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**Sustainable fisheries  
and aquaculture**

Photo: J. Boethling

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### Dear Reader,

In the debate about food security and poverty alleviation the fishery sector is mostly mentioned only in passing, if at all, even though at least one billion people depend on fish as the main source of animal food and at least one-tenth of the world population depend on fisheries and aquaculture for their livelihood. The World Bank and FAO estimate that demand for aquatic food will continue to rise.

But around one-third of all fish populations are already over-fished. Large-scale illegal, unreported and unregulated fisheries worsen the problem, and also contribute to loss of revenues, employment and fish supplies for local populations. Numerous other factors, such as environmental pollution, littering and increasing extraction of raw materials from the seabed, and also natural disasters and climate change have an impact on the state of the oceans. How can we succeed in using aquatic resources sustainably while at the same time ensuring that inequalities in access to them are eliminated so that small-scale fishers and aquaculture communities also benefit from the value chains? Our authors present the challenges, lessons learned and approaches to solutions from the point of view of development cooperation, civil society and science.

In the Philippines, for example, the WWF and European retailers and processing companies have joined in a public-private partnership project to halt the downward trend in the yellowfin tuna population and secure the income of small-scale fishers in the long term. Artisanal handline fishers are being trained in proper tuna handling, learning to improve the quality of their catch. Together with the local authorities, a registration and licensing system has been established to better regulate fishing. Marine Stewardship Council (MSC) certification of the yellowfin handline fisheries is being sought for 2017, the partners from the industry have committed to buy the fish and market them in Europe (p. 14).

In India, the Government has supported its fishery sector for over 20 years with information on potential fishing zones. Satellite data on sea surface temperature and chlorophyll concentration is used to identify where there will be fish aggregation. Supplemented by weather data, this information is forwarded daily without charge to 586 fish landing centres in 14 states along the Indian coast. Fishermen can call up the information in the local language with various ICT tools, saving time and fuel in fishing (p. 22).

Unlike in agriculture, women play a powerful role in the fishery sector. While men dominate actual fishing, processing and marketing are mainly in the hands of women in many countries. Our authors take the example of the small sardine-like silver cyprinid to show how gender roles are divided in the value chain in Kenya, and what possibilities there are for increasing women's incomes

(p. 24). However, well-meant projects can all too easily backfire. For example, development cooperation in West Africa has been trying for some time to reduce losses in the fish value chain – which account for just under one-third of total volume – by establishing an unbroken cold chain from the boats to the supermarket. While this is intrinsically a helpful measure, it threatens to destroy the local processing and marketing structures. Primarily women are affected, who not only lose income as a result but also their social status in the fish economy, whose structure – although not free from conflict – is in balance (p. 30).

Aquaculture already provides around half of the fish eaten by humans, and recent analysis suggests that aquaculture supply will overtake capture fisheries within the next decade. The actors, including development cooperation are faced with the task of developing appropriate aquaculture production systems which fit into the social and economic context of small and medium-scale producers (p. 10). Research has to identify models that maximise benefits for humans and the environment. Examples include increasing the nutritional value of fish and improving food safety, along with development of improved breeds, feed and farming systems and reducing aquaculture's footprint (p. 36). The use of insects as converters of food waste and a protein source could give small-scale fishers access to cheap fish feed (p. 34).

Without regulation and effective monitoring, sustainable use of aquatic resources cannot be achieved – the business is simply too lucrative. In Mauritania a satellite system combined with a range of surveillance and radar stations ensure that illegal fishing and catching of prohibited species are largely a matter of the past in the 200-mile zone off the coast (p. 27). The country has also committed since the start of the year to establishing a Fisheries Transparency Initiative (FiTI), on the lines of the working process applied in the Extractive Industries Transparency Initiative (p. 29).

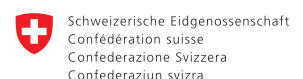
Small-scale fishers will continue to have to compete with large fishing vessels and 'aquapreneurs' over access to resources and value chains. To strengthen their position, the FAO has issued the Guidelines for Securing Sustainable Small-Scale Fisheries (p. 20). Group certification is to help small aquapreneurs to open up export markets (p. 18). It remains to be seen if these relatively young instruments will live up to their promise.

We wish you inspired reading.

*Silvia Richter*



#### Partner institutions of Rural 21:



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Photo: UN Photo/E. Debebe



Photo: WWF/G. Yan



Photo: F. Marr



Photo: M. Egbert

## Is the world prepared for sustainable development?

Since the Millennium Declaration of 2000, significant progress has been made worldwide in the areas of health, education and poverty alleviation, but some countries are still lagging behind. Inequalities have taken deeper roots and environmental degradation and climate disturbances imperil future development prospects. Strong political commitments and the mobilisation of all financing sources – public and private; domestic and international – are crucially needed to meet the sustainable development challenges ahead.

After months of negotiations in New York, over 11,000 government representatives, academics, members of civil society and businesses gathered for the third UN Conference on Financing for Development in Addis Ababa in July. The Addis Ababa conference was the first of three major events which are hoped to bring significant changes towards addressing global challenges and moving the world to a more sustainable development path. It will be followed by the September UN General Assembly where a new set of Sustainable Development Goals (SDGs) will be adopted and the December Paris Summit where a new climate deal will hopefully be reached. So, did the Addis Ababa conference set the bar high enough and did it lay the foundation for real change?

Recognising the enormous investment needs for sustainable development worldwide – estimated to be of the order of 3.5 to 5 trillions of US dollars per year – the conference resulted in the adoption of an Addis Ababa Action Agenda. The Agenda includes a range of government commitments, from the provision of social protection and public services for all, to substantially reducing illicit financial flows and setting up a new global infrastructure forum that will help poor rural communities access the markets they desperately need. These initiatives, if properly implemented, will be decisive in increasing financial re-



*Opening ceremony of the Third International Conference on Financing for Development in Addis Ababa, Ethiopia.*

*Photo: UN Photo/E. Debebe*

sources for sustainable development, implementing the SDGs and lifting millions out of poverty.

Where the Action Agenda makes a significant step forward from its predecessors, the Monterrey and Doha conferences, is the shift towards sustainable development. By acknowledging that social, economic and environmental challenges are interconnected, it highlights that these challenges cannot be dealt with, and resolved, in isolation. Sound management of natural resources goes hand in hand with economic prosperity and social development. Ecosystems and the services they provide to communities – such as fertile soil and clean water – are vital for people's livelihoods and food security. In this light, the Action Agenda calls for policymakers to embrace holistic approaches to financing sustainable development. For example, it calls for development finance to be climate resilient and environmentally sound, through the promotion of clean energy technologies, for instance.

The Agenda also emphasises the need to go beyond finance and introduce the right policy incentives and ensure policy coherence. This latter

principle aims to ensure that policies across many different sectors – such as industry, trade or migration – do not undermine but support the objectives of poverty eradication and sustainable development both at home and internationally.

While the Action Agenda could have been strengthened by more concrete deliverables in some areas – such as more binding timetables for developed countries to reach their official development assistance (ODA) commitments or stronger measures to tackle harmful tax competition at the global level, as has been advocated for by many NGOs – we believe the Addis Ababa Action Agenda sets the bar high for a more comprehensive set of actions that goes beyond financing. It will now be upon the international community, relevant ministries, local authorities, national parliaments and other stakeholders to turn these words into actions, policies and funding and ensure that this historic opportunity to put the world on an inclusive and sustainable development path is seized.

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## World Farmers Organisation meets at World EXPO in Milan

Italy's EXPO is being held under the motto: Feeding the World – Energy for Life. The World Farmers Organisation (WFO) that held its General Assembly at the end of June during EXPO Milano took up this topic and invited experts from politics, science and the international farming community to a conference.

WFO President Evelyn Nguleka, from Zambia, told the 66 farmers' organisations represented at the meeting that the world's farmers had "to make sure that by 2030 nobody in this world goes hungry". Nguleka stressed two important aspects in this context: food security and adapting to climate change. Sustainable agriculture was the only solution and also ought to be discussed as such at the conference. This challenge could only be met in a joint effort by the public and the private sector, and with the support of science and experts.

### ■ Sustainable, equitable and inclusive solutions

All participants demanded that agriculture gain more esteem and be regarded as an economic sector. Only when farmers could reckon with a profit would they also invest and raise productivity. "Farmers are not charity people, they need to make profit, otherwise they leave," said Aggrey Mahanjana, Secretary General of AFASA (African Farmers Association of South Africa). "If we want to feed nine billion people, we must embark on new policies particularly to support small-scale farmers." Mahanjana stressed that it was precisely for this interface between small-scale and profitable farming that new technologies were required.

It was small-scale farmers who were at the centre of the UN Year of Family Farming, said Marcella Villareal of the UN Food and Agriculture Organization (FAO). Numerous political and technological solutions were found and elaborated, for example appro-

priate machinery and equipment for small-scale agriculture in Brazil or Argentina or new small-scale credits offered by the Dutch Rabobank. However, these private approaches had to be supported by politics in order to develop the corresponding structures in the rural regions and eliminate financial bottlenecks, the FAO representative explained. The participants also called for new political approaches and improved technologies to reduce the considerable food losses in the North and the South, which was also one of the chief concerns of President Nguleka. "Why do we waste so much food, and why are so many people obese, and at the same time, why must so many people go hungry?" she asked, and demanded new nutrition patterns.

The competitiveness of family farms was addressed by the President of the Italian Farmers' Federation Coldiretti, Roberto Moncalvo. "Farmers produce a lot of food but are challenged by cheaper food on the markets," Moncalvo complained. This applied e.g. to the Italian rice sector, which was suffering from cheap imported rice. His proposal for a solution regarding sustainable agriculture was a consumer-centred, local agricultural production and a focus on regional specialities that were suitable for export. The Farmers' President showed how the Italian food industry had tapped new markets with these specialities. Its partners had to be the many family farms that were able to sell their products at competitive prices.

### ■ Facing climate change

Not only is agriculture a key actor in food security in the 21st century, but it is also the biggest CO<sub>2</sub> emitter, which caused all participants of the WFO conference in Milan to conclude that farmers had to produce more in future but had to do so using fewer inputs and with climate-friendly production methods. According to Joachim Rukwied, President of the

German Farmers' Association (DBV), the end of the fossil era, heralded by the energy transition in Germany, was the right point in time for the application of new, environmentally friendly technologies, such as no-tillage agriculture, precision agriculture with the aid of GPS, a more targeted use of fertiliser and pesticides, and incorporating bioenergy in the operation of farming machinery.

Agriculture would always remain an emitter, noted Charlotte Hebebrand, the representative of the International Fertilizer Industry Association (IFA); mineral fertiliser was also contributing to CO<sub>2</sub> emissions. However, targets had to remain realistic, and adaptation to climate change was the premise to set out from. There could be no secure agricultural production without fertiliser, Hebebrand stressed and explained that the fertiliser industry was opting for more efficiency in applying fertiliser with the aim of halving CO<sub>2</sub> emissions.

In addition to climate change issues and water management, the retention of soil fertility is of major concern to farmers. Matteo Bartolini, Chairman of the European Council of Young Farmers (CEJA), presented an interesting approach to efficient water use. With the aid of daily soil samples, he was precisely determining the true water requirements of cropland, achieving growing yields with a minimum of water consumption. Water and lower carbon emission levels were at the centre of the presentation given by Sok Sotha, managing director of the Cambodian Farmers Association. He described soil conservation and efficient water use measures. Cropland on small farms in particular was often covered with plastic to protect the soils; furthermore, the family farmers were trained in options to maintain soil fertility. Making use of the annual floods along the Mekong, Cambodia's lifeline, for irrigation and fertilising of soils was an additional measure.

*Angelika Wilcke*





Photo: J. Boethling



Photo: J. Boethling



# Sustainable management of

## ... a key to food security and poverty alleviation

Fishery plays a crucial role in poverty and hunger alleviation. It is therefore all the more important to secure the long-term conservation of fish stocks as a natural resource and to ensure fair access to them.

Our oceans cover 71 per cent of the Earth's surface. Their importance and their resources are enormous regarding food security and protection of livelihoods of the further increasing global population. It is estimated that fisheries and aquaculture are the basis of the livelihoods for 660 to 820 million people (fishers, fish farmers, fish traders, workers in fish-processing factories, and their families), representing ten to twelve per cent of the world's population. Ninety per cent of these people are employed by capture fisheries operating on a small scale in developing countries. Nearly half of the 120 million people who work in the capture fisheries sector and its supply chains are women.

Fish has unique nutritional properties which make it essential to the health of billions of consumers in both

developed and developing countries. Worldwide, annual fish per capita consumption tripled from 6 kg in 1950 to 18.8 kg in 2011. Rising economic wealth and health consciousness have contributed to this tangibly increasing demand. Today, almost every fish caught by small-scale fisheries and about 80 per cent of the industrial fleets' landings is for human consumption. The aquaculture sector also makes a significant contribution to meeting the demand.

However, there are still inequalities in who eats the fish and who benefits from the value chains. Small-scale fishers and aquaculture communities, including poor and marginalised people, are often in tension with large corporations and production units over access to fish and fish-related employment. Thus we have to ask ourselves how we can achieve sustainably managed fisheries that benefit all of us.

At the same time, scientific data confirms the critical status of global fish stocks. Apart from over-fishing, illegal, unreported and unregulated fisheries (IUU) is one major factor that contributes to jeopardising effective and efficient fish supply for human

consumption. It leads to loss of revenues, employment and fish supply for local populations. In addition, the value chains of international fisheries call for improvements as by-catch and post-landing losses are significant. To this end, we collaborate closely with the private sector for the certification of wild catch and aquaculture produce.

