to the joint needs for gender equity and strengthening scientific competence, seeing women as a vital resource in science.

Recommendations from the expert panel presentations during the Global Conference on Aquaculture (GCA) 2010

Expert Panel VI.3 – *Addressing HCD and gender issues in the aquaculture sector* was one of four expert themes under Thematic Session VI – *Enhancing the contribution of aquaculture to poverty alleviation, food security and rural development*. The three others were: Expert Panel VI.1 – *Protecting small-scale farmers: a reality within a globalised economy?;* Expert Panel VI.2 – *Alleviating poverty through aquaculture: how can we improve?;* and Expert Panel VI.4 – *Supporting farmer innovations, disseminating indigenous knowledge and aquaculture success stories*. Although located within Thematic Session VI, Expert Panel VI.3 has gone beyond poverty alleviation, food security and rural development in addressing HCD and gender issues, as these also have critical wider importance. From the many above Issues and Opportunities, a set of key recommendations were presented and discussed at the 2010 GCA, as follows:

- Include HCD and especially gender in the Phuket Declaration! Make sure that statistics are gender disaggregated.
- Tackle data collection requirements to document gender roles and relations throughout the aquaculture value chain and to assess training and educational needs at all levels in aquaculture.
- Promote the inclusion of social science disciplines (including business administration, sociology, anthropology and geography development studies) in aquaculture curricula and training to keep up with the broader needs of aquaculture development.Support the formation of platforms/networks of professionals to enhance the sharing of information and experiences, and facilitate harmonization of curricula and integration of women in the profession.
- Make assessment of institutional arrangements (e.g. legal framework and entitlements), organizational culture and practices and curricula from a gender perspective to create an enabling working environment for women and men professionals and farmers.

In addition, The Phuket Consensus (FAO/NACA/Department of Fisheries Thailand, 2010) contained the following on HCD and gender:

- HCD: (from Preamble) re-affirmed implicitly commitment to the 2000 Bangkok Declaration and Strategy. "*…the Strategy continues to be relevant to the aquaculture development needs and aspirations of States.*"
- Gender: Recommendation "*5. Support gender sensitive policies and implement programmes that facilitate economic, social and political empowerment of women through their active participation in aquaculture development, in line with the globally accepted principles of gender equality and women's empowerment.*"

The way forward

HCD and gender issues are at the heart of the future development of sustainable aquaculture. As the global leader, FAO should place HCD and gender firmly in its programmes, lead in developing methods for collecting gender-disaggregated information and select suitable indicators to track progress of gender equality and equity. The FAO HCD Strategic Framework should be adapted for future aquaculture needs, augmented to strongly incorporate gender equity and equality and adopted to guide the work programme for aquaculture.

When formulating the HCD and gender work programme priorities, FAO should look not only at the people in aquaculture production but include those engaged throughout aquaculture supply chains and address issues such as the gender impacts and gender vulnerabilities of the sector to market and social changes.

In light of the ongoing world food security challenges, the conditions in which poor women and men farmers practice aquaculture should receive special attention and be included in education and training priorities. Professional bodies should host substantial expert sessions on HCD and gender within their conferences, publications and work programmes.

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