Factors such as environmental pollution, littering, increasing extraction of raw materials from the seabed, destruction of marine habitats and biodiversity, natural disasters and climate change have an impact on fish stocks and the state of our oceans. The policy of the German Federal Ministry for Economic Cooperation and Development (BMZ) is designed to meet these challenges. We are reinforcing our efforts to better protect and sustainably manage the marine environment. Experiences made, for example in the framework of the European Union's fishery partnership agreements, must be up-scaled to other partner countries, in particular the developing ones. We are supporting these countries in achieving responsible and sustainable fisheries development.

In the "One World – No Hunger" initiative, launched by the BMZ last

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Photo: N. Wöhner



Photo: Bilderbox.com



Photo: J. Boethling

# fisheries and aquaculture

year (see also Rural 21, No 1/2015), fish is strategically integrated to reduce hunger and malnutrition in our developing partner countries as well as to ascertain livelihoods for millions of families, including women and minority groups. Together with our international and national partners, German development cooperation is working to improve key issues in the fishery and aquaculture sector in the following areas: (i) combating IUU; (ii) improving value chains; (iii) reducing

fish meal and fish oil production from wild catch; (iv) supporting small-scale fisheries through the application of the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries and the Voluntary Guidelines for Sustainable Small-Scale Fisheries; (v) supporting cross-country fishery agreements for a joint and efficient governance of fish stocks and their exploitation; (vi) promoting sustainable aquaculture; (vii) certifying of capture fisheries and aquaculture

produce, and (viii) respecting human rights and social standards in the fisheries sector.

Our goal is to eradicate hunger and malnutrition and to put in place a basis for making sure that future generations of a growing world population will be able to feed themselves. Therefore, the BMZ welcomes the focus of the current Rural 21 issue as sustainably managed fisheries contribute significantly to reaching this goal.

## ... a huge challenge for development cooperation

The global demand for fish and fish products is continuously increasing. However, fisheries management is still insufficient, leading to over-exploitation, illegal fishing and massive post-harvest losses. Our authors describe what has to be done.

Globally, 158 million tonnes of fish was produced in 2012: 11.6 from inland fisheries, 79.7 from marine capture fisheries, 41.9 from inland aquaculture and 24.7 from marine aquaculture. From these landings, 136 million tonnes was used for human

consumption. This amount, however, does not represent all global catches. The UN Food and Agriculture Organization (FAO) only receives information of an estimated 70 per cent of all commercially targeted fish stocks. Catches of small-scale fisheries are often underestimated or not included in national fishery statistics.

per cent of their daily per capita protein consumption from fish. In 2010, fish as a protein source was twice as important as poultry and three times as large as cattle. Fish is directly used for human consumption and indirectly as fishmeal for aquaculture and poultry or livestock feed. Three quarters of all countries where fish represents more than half of daily protein consumption are amongst the poorest countries of the world, with insufficient nutritional supply. However, inadequate handling and processing methods can lead to quality and nutritional loss and, in turn, substantial economic losses. Specific require-

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Fishes are among the most efficient converters of feed into high quality food. Their carbon footprint is low compared to that of other animals that we eat. More than 1.5 billion people cover about 20 per cent, and another three billion people 15





February 2012: Greenpeace activists protesting against foreign overfishing in Senegalese waters. "Stop fishing away Africa's Future" says the French banner. The 120 meter long Russian super trawler "Mikhail Verbitsky" is an example of unsustainable fishing practices by foreign super trawlers in the region.

Photo: laif

ments and preservation techniques are needed to preserve the nutritional quality of fish, extend its shelf-life, minimise the activity of bacteria spoilage and avoid losses caused by poor handling.

### ■ Pressure is building up on the resource

The FAO estimates that approximately 30 per cent of all fish stocks are over-exploited, while 57 per cent are fully exploited, and only 13 per cent of the stocks are subject to low or moderate fishing pressure. The International Union for Conservation of Nature and Natural Resources (IUCN) has already drawn up a long list of fish and marine species that are threatened or at risk. The World Bank has examined the economic impact of this development. It estimates that poor fisheries management costs roughly 56 billion euro annually. Over the last 30 years, losses in economic potential have amounted to over two trillion euro. Public awareness about facts and figures has triggered a rising expectation to urgently restore fish stocks and sustainable production levels. But this is not an easy task.

Fisheries can be grouped into two main categories: small-scale and industrial fisheries. Compared to small-scale fisheries, characteristics of large-scale industrial fisheries are an increasing ocean area that is fished, reduced labour intensity, increased supply to external and global markets, increased energy consumption and often the use of environmentally unfriendly catch and production methods. In 2010, there were about 4.36 million fishing vessels in the world, 3.23 million vessels (74 %) of which are considered to operate in marine waters and 1.13 million in inland waters. World-wide subsidies of fishing fleets amount to an annual range of about 20 billion euros. Although catches are increasingly smaller due to over-fished and reduced fish stocks, innovative technology leads to fishing vessels progressively equipped with more effective, capital intensive and less environmentally friendly catch methods.

Whereas fish stocks are constantly decreasing, high economic and population pressure and poverty are causing the number of small-scale fishing vessels operating in near shore areas of coastal countries to grow. Although global capture fisheries have remained

at a relatively stable level, an increasing number of parties will want a share of this catch in future. This is a clear indicator of progressive over-fishing, i.e. an exploitation that exceeds the maximum sustainable yield (MSY) – the defined natural productivity level of our marine stocks that can be harvested sustainably. Additional signs of overfishing include the decreasing size of targeted fish towards immature individuals. Shifts in species compositions in the fished ecosystems indicate a strong reduction in the biomass and abundance of high-value larger predator species (e.g. sharks, billfish, tunas and groupers) and increases in biomass and abundance of smaller short-lived species (e.g. small pelagic fish and cephalopods).

Illegal, unreported and unregulated fisheries (IUU) – including unauthorised fishing gear and lack of catch documentation – accounts for at least 15 per cent of world catches globally, i.e. roughly 11 to 26 million tonnes of fish per year, or 10 to 23 billion euros in loss of revenues for the coastal countries concerned. IUU contributes to reducing the food supply of coastal countries.

### ■ Nearly a third is lost

Fish not worth landing commercially, such as by-catch of non-targeted species, legally undersized, low-quality, partially damaged or spoiled fish, can end up dumped overboard. Global discard rates of the world's total capture fisheries are estimated at eight per cent, with a lower rate of 3.7 per cent for small-scale fisheries. This equals losses in food supply of 10 to 12 million tons of fish annually.

As a very perishable food, fish is susceptible to high post-harvest losses after landing, either in quantity or quality, due to post-harvest handling during transports, storage, processing, on the way to markets or in markets waiting to be sold. Globally, 27 per cent of landed fish is lost or wasted from landing to consumption. While this is particularly crucial to food security and income in developing coun-



tries, waste at consumer level is quite important in rich countries too.

### ■ The triumph of aquaculture – and its consequences

Over the past 25 years, the aquaculture sector has grown enormously. Per capita supply from this sector increased from 0.7 kg in 1970 to 7.8 kg in 2006. Aquaculture has increased the availability of fish and contributed to the awareness and consumption of fish products worldwide. It has created a more competitive fish market overall that generally sells its produce at lower prices than wild caught fish, benefiting income generation, food security and nutritional status for aquaculture households, such as reduction in underweight children.

The World Bank and FAO estimate that the demand for aquatic food will continue to rise, and that part of this demand will be supplied by aquaculture, with an estimated 62 per cent of total human aquatic food consumption by 2030. Aquaculture has the potential to make a significant contribution to the increasing demand in most regions of the world. However, the sector (and its aqua-farmers) face great challenges. For example, high-input high-output intensive aquaculture systems (culture of salmonids in raceways and cages) lead to discharge of suspended solids, nutrient and organic enrichment of recipient waters resulting in build-up of anoxic sedi-

ments, changes in benthic communities and the eutrophication of lakes. Large-scale shrimp culture has caused physical degradation of coastal habitats, for example mangrove forests, destruction of wetlands and salinisation of agriculture and drinking water supplies. Growth of aquaculture has been accompanied by a rapid increase in the use of antibiotics and antimicrobial agents to overcome shortcomings in sanitary and unhealthy conditions in fish farming. These can be detrimental to the environment and human health.

### ■ A multitude of influential factors

More than 90 per cent of all transport world-wide is maritime. Unlike other transportation systems, maritime transport is not taxed and little controlled. Given the globalisation of trade, ensuring cost transparency between all transport systems, including costs of consequences, is crucial. The 'polluter pays' principle must be applied for the maritime transport sector in view of its ecological and socio-economic consequences. Climate change causes proven stress factors including sea level rise, acidification, slow-onset changes such as warming and oceanographic changes and storm surges that impact on the marine habitat and fish stocks. The fishery sector is accountable for annual CO<sub>2</sub> emissions of 43 to 134 million tonnes. Large-scale industrial fishing vessels and production chains are the main emitters.

Today, we are aware that traditional indicators of the status of fisheries based on annual landings, sizes of fish stocks and fishing fleets are no longer sufficient. They need to be complemented by approaches including access rights to fishery resources, improved governance, including the participation of fisheries and coastal communities, particularly women, locally available technologies, traditional knowledge and social cohesion among user groups. For the successful development of sustainable management mechanisms, it is imperative to reach a balance between the protection of marine life and the vital role that fisheries plays in many economic regions. On behalf of Germany's Federal Ministry for Economic Cooperation and Development (BMZ) and in close cooperation with national, European and international governmental, civil society and private organisations and partners worldwide, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has been operating here for many years. In particular, its global project 'Support to Sustainable Fisheries and Aquaculture' aims at contributing to improving fisheries and aquaculture governance and management. Our aim is to help safeguard livelihoods, food security and nutrition as well as to support economic growth in the fishery sector by promoting and supporting sustainable, ecosystem based and socially acceptable approaches, methods and solutions. Some of the articles in this issue of Rural 21 (e.g. on pages 10 and 24) provide deeper insight in our work.

## Who may fish where? – Ownership, access rights and the value of deep sea fishes

Ownership, governance and access rights are crucial factors that determine the sustainable management of our oceans. The Law of the Sea Treaty under the United Nations Convention on the Law of the Sea (UNCLOS), adopted in 1982, established a comprehensive set of rules governing the oceans. It is based on the concept of common heritage of humankind. It introduced the exclusive economic zone (EEZ), also known as the 200 nautical mile (nm) zone. Accordingly, coastal countries have the right to exclusively use an ocean area within 200 nm from their shoreline, including the exploitation of fisheries resources. The Law of the Sea also regulates the protection and conservation of the marine environment, marine scientific exploration, as well as development and transfer of marine technologies. The high sea, however, remains international water and thus property of humankind.

Coastal areas are very productive ecosystems. They are rich in nutrients and fish life. Therefore, it is not surprising that more than 90 per cent of the global fisheries take place within the EEZ. In the high sea, only areas that are relatively productive are of economic interest for fisheries. These areas include the waters adjacent to the EEZ of maritime countries (spill-over effects), seamounts and ridges. Here, the groups of interest are commercially high-value target species such as tuna, swordfish and deep sea benthic fishes. Given the nutrient and low-light environment they live in, deep sea fishes grow slowly and have long life cycles. Our knowledge on their stocks and ecology is rather scarce, and the significant exploitation of these fishes thanks to modern technologies could be putting deep sea fishes at risk.



*The integration of chicken farms over large fish ponds benefits from the recycling of chicken droppings for fish pond fertilisation. In Myanmar, this system has been widely expanded and is delivering large amounts of freshwater fish (aside from chickens) to local consumers at affordable prices.*

*Photo: M. Prein*

# Can aquaculture help the hungry poor?

Aquaculture holds a big potential to satisfy the growing demand for aquatic food. Setting out from lessons learnt in past development projects, our author describes what fish farming systems must look like to fit the needs of smallholders and the environment.

Aquaculture, also known as fish farming, is the fastest growing sector in food production. In 2012, 66.6 million tons of fish was produced in aquaculture, which represents 42 per cent of total fish production world-wide. In the last three decades, farmed fish production, which can be either 'freshwater' or 'marine', has increased twelve times at an average annual growth of over eight per cent. With the levelling out of global wild fish catches, it is now widely agreed that the foreseeable future increase in

demand for fish will have to be satisfied through aquaculture production. World aquaculture is heavily dominated by the Asia-Pacific region, which accounts for 89 per cent of production in terms of quantity and 77 per cent in terms of value. Today, in a number of countries in Asia, the supply of fish from aquaculture is larger than that from capture fisheries (e.g. over 80 per cent in the case of Bangladesh), with an increasing trend.

For developing countries, aside from wild-caught small pelagic marine fishes, freshwater fish play a major role for food security. The supply of the latter from inland water bodies, rivers and streams as well as floodplains is declining, while human populations are increasing. The resulting supply gap is partly being met by a growing aquaculture sector. But is

farmed fish really the saviour of the hungry poor? Its contribution to global food security depends on where production occurs and what is being produced. The major species groups contributing to global production by aquaculture comprise marine fishes, at above five per cent, crustaceans at around 40 per cent, a majority of 60 to 80 per cent for diadromous fishes (e.g. salmon), molluscs and freshwater fishes, and aquatic plants (e.g. algae), in excess of 90 per cent. Obviously, small fisheries involving poorer people have hardly a role to play in many areas.

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## ■ Pros and cons of the system

The development of aquaculture, particularly between 2000 and 2010, has resulted in lower fish prices. Aqua-



culture has increased fish supply on the world market, while competition causes it to generally sell at lower prices than wild caught fish. For some species, e.g. tilapia, the production efficiencies and supply volumes have resulted in their prices being comparable to or even cheaper than chicken meat. Today, tilapia (originally of African origin) grown in large-scale aquaculture in China are available in remote markets in Africa (frozen, gutted, Hazard Analysis & Critical Control Points [HACCP] certified) at prices lower than those for local tilapias caught in rivers and lakes nearby.

While increasing fish availability at low price is beneficial for consumers, it can imply economic difficulties for fishers. Nevertheless, aquaculture has created an enormous labour market. Over the last 20 years, the global number of employees in aquaculture has been growing faster than average population growth. In 2013, aquaculture provided direct employment to 16 million people globally, compared to 38 million in capture fisheries.

Fish in aquaculture systems are very efficient converters of feed into protein and provide advantages over most terrestrial livestock systems. Aquaculture has a lower carbon footprint compared to other terrestrial animal production systems. Its contribution to global greenhouse gas emissions is rather insignificant, while agriculture contributes 10–12 per cent. Nitrogen and phosphorous emissions from aquaculture are much lower compared to beef and pork production systems, but slightly higher than those of poultry. Domestication is a major driver of rendering aquaculture production more efficient and lowering the sector's ecological footprint. The proportion of domesticated species will increase with improved efficiency and profitability.

There are two distinct sets of environmental concerns related to aquaculture, globally and locally. Globally, the increased demand for fishmeal and fish oil from so-called reduction fisheries as feed for aquaculture production has increased fishing pressure

on wild stocks. Locally, discharges from farming sites, destruction of local habitat, and escapees and spreading of pathogens are causing more concern.

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### ■ Making aquaculture work for small-scale producers – lessons learnt

Similar to the agricultural sector, for a long time, research in aquaculture with regard to development cooperation focused on developing more efficient systems in terms of costs, space, labour, hence to maximise outputs and revenues, e.g. fish per unit area (or volume). This development process started in the 1970s, including various steps of intensification: fertilisation of the water to enhance natural productivity, provision of feed, breeding varieties with better growth performance, improved disease control (e.g. biosecurity, vaccinations), moving from polycultures of several species to monocultures, managing water quality (e.g. bio-filters) and improved holding systems (e.g. net cages, closed recycling systems). However, all these innovations are highly complex. They demand a high level of technical skills and knowledge, investment and hence risks. As a result, their adoption by the usually poor small-scale farmers was impossible. However, aquaculture remained one of the best options to diversify smallholder production systems and to equally contribute to food security, particularly by providing protein and micronutrients.

Subsequent research revealed that targeting smallholders for the introduction of aquaculture requires the provision of production systems that are technically, operationally and financially feasible and are adapted to the current situation on the farm. Aquaculture must fit into the existing structure, e.g. a trench in a rice field, seasonally flooded crop production plains, or a small fish pond. It can also utilise fallow areas where floodplains used for rice cultivation are seasonally flooded. Traditional use of 'wild' fish that may occur can be significantly

enhanced by introducing stocked fish resulting in more high-quality, nutrient-dense food fish production. The community based floodplain fish farming approach has been widely adopted and proved beneficial at the national level in Bangladesh, India and Myanmar.

Given the necessary preconditions (labour, land access, water supply, suitable soil and an appropriate topography), the aquaculture production system needs to be integrated according to the preferences, operational criteria as well as the social and economic context of the farmer. However, starting from the 1980s, only small numbers of such systems existed in Asia and practically none in Africa. In order to introduce such complex management to novices, a farmer-focused participatory approach and procedures were devised in the 1990s that promoted simple and robust aquaculture-specific operational rules and principles. As a result the aquaculture component started to succeed as an integrated component within existing farm environments and in compliance with the household's capabilities. Implementation of appropriate solutions usually began in small steps, following a gradual process of increasing productivity and building up of knowledge among farmers over several years. Scaling-up and incremental successes were achieved by engaging novice aquafarmers in groups or clusters reinforcing each other, utilising elements of the Farmer Field School Approach for widespread aquaculture dissemination.

Benefits of this approach are the provision of fish to enrich the farmer family diet with animal protein and valuable micronutrients, as well as the fulfilment of social obligations such as providing meals to community labour (e.g. joint planting of rice fields, social events, etc.). Ponds and rice field trenches serve as "fish banks" for discretionary access, often far beyond the time that the fish attain their maximum size. Use is made according to market demand, price, customary or social situations.

### ■ Success factors: market access and certification

Initiatives in the introduction of aquaculture to subsistence smallholders in developing countries have a long history with mixed successes. These were limited to their introduction and promotion by NGOs and development initiatives, which in the end were costly per adopted farmer. Experience in both Africa and Asia led to the conclusion that a stronger market orientation leads to wider and faster growth and contribution of the sector to fish availability and income. Increased connectedness to and between markets is the major driver that either turned subsistence mixed farmers with a fish pond into market-oriented small aqua-farmers, or attracted outsiders to embark in aquaculture, e.g. 'aquapreneurs', particularly around urban areas (towns, cities). This change provides greater benefits to smallholder producers as well as poor consumers. For example, in Kenya, small and medium-sized farmers became such "aquapreneurs" by taking a market-oriented business approach. This was triggered by the doubling of fish prices from Lake Victoria as a result of a rise in local fish demand driven by population growth and the decline of fish catch from the lake. An on-going development cooperation project is focused on capacity development of farmer group leaders, farmer group formation, and training of trainers in fingerling and feed production as well as fish farm management.

The recognition of "Best Aquaculture Practice" and the introduction of environmental standards and certification (organic, Good Agricultural Practice [GlobalG.A.P.] and Aquaculture Stewardship Council [ASC]) promoted by government institutions or industry associations can lead to improved performance in terms of environmental, economic and food safety criteria at local and national levels. At the moment, these standards apply to species that are exported to markets notably in Europe and North America. Additionally, examples exist where aquaculture is also engaged in environmental (e.g. biodiversity) and climate change adaptation initiatives, such as in the mangrove areas along the Mekong Delta of Vietnam. Here, shrimp, crabs, molluscs and various fish species are cultivated in "silv-aquaculture", i.e. integrated with mangrove conservation. This means aquaculture production sites are positioned seaward of the protection dikes for coastal zone management, enabling "wise use" of the resources, instead of entirely prohibiting human access and use.

While the process and requirements to meet sustainability standards ('Eco-labels') are more affordable by large export-oriented farms they can also be adapted to smallholder production systems under the "group certification" scheme. For this, the internal control system (ICS) is required such as that under the GlobalG.A.P. Type 2, or the Naturland organic aquaculture criteria. In the near future, the Aqua-

culture Stewardship Council (ASC) plans to release group certification criteria as a means to provide export opportunities to small aquaculture entrepreneurs otherwise oriented towards local markets. However, this scheme requires considerable efforts, including long-term support to succeed, usually from a company within the value chain. Group certification of smallholder organic aquaculture farmers has a history of just over ten years (see also article on page 18). The viability of the approach has been demonstrated, notably in shrimp farming (e.g. in Bangladesh, India and Vietnam). Experiences show that in some sectors, certified products can become a listed item in discounter shops (e.g. organic shrimp), whereas in others they may remain a niche item (e.g. organic pangasius from Vietnam).

### ■ Future challenges and potential

Aquaculture will intensify, diversify and expand. Production of all species groups (including seaweed) will increase. New species will appear in aquaculture, notably in those countries where wild catch of traditional species has declined and their cost to consumers has considerably increased. To achieve this, all environments will be increasingly utilised for aquaculture (e.g. water bodies, rivers, wetlands as well as all artificial impoundments and structures). For higher production volumes, more and more resources and inputs will be used in increasing quantities. However, improving efficiencies will also lead to reduced need for fish oil and fish meal as ingredients in formulated fish feed. More people will be involved in aquaculture production and value chains, providing employment and income,

*Today, more than 80 per cent of fish consumed in Bangladesh comes from aquaculture, largely thanks to the wide availability of juvenile fish for stocking of ponds and enclosures from such small entrepreneurial operators of fish hatcheries and fish nurseries widely distributed in the rural areas.*

*Photo: M. Prein*





but requiring capacity building, appropriate training for the required specialised and complex skills and experience. In this growing sector, more and more constraints will have to be faced too. Informed and responsible governance will need to steer these developments to ensure sustainability. New countries will become important producer nations, e.g. Myanmar and Brazil.

Development needs to be supported to supply growing markets, notably in Asia. Ninety per cent of this production growth will happen in developing countries through highly efficient and productive aquaculture production systems in a range of intensities that supply the growing and quickly urbanising Asian and also Western markets. In parallel, system development needs to continue targeting poorer small to medium-scale farmers contributing to food security and livelihood security in the rural context of developing countries.

Research is needed to enhance productivity as well as sustainability of aquaculture, both in small, medium and large-scale systems. Improvements are needed in health control



*The reliable supply of young fish "fingerlings" for stocking of fish ponds is the most important step in the establishment of an aquaculture "industry", followed by artificial feed supply.*

*Photo: M. Prein*

and food safety, feed ingredients that do not directly compete with human foods, integration of aquaculture in agro-ecological models of production at farm and landscape levels and linkages with the food chain. Domestication allowing for genetic improvement of stocks in aquaculture will be a major driver of production efficiency, creating opportunities to lower the sector's ecological footprint.

Under the scenarios described above, the role for small – to medium-scale aquaculture producers will remain key to contributing to food and livelihood security in the con-

text of developing countries. For instance, the Food and Agriculture Organization's Blue Growth Initiative (BGI) for Small Island Development States (SIDS) estimates that aquaculture can increase total fish production in the Caribbean island states by 30 per cent within ten years if essential investments are made, together with an enabling policy and legal frameworks and supported by applied research, capacity building and information provision.

Developing countries targeting export to industrialised countries will be increasingly faced with a growing range of demand criteria, i.e. certification or labels, price volatility and variability in quality standards in their supply chains. While the European market, driven by societal and economic values, continuously stipulates demanding criteria and standards, this trend may not yet be entirely replicated by other faster-growing markets, e.g. China, India, the Middle East, Russia, Mexico, Brazil, and South-East Asia, although there are trends to establish own national or regional labels and standards, e.g. ASEAN in Asia and the African Ecolabelling Mechanism in Africa.

### Fish feeding – in competition with human consumption?

Up to 25 per cent of all wild-caught fish is processed into fishmeal and fish oil to feed carnivorous and omnivorous farmed fish and crustacean species (salmon, trout, tuna, shrimps and tilapia), poultry and other livestock. Fed aquaculture represents 69 per cent of global fish and crustacean aquaculture production. However, more strategic and efficient use, as well as the development and use of substitutes (vegetable protein and oil ingredients, waste from fish and animal production) caused global fish production used as fishmeal to decrease from an average 23 per cent (26 million tons/year) in the 1990s to 10 per cent in 2012 (16 million tons). Usage of fishmeal has switched from mainly pig and poultry feed to mainly aquafeed, and that of fish oil from mainly production of hydrogenated fats (for margarine) to aquafeed and direct human consumption as supplements (e.g. fish oil capsules). Low-trophic level species mostly farmed in developing countries use fewer supplementary feeds and fishmeal as compared to the higher trophic level species that are mainly supplying markets in industrialised countries. Continued technological improvement of formulated feeds utilising mainly non-fish protein and lipid sources is decreasing production costs. An impact on food security and nutrition would increasingly be achieved if small pelagic fish species caught for feed were sold on the local markets, particularly in Low-Income Food-Deficient Countries (LIFDC).

### Why promote aquaculture?

Overall, reasons for development cooperation involvement in the introduction and spreading of aquaculture are that: (a) more fish is produced and supplied to markets at affordable prices, (b) leading to higher incomes of producers and to economic growth not only along the aquaculture value chain but also in ancillary sectors such as fingerling producers/hatcheries, feed producers, advisory services; (c) certification, at least initially, opens the door to premium-price markets, which helps improve the socioeconomic situation of the farmers; and (d) farmers can lead by successful examples to showcase that such an approach can be successful, earning them local appreciation and prestige. Additional benefits are that the ecosystem services of the natural system are maintained (i.e. non-disruption of ecosystem functions; reduction of external cost to a minimum) and that low input systems also equate to a low ecological footprint (carbon emission per product volume, low inputs for fertiliser, feed, etc.).



A fisher and his catch in Mamburao/Mindoro Strait. The dwindling tuna stocks in the Philippine waters are putting the fishers and their families at risk of losing their livelihoods.

Photo: WWF/G. Yan

# Towards sustainable tuna fisheries in the Philippines

A project run by the WWF has set itself the goal of transforming Philippine tuna fisheries towards more sustainable practices, securing the livelihoods of the small-scale fishers in the long term. European buyers who have committed to source from them provide the necessary incentives.

Tuna are highly migratory fish which undertake long distance migrations through the world's oceans. With annual global catches of about 4.6 million tonnes of the major commercial tuna species (2013), they belong to the most popular food fishes. But industrialised tuna fishing comes at a high ecological price: longline vessels deploy millions of hooks every

day, and purse seiners with huge nets encircle anything that swims under the fish aggregating devices (FADs). These unselective fishing methods cause millions of other non-target marine animals to die as by-catch, such as threatened sharks, billfish and sea turtles. Purse seines also catch small, juvenile fish of overfished tuna stocks, such as bigeye tuna (*Thunnus obesus*) or bluefin tuna (*Thunnus orientalis*). Due to the high fishing pressure, 35 per cent of tuna stocks are overfished.

Catches of yellowfin tuna (*Thunnus albacares*) in the Western and Central Pacific Ocean reached 536,000 tonnes in 2013, to which the Philippines domestic fisheries contributed about 47,000 tonnes. Yellowfin tuna supports the Philippines' domestic food supplies while also being the country's biggest seafood export commodity at 260 million euros per year.

## ■ A case for handline fishing

Tuna fishery in the Philippines is more or less open access, with few measures in place to restrict catch levels. It is divided into municipal fisheries, mainly artisanal fishers using small boats, and commercial fisheries with boats larger than three gross tonnes. The commercial vessels use various fishing gears such as trawls or ring-nets which can catch large amounts of juvenile yellowfin tuna and other non-target species. Up to 87 per cent of total yellowfin tuna landings are small juveniles (0.5–3 kg), with pressure exceeding sustainable levels. This has led to a decrease of yellowfin tuna biomass in Philippine waters and a dramatic decline of the adult yellowfin tuna catches to only 25 per cent of their 1990 level within 20 years. Artisanal handline fishing operations need to extend further out into the

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sea to evade the increasing fishing pressure in nearshore areas. These fishers, originally fishing inwaters up to 15 km from the shore, are now operating up to 100 km offshore.

Artisanal tuna handline fishery has very little by-catch of other species or juvenile tuna. Two to five fishers are employed on each vessel. Every fisher works with a single hook and line deployed at depths of between 50–150 metres targeting only individual, mature tuna. Its selectivity makes the handline fishing method an environmentally sound practice. It has been securing the income of many families for generations.

The dwindling tuna stocks in Philippine waters are putting these fishers and their families at risk of losing their livelihoods. To halt the downward trend of the yellowfin tuna stock and to secure the income for artisanal fishers in the long-term, the World Wide Fund for Nature (WWF) and the food processing company Bell Schweiz AG explored possibilities of improving the sustainability of tuna fisheries. In 2011, WWF launched the “Partnership Project Towards Sustainable Tuna Fisheries” (see Box) in two of the most productive fishing areas in the Philippines: Lagonoy Gulf and Mindoro Strait. Roughly 5,800 handline fishers with 3,200 vessels joined the project.

### ■ Training the fishers, gaining support of local authority staff

To empower handline fishers to participate in fisheries management, the project facilitated the formation of tuna handline associations. A series of community consultations were conducted among the 112 tuna fishing villages of Lagonoy Gulf and 28 tuna fishing villages of Mindoro Strait, during which fishers’ representatives were identified. Based on community feedback and issues identified by the tuna fishers, a community organising framework was designed. Several municipal tuna fishers associations were then founded and legally registered with the authorised agencies.

Close collaboration with partner institutions, such as the Bureau of Fisheries and Aquatic Resources (BFAR) and the Local Government Units, was instrumental in the formation of tuna fishers’ organisations. In order to give the fisheries sector higher priority than it had previously had in all municipalities, the project employed an outreach strategy to gain the support of key local authority staff. The local officers were explained that project interventions were designed to improve governance and secure the livelihood of their constituents via meaningful and active participation of stakeholders in the tuna fisheries management process.

The project encouraged transparent and fair pricing practices and taught fishers how to determine the quality of their fish. Tuna prices are determined through a grading system, ranging from A grade for high-quality red meat down to C grade for light-coloured meat. Tuna that has been exposed to higher temperatures during catch and transport usually turns out with a light-coloured meat and is not suitable for the high-priced surimi market. Through improved handling practices, such as correct storage and improved cooling techniques for the catch, fishers can now actually earn more without having to catch more. The improved quality of the tuna adds substantial value to the catch. The fishery thus becomes more profitable without the need to increase fishing pressure.

In addition, WWF conducted numerous hands-on trainings as well as providing traceability manuals to

the owners of the landing sites and processing companies in the supply chain. These training included discussions on illegal, unreported and unregulated (IUU) fishing that emphasised the importance of adhering to fishing regulations and the monitoring of fishing efforts through licensing and registration, on the proper use of the fish catch documentation and the importance of traceability back to the catching vessel.

### ■ What has been achieved?

The project supported local fishery authorities and fishers in introducing a registration and licensing system to better regulate fishery. More than 70 per cent of the tuna fishing vessels in the project regions have now registered, and fishers have obtained fishing licenses. This provides local authorities with a system to monitor and control fishing activities and combat illegal and undocumented fishing in their waters. To ensure compliance with fisheries laws, WWF also trained fishers volunteering to help patrol fishing areas to detect and report non-compliant fishing activities.

In addition, governance structures have been strengthened by facilitating the establishment of so-called Fisheries and Aquatic Resources Management Councils (FARMCs), which are required by Philippine Law to enable participation of stakeholders in the governance of aquatic resources. The Councils bring together scientists, relevant government agencies as well as representatives of the newly formed

#### The “Partnership Project Towards Sustainable Tuna Fisheries”

The WWF project is aiming to transform Philippine tuna fisheries towards more sustainable practices. Through strong stakeholder involvement and market incentives from buyers in Europe, fisheries governance is gradually being improved. The project is aiming for Marine Stewardship Council (MSC) certification of the yellowfin handline fisheries in the project sites by 2017. In addition, it seeks to provide economic benefits to small-scale tuna handline fishery through capacity building on the proper handling of tuna, as well as generally improving the supply chain through ensuring a robust traceability back to legal catch and quality improvement work with the landing stations and tuna processors. The European-based retailer COOP and the processing companies Bell Schweiz AG and Sea Fresh BV have made long-term commitments to market the handline-caught tuna in Europe. They financially support the project, which is a private-public partnership, together with the German Investment and Development Corporation (Deutsche Entwicklungs- und Investitionsgesellschaft, DEG).

tuna fishers' organisations, who now have seats in the Council and a voice on matters related to governance of their tuna resources.

Fishers now document the catches and provide certificates that give information on the location and time of the catch. Moreover, research plans have been developed to be implemented by local universities in both project sites to help inform a sound management of the tuna resources in future. WWF carried out additional data collection on bait and by-catch species to assess the risk of negative impacts of handline fishery. It appears that the risk of fishery negatively impacting on other marine species or the ecosystem is negligible.

### ■ Challenges and subsequent implementation

The annual process of licensing of tuna vessels grants fishers the right to gain access to fishery resources within the Philippine waters. But the implementation of the licensing systems varies from one municipality to the other. While some offer a free system, others charge, and licensing fees are difficult for the fishers to afford. A major challenge of the project was to harmonise these varying policies in order to find some licensing scheme that facilitated high compliance for tuna fishers in order to combat illegal, unreported and unregulated (IUU) fishing.

By using the MSC criteria for assessing progress, improvements regarding socio-economic conditions of the fishers were not sufficiently quantified, as the MSC does not include such criteria. Clearly, there are benefits for the fishers in the project, such as a higher value of catch through capacity building on fish handling, as well as empowerment of the small-scale sector to participate in governance, which enables a degree of co-management. However, to measure effects of these improvements in socio-economic terms, additional benchmarking criteria to objectively quantify the so-

cio-economic changes are necessary. Therefore, WWF will explore the use of socio-economic criteria for small-scale fishers further. Guidelines and standards such as the FAO Guidelines for small-scale fisheries (see article on page 20) and fair trade standards are likely to form a good basis in this respect.

In June 2014, the Philippines had been warned by the European Commission by means of a so-called "yellow card" for being non-co-operative in the fight against IUU fishing. Shortcomings, such as lack of system of sanctions to deter IUU activities and lack of adherence to regional conservation management measures for fish stocks, had been identified. The EU warning triggered a rapid reform of the fisheries law in the Philippines. The reform has also led to the political will to review the national and local tuna management plans for Lagonoy Gulf and Mindoro Strait, which means stronger measures to ensure a sustainable tuna fishery can be included.

### ■ Outlook

First policy measures for sustainable fisheries management have been enacted. A major task ahead to reach MSC certification is to see to it that the tuna management plans are reviewed to ensure sustainable catch levels of yellowfin tuna in Philippine waters. With the newly formed handline fishers associations, small-scale fishers in the project sites now have the mandate to participate in the drafting of the tuna management plans, thus enabling them to secure their access rights in years to come.


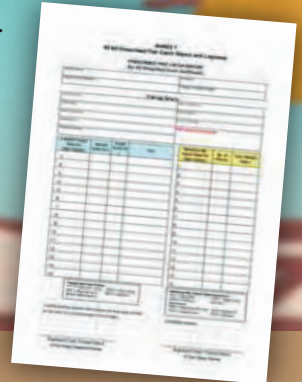
With the envisaged MSC ecolabel, tuna from the Philippine handline fisheries can be readily recognised and accessed by the consumer. The project will set a precedent: tuna travel across entire oceans, so it is important that their stocks are managed sustainably not only at local, but on a regional scale. To this end, the WWF Partnership Project can be used as a learning model for tuna managers in other regions.

### PANGINGISDA AT ANG WASTONG PANGANGASIWA NG MGA HULING TUNA

**Dalihin ang mga huling tuna sa iyong piling buying station.**

Mga dapat alalahanin sa paghatid ng tuna sa buying station:

- i. Suriin ng mabuti ang impormasyon sa Tuna Tags.
- ii. Sasagutan ng kapitan kasama ang taga buying station ang Fish Catch Report.

*Filling in the catch report: An excerpt from the Manual for Fishers. The project provided various training manuals on proper tuna handling and processing to tuna fishers and traders to improve the quality of their catch in a series of workshops.*



## Building confidence in certified seafood: the GSSI

Landing in Ca Mau in the Mekong Delta, Vietnam, among its patchwork of ponds that range from large-scale intensive to small extensive farms, you find yourself in one of the world's most important aquaculture producer regions. It is part of the trend towards a global increase in seafood production that is responding to a growing demand. Per capita fish consumption has more than doubled since 1961, and the Food and Agriculture Organization of the United Nations (FAO) estimates that by 2030, world fish production will have to increase by more than 20 million tons. In terms of helping to minimise the overall environmental impact of how we catch, grow and deliver seafood to meet this growing demand, certification is becoming increasingly important.

In many regions like Ca Mau, the story of seafood certification plays out daily in the lives of local businesses. Here, producers accessing different markets often have to bear multiple audit costs for different seafood certification schemes to satisfy buyers' demands. For smallholders, the costs involved are too high, and even as co-operatives, they can be dependent on a specific market and its fluctuations. At the other end of the supply chain, the increase in certification schemes has been leading to confusion, making decision-making more difficult. Retailers face dozens of certification schemes to choose from, and identifying the credible ones is a challenge as is trying to make sense of it for consumers. In the end, it is making seafood more costly for everyone.

Here, the Global Sustainable Seafood Initiative (GSSI) offers a remedy. In 2013, seafood companies, NGOs, experts, governmental and intergovernmental organisations joined forces in the global platform and partnership to build confidence in certified seafood matters across the supply chain. Thirty-two companies are currently backing GSSI as funding partners, together with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

and the Dutch Sustainable Trade Initiative, IDH. GSSI also counts on the support of five non-profit affiliated partners including FAO and WWF.

### ■ Transparent, cost-cutting and environmentally friendly

In autumn 2015 GSSI will launch its Global Benchmark Tool for seafood certification schemes. It is the result of an extensive multi-stakeholder discussion focusing on three reference documents: the Code of Conduct for Responsible Fisheries, the FAO Guidelines for Ecolabelling of Fish and Fishery Products from Marine/ Inland Capture Fisheries and the FAO Technical Guidelines for Aquaculture Certification.

This tool is to make the certification landscape more straightforward as schemes sign up to be benchmarked and achieve GSSI recognition. GSSI's Expert Working Groups are currently working to finalise the tool based on feedback from a pilot test with eight schemes that participated world-wide (see box) and a second public consultation. GSSI's Global Benchmark Tool will be used to make information available across the supply chain to drive change and lower costs. Producers will have more options to choose the scheme that is right for them and reduce the need for multiple audits. Seafood buyers worldwide will then have simpler, more consistent data to guide their purchasing decisions. The

#### Seafood certification schemes participating in GSSI's Global Benchmark Tool pilot

- Alaska Seafood Marketing Institute
- Aquaculture Stewardship Council
- Global Aquaculture Alliance
- Iceland Responsible Fisheries Foundation
- IndoGAP
- Marine Stewardship Council
- Thai National Shrimp Standard
- VietGAP



*It is difficult for retailers to find the right certification scheme and inform the consumers why they should buy these goods.*

*Photo: J.C. Alexandre*

tool will also work towards minimising the environmental impact of seafood production to meet a growing demand. Open and checked information helps promote environmental sustainability.

### ■ Shaping the seafood sector's future

GSSI is inviting seafood certification schemes to go through the benchmarking process and get GSSI recognised. We aim that by 2020, 30 per cent of seafood production will be certified in accordance with a recognised scheme. Going forward, the post-2015 business model and future strategy are currently being developed. New partners are invited to join this global public-private partnership, and have the opportunity to work on a leading knowledge-exchange initiative and collaborate on topics shaping the seafood sector's future.

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*In the second half of 2015, GSSI, with FAO, is holding a series of regional workshops on certification. For more information, including a list of partners, see: [www.ourgssi.org](http://www.ourgssi.org).*

# Group certification: the silver bullet for smallholders?

Often with just one or two ponds managed by a single person or family, smallholders make up an important share of the world's seafood production. So why are by far the minority of certified aquaculture operations smallholders?

Developing countries account for the bulk of aquaculture production and smallholders dominate the rural landscape throughout the developing world (The WorldFish Center, 2011). Particularly in Asia there is a high concentration of smallholder fish farmers. Certification of seafood production in developing countries generally relates to export markets. A single smallholder does not have the harvest volumes to export alone. Rarely can a single smallholder handle the documentation requirements, administrative work and fees associated with certification. Amongst other reasons, this is why smallholders form groups for certification.

One difficulty is “who” should organise and “how” to organise such groups. Typically in aquaculture, there are three different systems: a) farmers increasingly working together to support each other and be stronger as a group than as x individual farmers, b) a processor selects similar farms to source from and control using group systems, and c) a company/organisation contracts farms to produce on its behalf. While external support increases from a) to c), so does dependency. This is true for both sides. While farms can benefit from external support, reduced risk, more stable

income and access to an export market, they may be bound to fixed sale prices or have to buy inputs from the group. The buying entity, for its part, can profit by sourcing from smallholders and selling to more consistent and premium export markets, but can also lose contracts with importers if smallholders sell elsewhere when prices on the local market rise temporarily. While a) has much less risk of dependency, these types of associations are not always strong enough to develop and maintain export markets. There is a fine line between support and dependency; it can be tricky to find

### ■ The pros and cons of group certification

When smallholders form cooperatives, associations or groups (the term typically used in certification language), small farms can gain access to finance, technology and export markets otherwise not feasible for a single smallholder. This is often achieved by being able to offer larger harvest volumes and having a supporting structure to handle marketing and trade issues. Within such groups, production is often improved thanks to knowledge transfer and resource sharing. In addition, costs for external services (e.g. certification) can be shared within the group.

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OSP – Organic Shrimp Project, Bangladesh: a smallholder carrying his shrimp harvest to the project collection centre.

Photo: M. Stark



a feasible long-term and fair balance between the two.

While sourcing from smallholders in an attempt to fight poverty and improve food security does fit the vision of some retailers, there is a general scepticism about traceability, and to a certain extent, about food safety and supply chains in general. If not very familiar with group systems, it is difficult to understand how an effective internal control system (ICS; see box) can work. There are also differing opinions and some confusion as to what level of traceability there should be in a group system. While a traceability system can be implemented to the lowest level, in this case a single smallholder (farm or hatchery), it is questionable whether product segregation efforts down to this level really make sense. If harvests of a couple of kilos cannot be pooled and must be transported, processed and stored separately, the system becomes inefficient and the group benefit is largely lost. It makes more sense to look at an ICS as a farm with many ponds. If there is reason to block products, an ICS can be suspended in the same way that a single large farm can be suspended.

### ■ Why are not more groups certified?

Not all seafood standards offer group certification. To date group certification requirements in aquaculture are available in the organic sector and under some other programmes such as GLOBALG.A.P. Why this is still fairly limited is not clear, but presumably the need to make the programme grow is crucial before aspects such as group certification for smallholders can be prioritised.

A further aspect which seems relevant is the recent tendency to go heavy on documentation and complexity of requirements. While previously a standard holding body was closer to the farm and a good management system was considered key, a more recent development is to assure independency and distance from

### Seafood standards – a complex system

In aquaculture, certification usually relates to a set of standards as to how an aquaculture operation should be managed and fish should be farmed (e.g. feed ingredients, effluent thresholds, input restrictions). A farm is audited against this set of standards. If production is adequately compliant, the farm is certified as being in conformity with these standards. Standards thus often only address the production system. A standard can then be applied, depending on the scope, to different farm structures, most typically a single farm. This is where things become complicated. A group of smallholder farms, compliant with production system requirements, may not be certifiable if the standard does not allow for group systems, or does not have group certification requirements.

#### What is required to certify a group?

Besides the production system, group structure requirements are needed in order for a group to be certified. The way this typically works is that the group implements an internal control system (ICS), mirroring the tasks of a certification body. When the actual external certification body comes on site, it mainly audits the systems and functioning of the ICS, combined with on-site spot checks of group members' farms and their documentation. The size of certified groups can vary – most have something in the order of 30 up to several hundred group members.



OSP – Organic Shrimp Project, Bangladesh: the certification body IMO (Institute for Marketecology) auditing a smallholder group.

Photo: M. Stark

the farm, and to rely on the recording of parameters. This makes it easier to evaluate and provide evidence (to stakeholders), which is probably the reason for this development. For smallholders, however, this is a tendency that strangles them. The majority of smallholders do not and cannot work with complex recording requirements. And the arguably more valuable aspect of an association such as social mechanisms (structure, support and control) instead of recording are currently not part of group certification requirements. A shift from these administrative and documentation requirements to using other mechanisms as evidence for a well-functioning association would have to be addressed in group certification requirements if smallholders are to

make up a larger share of certified farms. The complexity of setting up such group systems correctly is often underestimated. This is one of the reasons why such systems have sometimes failed in the past. In spite of this, there are a number of well performing groups which show that this concept, given an appropriate set-up, certainly has a future.

There is also some debate and controversy over the question whether smallholders should benefit from simpler requirements to allow their participation in the certified market. Conversely, it is difficult to communicate to consumers why a labelled product may have been produced according to two different sets of requirements.

# SSF Guidelines: Vital momentum for small-scale fishers

With its Guidelines for Securing Sustainable Small-Scale Fisheries (SSF Guidelines), FAO has created a tool that is to help small-scale fisheries stakeholders empower themselves. Our authors describe its strengths and weaknesses and how it is being put into practice.



*The majority of workers depending on commercial capture fisheries value chains operate in the small-scale fisheries sector.  
Photo: N. Franz*

This is changing. The 10<sup>th</sup> June 2014 represented a landmark event for global small-scale fisheries which occurred during FAO's Committee on Fisheries, the leading global inter-governmental forum on fisheries and aquaculture issues. On that day, representatives of over 100 countries as well as observers from Civil Society Organisations (CSOs), regional organisations and non-governmental organisations (NGOs) welcomed the **Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication** (SSF Guidelines). This new international instrument is the first one dedicated entirely to the sector, and it represents a global consensus on principles and guidance for small-scale fisheries governance and development.

Sea-cucumber collectors in the Solomon Islands, women smoking fish in Côte d'Ivoire, gillnetters from Corsica harvesting finfish, rock lobster fishers in Chile, members of the Community Fisheries organisations operating in the Cambodian Tonlé Sap – they all belong to what we call small-scale fisheries. The diversity of small-scale

fisheries in various countries does not allow for a global definition of the sector, but there are many commonalities among these people, be it from marine waters or inland waters, in developing countries or in developed countries.

The often informal nature of operations, the frequently remote and scattered location of small-scale fishing communities as well as a prevalence of social, economic and political marginalisation of its actors have resulted in a lack of attention to small-scale fisheries at all levels. As it is estimated that over 90 per cent of the about 120 million full-time and part-time workers directly depending on commercial capture fisheries value chains operate in the small-scale fisheries sector, it means we are inadvertently neglecting an enormous portion of our fisheries stakeholders.

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## ■ Why are the SSF Guidelines needed?

The small-scale fisheries sector contributes to food security and poverty eradication. It provides food, both for direct consumption and to supply markets. It delivers income and employment to millions of people, with women comprising about 50 per cent of the total workforce in small-scale fisheries, particularly in relation to processing and trade. Despite these positive aspects, the small-scale fisheries sector faces a number of important challenges to being able to fully contribute to food security and poverty eradication. Fisheries resources are often declining, aquatic habitats are de-



grading and competition over space from other, more powerful sectors like mining, industry or tourism are threatening small-scale fishing communities' access to land and water. Small-scale fishers, fish workers and their communities also face a myriad of other challenges, including unequal power relations, lack of access to services and limited participation in decision-making processes, which may lead to unfavourable policies and practices within the fisheries sector and beyond. Weak tenure systems, inadequate fisheries governance structures and non-inclusive management styles exacerbate these problems.

The SSF Guidelines provide an important tool that small-scale stakeholders can use to empower themselves, get their needs addressed and secure sustainable small-scale fisheries. They complement the FAO Code of Conduct for Responsible Fisheries adopted in 1995, as well as other related international instruments, in particular the 2012 Voluntary Guidelines for the Responsible Governance of Tenure of Land, Fisheries and Forestry in the Context of National Food Security and the 2004 Voluntary Guidelines to support the Progressive Realizations of the Right to Adequate Food in the Context of National Food Security. The SSF Guidelines offer guidance and encouragement for governments, fishing communities and other stakeholders to work together and ensure secure and sustainable small-scale fisheries, for the benefit of small-scale fishing communities and society at large.

## ■ Strengths and weaknesses

### Let's start with some weaknesses.

The SSF Guidelines are voluntary in nature. This means that not all countries will necessarily review their approach to small-scale fisheries in light of the principles of the SSF Guidelines.

The SSF Guidelines go beyond what is usually covered in fisheries instruments. There are chapters dedicated to issues such as social development, employment and decent work, gender equality, disaster risk and cli-

mate change, and the SSF Guidelines are promoting a human rights-based approach. These topics pose challenges for fisheries stakeholders who may not be accustomed to reaching out to those outside the fisheries sector because embracing the human rights-based approach to development means analysing inequalities which lie at the heart of development problems and redressing discriminatory practices and unjust distributions of power that impede development progress.

### But there are plenty of strengths.

The SSF Guidelines were developed through a participatory process, directly involving over 4,000 stakeholders from more than 120 countries representing fishing communities, governments, CSOs, regional organisations, international organisations, academia and NGOs. This high level of participation has generated a powerful sense of ownership of and commitment to the SSF Guidelines that continues to grow.

The SSF Guidelines go beyond what is usually dealt with in fisheries instruments. As much as this is a weakness, it is also an opportunity. Small-scale fisheries do not exist in isolation. They are embedded in wider societal and institutional dynamics which, if shaped appropriately, can provide the enabling environment the sector needs to thrive.

## ■ Making it happen: implementing the SSF Guidelines

Mainstreaming the principles of the SSF Guidelines in policies, strategies and actions at all levels will require ongoing collaboration among a diverse group of actors, and there is already evidence of important steps in the right direction. For example, at global level the SSF Guidelines have been incorporated in principle 5 of the *Principles of Responsible Investment in Agriculture* that was adopted by the Committee for Global Food Security in 2014. Members of the research community have connected through the "Too Big To Ignore" network on small-

scale fisheries, which has a cluster dedicated specifically to SSF Guidelines activities. CSOs like the *International Collective in Support of Fishworkers*, the *World Forum of Fisher Peoples* and the *World Forum of Fish Harvesters and Fishworkers* have organised workshops to strategise in relation to their role in facilitating and ensuring uptake of the SSF Guidelines. And FAO is organising regional workshops for South East Asia, East Africa and North Africa and the Near East to work towards regional action plans and facilitate the development of national action plans.

At **regional level**, a number of organisations have already integrated the SSF Guidelines in their strategies including, for example: NEPAD's policy framework and reform strategy for fisheries and aquaculture in Africa, Resolution 15/2014/8 of the Western Central Atlantic Fishery Commission, the Central America Fisheries and Aquaculture Organization's fisheries and aquaculture policy for Central America 2015–25 and the General Fisheries Commission for the Mediterranean's Regional Programme on small-scale fisheries. At **national level**, Costa Rica has included the SSF Guidelines in the National Development Plan 2015–18, CSOs in Mauritania, India, Sri Lanka and Costa Rica have organised workshops and prepared local language versions and videos of the SSF Guidelines to facilitate the fisheries stakeholders' understanding of the principles.

All of these developments are encouraging, and FAO is working to ensure this work continues to happen by setting up a Global Assistance Programme. Partners are encouraged to contribute to this programme to support the implementation of the SSF Guidelines, thereby helping to reverse the history of neglecting an enormous portion of our fisheries stakeholders and enabling the small-scale fisheries sector to make vibrant and sustainable contributions to food security and nutrition, livelihoods and poverty alleviation.

For more information and downloading the SSF Guidelines, see:

➤ [www.rural21.com](http://www.rural21.com)

# Satellite data aid India's fishermen for better livelihood

Sailing out to sea in the morning and returning without a catch in the evening is now a thing of the past for many Indian fishermen. A satellite-based information system shows where they can find rich fishing grounds.

It's 5 pm in the village of Velankanni in the southern state of Tamilnadu. Arumugam Nagaraj prepares his boat for fishing in the sea. He casually looks at his smart phone and checks the GPS location to find his way to fishes. Confidently, he steps into his boat, ready to catch fish for the day.

Like Arumugam, about seven million people spread across the 8,100 km coastline in India depend on fishing for their livelihood. In the past few years, unpredictable weather patterns and non-availability of fish in the usually available locations has, however, raised questions on the future of fishermen's livelihood. Nagapattinam district, where Arumugam lives, faced the serious wrath of tsunami in 2004. "Since the tsunami devastated this coastal region, the fish catch and availability has changed, and so have the wind movements," says Arumugam. "We used to go long distances into the sea, only to come back empty-handed. Today, with the 'potential fishing zone' advisory, we know the GPS location of the places where fishes can be found."

## ■ The science behind PFZ

Scientists from government research institutes on Earth Sciences, Space and Fishery Sciences collabo-

rated to bring a unique fishery service called Potential Fishing Zone (PFZ) advisories in the 1990s. A potential fishing zone is identified on the basis of sea surface temperature (SST) and chlorophyll concentration. "This information, which is received through satellite, indicates us where fish aggregation happens," says Nagaraja Kumar, a scientist at the Indian National Centre for Ocean Information Services (INCOIS). "The fishes need food to survive, and to find it, they will come to places where there is chlorophyll concentration." The Centre provides the advisory for the fishermen on a daily basis to 586 fish landing centres in 14 states along the Indian coast at no cost. A hundred thousand fishermen have been using this advisory until now. The information is given throughout the year except during the marine fishing ban imposed by the Government of India. The ban was for 45 days last year, but this year it has been increased to 61 days. The time of the ban varies across the East and West Coast of India. Says Nimit Kumar from INCOIS, "On the basis of monsoon observations, it has been found that the fish breeding season coincides with the south west monsoon period, when the ocean condition is hostile." A fishing ban is imposed because of bad weather conditions and to conserve fish species during breeding time. The forecasts are not given during adverse conditions like cyclones, high waves, tsunamis, etc. either.

The advisories are in the form of PFZ maps and text with details on di-



A fisherman from Velankanni uses his mobile phone to check weather conditions before entering the sea.

Photo: S. Balasubramanian

rection, distance, depth, latitude and longitude, and GPS location of the place where fishes could be found. Due to the changing nature of the ocean, the fishing zones identified on the maps could shift from the marked location. Hence, to guide the fishermen on the probable shifts in PFZ, information on wind speed and direction is incorporated in the PFZ maps. This information helps the fishermen in locating the PFZ identified in the maps, even if they reach it a day later. This information is not different from what is used in traditional ways of finding fish. A study on satellite-based PFZ in Tamilnadu and the Union Territory of Puducherry indicated that fishermen who used this information correlated their traditional knowledge with scientific data. For instance, fishermen traditionally use natural indicators such as water colour, wind speed and direction, tidal fluctuations and bird aggregation.

PFZ advisories were found more beneficial to artisanal, motorised and small mechanised sector fisher-

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men engaged in pelagic fishing than to activities such as ring seining, gill netting etc. Typically, the information given on pelagic fishes is traced through chlorophyll concentration via satellite. These fishes are found in upper water levels. Satellite information will only be available as far as light penetrates the ocean, which is where pelagic fishes live.

### ■ ICT tools for PFZ

INCOIS has partnered with NGOs, industry, government and private organisations to disseminate the satellite data to fishermen. For instance, the MS Swaminathan Research Foundation (MSSRF), one of INCOIS' partners, downloads real time information from the INCOIS website and converts the data into content for easy use by fishermen. The information is given through their Village Knowledge Centres and Village Resource Centres. "We get information for today and tomorrow at major fish landing centres, and this is given in the native language and local measurements the fisherman understand," says S. Velvizhi, a scientist at the MSSRF. Nagaraja adds: "Initially, fishermen were reluctant to accept the technology, but over time, we succeeded. This happened with the support of NGOs, who made this information available to fishermen on the ground."

The information is given through diverse information, communication

### What fishermen say

"PFZ advisory has changed the way we catch fish. We used to go to the fishing locations, using time-consuming old practices to find fish. Not only did we lose time, but we wasted fuel and were not even sure if we were going to find fish. Then I came to know of PFZ advisory and used the audio message to find the fishing location. Following the GPS points in the PFZ, I caught fish worth Rs 80,000 at one time."

*Kutti Andi, a fisherman from Nagore, Tamilnadu*

### What fishermen say

"I used PFZ on few occasions, and it is 80 per cent accurate. Once I got fishes worth Rs 75,000 in a single day, which helped me pay my debts. With scientific awareness, we are confident of catching fishes. Also, with additional information like wind speed and weather conditions, we know what to expect when we go to the ocean."

*Arumugam Nagaraj, a fisherman from Velankanni, Tamilnadu*

and technology (ICT) tools including a fisheries helpline number, audio messages, community radio, mobile applications, email, electronic display boards, local television networks, newspapers and text messages. In a survey done in 2012, it was found that over 77 per cent of the fishermen across Tamilnadu and Puducherry were receiving PFZ data through mobile-based text messages provided by MSSRF village resource centres. It was also found that information exchange among fishermen played a huge role in sharing PFZ location, which in turn is benefiting the community.

According to Nimit, the most important aspect of this advisory is that it is not about catching more fish, but about catching fishes efficiently, through environmentally responsible ways to reduce the time spent on searching and cutting fuel consumption. All the regions, whether deep sea fishing practised by large trawlers, or fishing close to shores by smaller fishermen are treated as an equal playground. Advisory is given to both these types of fishermen. Says Nimit: "When we give advisory for larger trawlers, they directly move into the ocean, taking the pressure off the coastal regions. This gives room to smaller and traditional fishermen to pursue fishing close to the coast, sufficiently fulfilling their requirement. Also, smaller fishermen now venture further into sea, using catamarans. Considering that only a tenth of fishermen are currently using it, there is no risk of overexploitation." And Nagaraja adds: "To prevent overex-

ploitation of fishes, we only give information on pelagic fishes, which are found throughout the year. This is given for reasonable locations and productive areas where there is high probability of getting fishes."

The study done on PFZ users in Tamilnadu and Puducherry in 2012 reveals that 60 per cent of fishermen using trawlers benefited from the information. Small craft fishermen constituted a whopping 40 per cent, indicating that smaller fishermen were making significant use of the PFZ advisories.

### ■ Huge economic benefits

PFZ advisory leads to a 30 to 70 per cent reduction in time spent to catch fish, and as a result, this adds to saving fuel and thus reducing carbon emissions. The National Council of Applied Economic Research (NCAER) estimated in December 2010 that annual net economic benefits due to PFZs based on satellite data would be in the range of Rs 340 billion to Rs 500 billion.

Over a decade, fishermen, who have taken technology in their hands, have witnessed a change after using PFZ advisory. It has not just made their livelihood more reliable, but has also contributed to savings in time, reducing fuel consumption, higher income, and preventing themselves from venturing into the sea in adverse conditions.

### What fishermen say

"On a single trip, I spend ten days for deep-sea fishing. I take 2,000 litres of diesel, and one trip will cost me 1,000 litres. Before using the PFZ advisory, we went to the same location twice if we didn't find anything, spending more fuel and time. Now, I save ten hours of time and almost 100 litres of diesel since I know where the fishes are, and I take my boat directly to the place."

*Rajkumar Selvaraj, a fisherman from Nagapattinam, Tamilnadu*

# Small fish with a big potential for women's business?

It would be difficult to imagine the diet of the local consumers around Lake Victoria without the silver cyprinid. The small fresh water sardine also plays an important role in women's participation in Kenya's fishery sector. However, in spite of intensive efforts, there is still a long way to go before they have achieved an equal role in the value chain.

The small fresh water sardine-like silver cyprinid (*Rastrineobola argentea*) is traditionally one of the most important fishery species for the food security of the local population around Lake Victoria. Next to the imported Nile Perch (*Lates niloticus*), it has become the second most important commercial species. With a surface of 68,000 km<sup>2</sup>, Lake Victoria is the largest lake in Africa. It is bordered by three countries: Kenya, Tanzania, and Uganda. Even though Kenya only governs six per cent of the lake's surface, local catches of the silver cyprinid, known locally as *omena* (*dagaa* in Tanzania, *mukene* in Uganda) accounted for more than half of Lake Victoria's total fish landings (456,721 metric tons) in 2011.



Women and children sun-drying omena on nets at Lake Victoria's seashore, Kenya.  
Photo: K. Schütz

## ■ The development of the sector

Supported by international investment, the export-oriented Nile perch fishery has constituted the highest landings in volume and become a major source of foreign revenue. This development has significantly changed the traditional multi-species into target species oriented fisheries. Thanks

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to its lower value, *omena* has maintained its role as the most dominant fishery resource sold to end consumers in local fish markets. The maximum sustainable yield (MSY) for the Kenyan *omena* sector of Lake Victoria was estimated at 190,000 tons in 2000. In 2008, the production of *omena* of 47,000 tons, valued 17 million euros, was still far below the estimated fishing potential. In Kenya alone, about 850,000 people directly depend on this fishery. Four main market channels developed that support over two million people. These include both local and export human food channels. While human food channels represent 30 per cent of total annual production, at 70 per cent, local and export-oriented animal feed channels account for the lion's share (Kamau & Ngigi, 2013). Export includes fishmeal for pet food and, to a minor extent, salted high-quality *omena* for the

Eastern and Southern African markets. A significant but unrecorded quantity of *omena* milled in Kenya comes from Tanzania and Uganda, either legally or illegally (in order to avoid customs duties and import tariffs).

## ■ An important element of food security

Estimated per capita fish consumption in Kenya ranges from 3 to 5 kg per person and year. *Omena* accounts for 35 per cent of the country's total fish consumption. By comparison, Nile perch is more expensive and is not the preferred fish by Kenyan taste. With tilapia prices having tripled over the past six years, *omena* has gained popularity, resulting in a demand for better quality *omena* at better prices. Since 2012, it has also been sold packaged in supermarkets.



*Omena* has the advantage of divisibility and affordability. It is valued thanks to its low cost, nutritive value and unit quantity that can be purchased at a given time. For the equivalent of 0.30 euros, an *omena* stew can be prepared that feeds two people. This is particularly important during dry spells when agricultural production is low, or fails. *Omena* is eaten with its bones (calcium) and head (vitamin A). It contains phosphor, polyunsaturated acids and oils such as omega 3 and 6. It is thus not only a valuable source of protein but also provides micronutrients that are particularly important for children and childbearing women.

### ■ Clearly defined roles

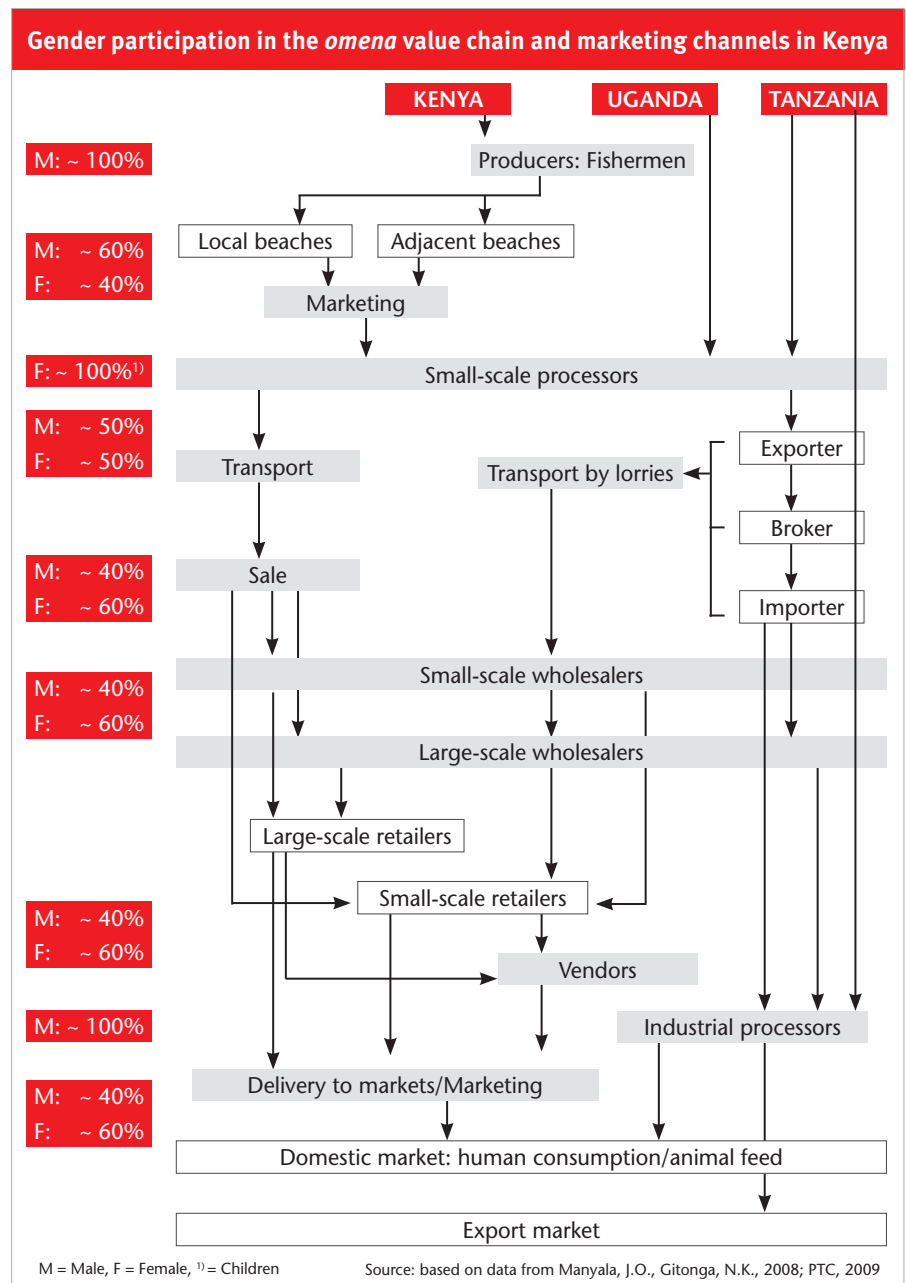
Women have always occupied a central place in Kenya's fishing sector. However, cultural, social, economic and political factors and a high rate of illiteracy amongst women in fishing communities account for their marginalisation and their being given little attention in fishing. As shown in the Figure, the *omena* fishery value chain includes men, women and children. Fishing, including ownership of boats (3,000 boats targeting *omena*) and gear, as well as industrial processing is mainly dominated by men (30,000 fishermen). Women, however, dominate the onshore post-harvest sector and are the main actors for small-scale processing (800,000 women). Transporting, marketing and sale is shared by men and women, with women accounting for the larger share.

*Omena* is caught by fishermen and landed at the lake site where it is mainly sold to women. However, the downside of this trade is that due to the high competition amongst buyers, the traditional *jaboya* – originally referring to a business partner in the fishery community – lead to a type of prostitution in kind. The main vulnerable victims are single women, divorced women and widows. The 'sex for fish' practice is thought to have contributed to the HIV/AIDS pandemic in the Lake Region (where prevalence rates are twice as high as in the rest of the country).

Post-harvest processing, i.e. the washing and sun-drying of fish on nets or on the ground, is almost exclusively done by women; children are also frequently involved in this business. In 2011, fresh *omena* was sold for 0.30 euros per kg, and after drying its price rose to 0.50 euros per kg depending on the quality and market demand. Today, prices of 0.90 and 1.30 euros per kg for fresh and dried *omena* respectively can be obtained at Kenya's markets. Approximately 20 euros is needed to start an *omena* drying business that provides a daily income. It is therefore very accessible for women who are landless and often

widowed and have little, if any, access to credits.

Sun-dried fish is favoured by the women as it provides choice of time and place for marketing, thus avoiding competition with their other chores. Its end-use for human consumption or animal feed (mainly chicken) depends on the quality. Rejections are mainly due to dampness, presence of debris, discolouration and the presence of freshwater shrimp (*Caridina*). The reasons for these shortcomings include the lack of adequate landing and processing sites, use of polluted lake water to



wash the fish, and insufficient drying during the wet season.

### ■ Value chain development

In order to counter these shortcomings, the German Corporation for International Development (GIZ), on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), and the Ministry of Agriculture, Kenya, started to implement the development of the *omena* fish value chain as a component of the 'Private Sector Development in Agriculture' (PSDA) programme. By 2008, the initiative had reached 5,000 households of Kenyan fishermen, women processors and traders. The main objectives were the formation and strengthening of market-oriented fishermen and traders groups and associations, and capacity building of the respective members and officials.

In total, three associations were formed and registered. Fishermen and traders were equipped with the necessary skills to improve quality, conditions of marketing for their products and the purchase of inputs. Special attention was provided to women groups to establish hygienic handling and processing and to improve business skills to reduce post-harvest losses and increase profitability. The

Umoja Fish Traders Sacco Group in Kisumu is an example of best practice. Supported by the programme, the group improved its financial management and management structure, leading to a doubling of savings to 12,000 euro within two years. These funds are used to grant loans to group members for establishing other commercial activities, or to improve their *omena* business.

Overall, the *omena* value chain component resulted in increases of 15 to 20 per cent in income for producers, processors and traders. Better quality (lower humidity, sand and debris-free dried produce) and well-packaged *omena* yielded economic benefits. It fetched 100 per cent higher retail prices compared to fish commonly processed under unhygienic conditions. Feed millers offered price increases of 50 per cent for quality *omena*. The higher income led to improvements in livelihood, especially in the areas of education and food security. Additional income was invested in the diversification of economic activities, for example poultry keeping, opening a shop or horticulture.

Moreover, GIZ supported the necessary policy development. Thus, PSDA's interventions have resulted in an increasing collaboration and networking between stakeholders of the *omena* fish value chain and their

organisations, for example the Lake Victoria *Omena* Fisherman and Traders Association (LOFTA). The results-oriented linkages between public and private stakeholders of the *omena* value chain were assured through the formation and regular meetings of a value chain committee. The linkages established helped to develop trust, partnership, and information exchange.

### ■ To sum up ...

The programme contributed to improving the livelihood of people depending on *omena* and the *omena* value chain in Kenya. One success is the incorporation of value chain development in Kenya's agricultural policy. The proportion of higher quality *omena* was also increased in the project region. For example, the feed industry responded with a 50 per cent increase in price for higher quality *omena*, i.e. free of sand. However, the women rejected drying on raised racks, opted for initially to further improve hygienic processing conditions. The expected rise in sale prices for such produce did not happen; hence additional investment costs were not accepted locally. Thus, in the context of the project, traditional air drying on old nets, but with improved hygiene standards (through washing) and reduced impurification (e.g. through sand or stones) was advocated. The development of construction options that use cheaper yet effective and durable materials or support from the public and private sector to access affordable drying racks may help to arrive at locally accepted solutions. Efforts are still needed to further improve the hygienic handling and processing regulations and standards. There continues to be a need to strengthen the role of women in the value chain. An inventory of fishing infrastructure and equipment carried out in 2014 revealed that 1.2 per cent of all fishing boats were owned by women. Although it is too early to predict a trend, it seems as if women are now entering the traditionally male-dominated sector of *omena* fishery.



Women marketing *omena* at Kisumu, Kenya.  
Photo: D. Ostermeier

For references, see: ► [www.rural21.com](http://www.rural21.com)



## High tech to secure fish stocks

Mauritania's coastal waters are among the world's richest fishing grounds. However, just as in many other countries around the globe, the sustainable use of this resource is under threat from illegal fishing and overfishing. KfW contributes to protecting the valuable fishing grounds with the aid of modern surveillance systems and rigorous conservation and species protection measures.



*In Mauritania, some 60,000 people directly or indirectly earn their living from fishing.*

*Photo: KfW Bankengruppe/M. Ruffert*

Few people would associate Mauritania with great abundance. Situated on the western edge of the Sahara, desert sands constitute roughly eighty percent of this African country. Water shortage and drought are prevalent. Nonetheless, this desert nation also has a lavish, abundant side to it where land meets ocean: Mauritania's 700 kilometre long coastline, which stretches from the Western Sahara in the north to Senegal in the south, is among the world's most plentiful ocean fishing grounds. Meagres, gilt-head seabreams, squid, as well as tuna, seabass, spiny lobsters, mackerels and

many other species can be found here. These waters owe their great diversity to two ocean currents of different temperatures which meet off the African seaboard and provide ideal conditions for numerous fish species.

For many years, mostly foreign fishers, if anyone at all, exploited these rich fishing grounds "outside" the country. The Mauritians themselves are nomads by tradition, herding livestock, which they drive with their families across the country. They had not much of an interest in fishing as they rarely consumed fish. As a result, fishing villages were few and far between. However, in the 1970s the situation began to change. Driven by government initiative the fishing sector has become a pillar of the Mauritanian economy and meanwhile has even developed into the backbone of the national budget. Almost a quarter of government revenue is generated

from the sale of fishing licenses and other income generated by the sector. Moreover, some 60,000 people directly or indirectly earn their living from fishing. The incomes generated in the sector feed more than 360,000 people or ten percent of the population. The fact that the processing industry and trade depend on the fishing production chain makes the sector that much more important for this structurally weak country. Women in particular find employment and prospects in the sector.

### ■ Controls to halt overfishing

Illegal fishing and overfishing, however, threaten fish stocks and thus the livelihoods of several hundred thousand Mauritians. One of KfW's objectives is, in consultation with the Mauritanian government and as commissioned by the German Federal

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Ministry for Economic Cooperation and Development (BMZ), to take action to remedy the situation. KfW has been committed for 25 years now to enabling effective monitoring of the 200-mile zone off the Mauritanian coast for illegal fishing and the catching of prohibited species. In 1990, KfW started by funding a first patrol vessel. Since that time, KfW has supported the installation of state-of-the-art technology, i.e. a satellite system combined with a variety of surveillance and radar stations that are lined up along the coast at regular intervals from north to south, like pearls on a string. A total of 40 million euros has been made available for fisheries surveillance to date. All vessels travelling through Mauritanian waters must now transmit exact location data and must comply with established fishing zones and times as a precondition for receiving licences for transit passage or fishing. Satellite communication is used to receive these data in modern monitoring stations where they are gathered and assessed. This system is complemented by radar stations along the entire coast which gather information on ships without satellite links or whose equipment is not active. Radar allows the coastguard to locate such vessels. Funding is also provided for surveillance vessels and patrol vessels, in addition to the satellite system and the radar array. As soon as the surveillance centre notifies the presence of an intruder, the boats move out to apprehend the offender. Thanks to modern technology this is no longer a major challenge.

All these measures aim at protecting the country's rich fish stocks, so

### KfW engagement in Mauritania

KfW, in addition to the French Development Agency AFD, the private conservation foundation MAVA, and the European Union, is among the main donors contributing to securing fish stocks and maintaining biodiversity in Mauritania. The KfW project on "Fisheries surveillance for sustainable resource management" has now entered its fifth phase. The next planned steps include a dedicated berth at the coastguard's headquarter and an additional radar station to further increase monitoring density. Moreover, KfW is funding a new patrol boat for Mauritania's southern coastal region.

as to also allow the next generation of Mauritians to earn a living from fishing and safeguard the state's future revenue from the sector. In its activities, KfW works in close cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) which for many years had seconded an advisor to the Mauritanian Fisheries Ministry.

### ■ Protecting juvenile fish and spawning grounds in the national park

The delivery of sustainable fisheries in Mauritania must however start at an earlier point, which is why KfW also fosters nature conservation and resource protection measures in the unique coastal Banc d'Arguin National Park, a 12,000 square kilometre nature reserve. More than 2.5 million migratory birds overwinter here every year. UNESCO even declared the area a World Heritage Site. The national park's waters are spawning and nurs-

ery areas for millions of juvenile fish. They are a prerequisite to the regeneration of Mauritania's fish stocks and thus essential to the country's abundant fish resources.

In order to protect and maintain these stocks, motorised vessels are completely banned from passing through or fishing in inshore areas; only a limited number of the indigenous fishers' traditional pirogues are permitted. The surveillance systems co-financed by KfW as part of its financial cooperation also help to protect and maintain these fishing grounds.

Given that sustainable fisheries management requires the coming together of a number of different components – orderly licensing, control of the 200-mile zone, maintenance of spawning grounds – KfW also supports the national park in the development of its infrastructure. It currently finances to the sum of 10 million euros, for example, the construction of new national park administration offices on the reserve's margin and of monitoring stations and access tracks. A further 10 million euros have so far been placed in an endowment fund entitled "BACoMaB" (Banc d'Arguin and Coastal and Marine Biodiversity Fund Limited). The yields of the fund provide long-term financing for coastal protection – a further contribution to sustainability.

### ■ A suitable model for other coastal states

The measures adopted to monitor and protect the waters are proving effective: in Mauritania's coastal waters, illegal fishing, formerly rampant, is now largely halted. This safeguards the regeneration of fish populations, thus contributing vitally to the country's future. The situation in other regions of the world is, however, less reassuring.

According to the Food and Agriculture Organization of the United Nations (FAO), overfishing of the oceans has been increasing continuously in recent years and has reached worry-

Important "low-tech" elements of monitoring: a nautical chart and a device to measure meshes.

Photo: B.Schoen





ing proportions: Almost 30 per cent of global stocks are already overfished, while fish constitutes a key component and vital protein source in the diet of three billion people, or almost half of humankind. Moreover, more than 500 million people are economically dependent of fishing, either directly or indirectly. The significance of the fisheries sector simply cannot be overestimated. Therefore it is all the more important to have in place good mechanisms for monitoring fishing activities in conjunction with the long-term maintenance of fish stocks. Mauritania has understood that the sustainable use of fisheries resources is in the country's long-term interest. But this was a long process; it took a lot of convincing and with the help of successive infrastructure development it had to be shown that set objectives can indeed be met.

Mauritania is the only country at present where KfW is engaged in this field. But many other countries are faced with the challenge of implementing efficient fisheries surveillance. The experiences gained could easily be transferred to other regions, starting with the West African coastal countries to Mauritania's south (the resources of which are largely not in similarly good condition). However, while undoubtedly there is a need for similar projects to strengthen often existing but weak structures, there is only a limited degree of interest among governments and donors. The introduction of an effective fisheries surveillance requires a strong political will as well as transparent decision-making – good governance in short. It has to be kept in mind that such protection policies curtail short-term economic interests of some powerful players.

The project in Mauritania was successful, in particular due to the fact that it enabled the Mauritanian coast-guard to use modern technologies to curb illegal fishing and simultaneously protect the spawning grounds. This is crucial for the regeneration of fish populations and thus safeguards not only species protection but also the livelihoods of many thousands of people.

## Eyes on the sea – Towards a more transparent fisheries sector

The Mauritians as a former nomadic people traditionally looked inland towards the desert; for a long time most Mauritians had no relationship with the ocean. They rarely ate or processed fish and for a long time failed to notice the potential of sustainable resource management on this front. This has changed over the past twenty years. Not only does fish feature ever more strongly in the diets of Mauritanian households (with a current annual per capita consumption of 6 kg), but public and private sector engagement has also very much increased in this area. The fisheries sector currently contributes approximately 15 per cent of direct government revenue and is thus, together with iron ore, the Mauritanian government's main source of revenue. In contrast to the mineral resources it also creates a large number of jobs.

Since 2005, Mauritania has participated in the Extractive Industries Transparency Initiative (EITI) process. EITI was founded in 2003 with the objective to increase transparency over state revenues from extractives companies with a view to fighting corruption in countries rich in raw materials worldwide. Since 2012, Mauritania has been counted amongst the 31 EITI "compliant countries" – a major success for this nation.

### A separate standard for fish resources

Lately the Mauritanian EITI Committee has also considered inclusion of fisheries, following the lead of other countries which have integrated renewable resources, and forestry in particular, into the EITI process. At the same time the discussion on sustainable and economic management of fish resources gained traction in the country and led to a paradigm change as well as reform efforts in Mauritania's official fisheries policy. At the initiative of the EITI Secretariat, the year 2012 saw the first meeting of more than sixty private sector and civil society stakeholders as well as representatives of relevant ministries who discussed increased transparency in the fisheries sector. In January 2015 the Mauritanian

President Abdel Aziz, the then Chairman of the African Union, expressed his ambition to establish such a transparency initiative for his country.

In response, the Mauritanian government, together with the Humboldt-Viadrina Governance Platform, a non-profit organisation based in Berlin/Germany, established a separate Fisheries Transparency Initiative (FiTI). In terms of its working process the FiTI takes its orientation from the EITI initiative. It is planned that from 2016 onwards national multi-stakeholder groups will begin FiTI implementation, starting with initial pilot countries including Mauritania.

The World Bank has simultaneously been working on an international fisheries transparency initiative. In Mauritania this initiative supports transparency in the fisheries sector under its "West Africa Regional Fisheries Program" which was adopted in March 2015. The initiative includes components addressing good governance and sustainable management of fisheries. Moreover, the European Union supports steps towards greater transparency as part of their fisheries agreement with Mauritania. Potential synergies between the various efforts towards transparency are currently being explored.

### The difficult path towards implementation

The measures show that the Mauritians are no longer solely focussing on their terrestrial resources but are turning the spotlight on activities in the fisheries sector. However, the declarations and initiatives of recent months must now be translated into concrete action. Judging from experience, in the fisheries sector this is bound to be a long and arduous process.

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## Captain Iglo mustn't come to Africa!

During the last few years, the donor community has increased its efforts to reduce the large amounts of fish lost in the distribution chain in artisanal fishery, an endeavour that ought to be welcomed in principle. However, focusing on one single solution, the development of an expensive cool chain and the supply of fresh or frozen fish, represents a massive interference with the traditional processing and distribution channels, with women being the main losers. Our author calls for more foresight in international co-operation.

Over the last 30 years, fish consumption has doubled world-wide. However, the developments this has entailed have virtually eclipsed people in Africa. This is despite the fact that, in terms of today's US dollar value, approximately ten billion dollars of official development assistance (ODA) was provided by the countries of the Organisation for Economic Co-operation and Development (OECD) for around 1,400 projects to develop the fisheries sector of sub-Saharan Africa. The assessment by the World Bank in its critical study on the state of the world's fisheries sector, "The Sunken Billions", applies especially to Africa. But for the people living on the coasts in the region, more is at issue than a business news item. With the decline in fish stocks, cultural values and social contexts in the fishing villages are disappearing as well. This is also the case in particular for the women's economies, for unlike, for example, in agriculture, women play a dominant role in artisanal fishery.

### ■ Returns on foreign exchange as the top priority

For decades, the fishing grounds in Africa were one of many natural resources that its governments and the international donors used to serve the economic development of the countries or at least to reduce their debts. A glance at the development projects reveals a long list of large-scale investments – in ship fleets, port expansion, warehousing and logistics, and all for industrial fisheries and to get those species of fish ready for export that earn foreign exchange on the world market. In this respect, fish, such as the Nile perch in Uganda, tuna in Mozambique or hake in Namibia, do not differ from the other foreign exchange favourites of the international donor community such as cotton, coffee,

fruit and vegetables, sometimes offering short-term success for the government budgets, but often having a disastrous impact on the fishing grounds of artisanal fishery.

### ■ Overfishing from all sides

One typical example of "catching-up development" can still be "admired" in the industrial port of Tema, Ghana's most important port city. Here, 30 tuna fishing boats are rusting away – all that is left of a proud fleet once numbering 150 vessels that the Soviet Union built for the country, albeit certainly not for altruistic reasons. Towards the end of the 1980s, when the European Union was staking its claims in the newly declared 200-mile zones for its own fishing fleet, there was no longer anything to do for most of the Ghanaian fishing boats. But by the time they were withdrawn, just like the European Union's fleet or the Japanese and Korean ships, many of them had decimated the fishing grounds of artisanal fisheries to an extent that in the 1990s, development co-operation no longer saw any point in further involvement in West Africa's fisheries sector. German development co-operation in particular withdrew from the seas – with one big exception. Mauritania has set an example of sustainable development in fisheries management that secures revenue for the state as well as fishing licences for the EU and other countries while massively promoting artisanal fishery (also see Article on page 27). Most of the other fisheries projects supported by the international donors are not in the same league as Mauritania's success story. Even Norwegian development co-operation, which strictly observes sustainability, has to note in an evaluation report on its biggest financial effort, the establishment of fisheries monitoring in Mozambique, that alone the annual follow-up costs of a rebuilt patrol ship are far higher than total revenue from the licences for industrial fishing boats.

### ■ Donors discovering artisanal fishery

In the wake of their experiences with supporting industrial fishery, international donors came back after the turn of the millennium to address artisanal fishery. It is no coincidence that, alongside Japan, the harshly criticised fishing nations off the coast of Africa such as Spain, France and Portugal,



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with EU, World Bank and Food and Agriculture Organization (FAO) support, should be trying to rid themselves of their guilty conscience by backing artisanal fishery, after decades of ruthless overfishing in African waters.

Since then, there is hardly any fishing village that has not become the object of some study on fisheries management. As the communities have had no feedback on the results of these analyses and the projects have no impact whatsoever on the conditions they are living in, people view new projects, also those of NGOs or environmental associations, with scepticism, well-meant thought they may be. Despite selected representatives of the fishing communities being invited to the countless workshops of the donor communities and international NGOs, levels of catch have hardly changed, and fishers still have to go to great lengths to finance boats, engines and nets in advance. There is hardly any training and absolutely no support for the formation of professional organisations that could address governments and the international community at eye level.

Currently, a development is being hotly debated that shows in an exemplary way how the short-term interest of the donors and governments of the partner countries to score fast economic success can result in conflicts in a professional area or social unrest and ultimately creates even more poverty.

### ■ Nothing works without women

World-wide, the activities when the catch has been landed have turned into a sector dominated by women. Unlike their role in agriculture, in the fisheries sector, they are not cheap labourers without (land) rights but represent the most important economic actors. Usually, it is women

*Kayar, Senegal. More and more often, the women processing the fish are left with these little anchovies, called "Yayyboy" in Wolof.*  
Photo: F. Marí



*Elmina, the centre of artisanal fishery on Ghana's Gold Coast. Far too few landing stages and outdated port logistics.*

Photo: F. Marí

who buy the catch, and also women who process the catch and trade it. At least this is the case with the small pelagic species which turn the catch into valuable food. With the income from processing and trading, the women pay the pirogue captains, advance the money for fuel and ice or offer loans for spare components, new nets or cooling boxes. This division of labour is accepted by the men, who are often not the husbands of the women, because they are unable to perform the post-catch activities themselves. This means that fish is only turned into money and food when women process or sell it. Increasingly more women are also becoming boat owners, for on poor fishing days, the fishermen are often unable to repay the money for fuel and loans.

### ■ The aim: gaining access to the export market

Sea bass, gilthead sea bream and tuna or other premium fish are only rarely processed by the women for the local demand, for only a few Africans can still afford such food. Provided that the expensive fish actually does enter the nets – it too was a target of the industrial fishing fleets for decades – it is almost exclusively earmarked for export. In this area, women are only rarely found as middlemen. They lack relations with clients in Europe or with the local processing factories.

Over the last few years, in their efforts to strengthen artisanal fishery for these export markets, donors and governments have focused on small-scale fishermen fulfilling international regulations such as traceability in the context of combating illegal fishery or the high hygiene standards for fish imports in the EU. The basic precondition for exports is constant, uninterrupted cooling that already starts on the pirogue. This is why French and Spanish development cooperation in particular has promoted the construction of ice factories and cold storage warehouses. The governments

have simplified the import of refrigerated lorries, and investors have been found to set up fish factories that immediately clean, cool or freeze the fish and make it transportable for the night flight to Europe.

In principle, this is sensible from a development angle. In Senegal, for example, where 60 per cent of exports are now provided by catch from pirogues, but partly also in Ghana, a higher added value and a higher share of artisanal fishery in exports has been achieved.

### ■ Undesirable side effects: competition with local processing

However, the existence of an unbroken cool chain for fish does also have side effects. For more and more often, refrigerated lorries can be seen at the landing stages for pirogues in Senegal or Ghana that are ordered by middlemen so that they can take the prime selection of the catch of local pelagic species (mackerel, anchovies). They then drive their cargo to the adjacent fish factory, which used to solely process premium fish for exports. Now prime selection pelagic fish is also deep-frozen. This fish is then brought into the hinterland or taken to neighbouring countries such as Mali or Burkina Faso on long night hauls. In the past, no fresh fish from the sea was on the market in these remote areas. Both the hinterland and the coastal cities were supplied with smoked, dried or salted fish that the women had previously preserved and that was brought by middlewomen. This ensures that the fish will keep. It is an important product for a healthy diet among the rural population, also in those locations where the lack of electricity does not allow for cooling and deep-freezing. Now frozen fish is becoming a rival product. Even though so far, only restaurants and the local middle classes have been able to afford it, a distribution channel is developing for fish that could dominate the market in the future. For in West Africa, just like elsewhere, supermarkets

*Mbour, Senegal. More and more often, middlemen now come from Dakar to take their pick of the best fish for hotels, tourists or exports.*

*Photo: F. Mari*



are penetrating the provincial areas. And this means that international standards are being introduced that can hardly be fulfilled by local products such as smoked fish.

### ■ Women are losing their source of income

The situation in other countries of West and Central Africa that are low in fish shows how at least small towns with a power supply can be provided with frozen fish. For the big catches of the EU pelagic “monster” ships casting their nets off the coast of Mauritania are not brought to Europe but are frozen on board and sold as EU exports throughout West Africa. Nigeria, Cameroon, Ghana or Côte d’Ivoire rely on this imported fish throughout the year or at least seasonally. Where a local processing tradition exists, this imported fish serves as a year-round input. In a country like Cameroon, which has only little fish off the coast and little experience in fish processing, imported frozen fish is sold on the market in pieces and is only then prepared in private kitchens, similar to meat. This “privatisation” of processing is also thriving in the women’s economies along the West African coast. It is threatening the income of thousands of women in the fisheries sector and, ultimately, also the relationship between fishermen and the downstream women’s economies which, while not being free of conflict, has as yet remained balanced.

Women can still process “second-choice” fish from the pirogues because, at least during the season, enough fish is available. But they are getting smaller and smaller fish that is not so well suited for drying or smoking and then loses even more weight through water evaporation. The women are therefore calling on their governments and on the international donors to take their needs and their role in maintaining fish supplies for the population into consideration. If the women cannot process the fish, poor households will lack food rich in protein in the off-season. If the women are earning a lower income, they will more seldom be able to pay the fishermen sailing out to catch fish that is not exported.

Of course it is not as if women in the fisheries sector were against public-supported cooling facilities for the storage of fish. On the contrary. If cooling and refrigerating facilities with a subsidised power consumption were available, women could process fish throughout the year. Fish would not have to rot on the beaches because it is not processed, and all year round, consumers would have their local fish sold at stable prices that they could afford. But the development of long cool chains along the entire distribution route encourages more women being ousted from the sector.

Women are now beginning to work out their own strategies that also serve maintaining the supply of fish for the poor population. Women’s groups are pooling their assets and financing pirogues and their crews who may only deliver their catch to them. Often enough, thanks to their strong position in the sector, they are already the owners of the fishing boats or the engines and nets and can thus force



the fishermen to exclusively supply them. In Côte d'Ivoire a businesswoman has bought small refrigerated lorries in order to buy fish along the Ivorian coast that is then centrally provided for traditional processing in Abidjan.

### ■ Lessons learnt?

However, the women in the sector are aware that they will have to meet higher standards in the markets of the future. It remains to be seen whether this will prompt them to invest in more modern smokers, like the one now advocated by the UN Food and Agriculture Organization (FAO). This new oven, based on the Thiaroye Processing Technique (FTT-Thiaroye), reduces firewood use and health risks through smoke emissions. Unlike the men working in the fisheries sector, women are proficient in business management. They know only too well that donor support will come to an end one day. It is therefore surprising that the FAO should be distributing videos advertising the new smoker in order to persuade women to use it without making any mention of how much they would have to invest and, above all, what the follow-up costs are like. Just like many of the improved and certainly useful predecessor smokers, the FTT-Thiaroye ovens are now probably going to become the favourite tools of the donors and NGOs providing them free of charge. But if they do not pay their way on the market in the poverty economies, they will not find further distribution.

So enough aspects remain for all development co-operation programmes in the entire field of artisanal fishery to rectify mistakes and support and strengthen the sector. But not only must this be performed taking gender issues into account. There must also be greater involvement of all those employed in the sector. Fish products are too important for reducing hunger and malnutrition to dispense with efforts in the fisheries sector of Africa and other developing regions.



*Kayar, Senegal. Competition from refrigerated transports is making the marketing of dried fish for exporting more and more difficult.*  
Photo: F. Marí

So far, German development co-operation has failed to enhance the local value chains supplying the informal markets with a sustainable fisheries strategy of its own, which is what the German Ministry for Economic Cooperation and Development (BMZ) does in the agricultural sector. In its "One World – No Hunger" initiative, for example in the Green Innovation Centres, one will unfortunately look for fish in vain. However, there are indications that this is set to change and that the Ministry has approved of a special "Sustainable Fisheries Global Venture". This would certainly be welcomed in the coastal countries, especially by the women working in the sector – provided that the same mistakes aren't made all over again.

## Georg Forster Research Award

The Alexander von Humboldt Foundation grants the Georg Forster Research Award to researchers of all disciplines from transition and developing countries. The award winners should already have an international reputation and be involved in academic work that is expected to help solve issues of relevance to development.

Scientists and scholars at research institutions in Germany can nominate outstanding research personalities in order to develop long-term international research collaborations. Funding for the awards, which are valued at € 60,000 each, derives from the Federal Ministry for Economic Cooperation and Development.

The closing date for nominations is 15 January 2016.

[www.humboldt-foundation.de/web/georg-forster-award.html](http://www.humboldt-foundation.de/web/georg-forster-award.html)





# Insects – a protein source with a recycling potential

Like in other areas of livestock keeping, the growing demand for fish raises the question of how the feeding of animals can be maintained without competing with the provision of food for humans. The use of insect proteins could help save natural resources while simultaneously making use of organic waste.

Feeding livestock in farming results in an enormous world-wide demand for animal feed, which nowadays substantially exceeds a billion tons a year (Alltech, Global Feed Survey Results, 2014). The chief components are grain, soy, fishmeal and oilseeds, and all of them are either directly or indirectly in competition with human nutrition. At the same time, approx. 1.3 billion tons of food is wasted each year through harvest and processing losses, damage during transportation and simply being thrown away (FAO, 2011). The UN Food and Agriculture Organization (FAO) is reckoning with the world population growing to around nine billion people by 2050 and, as a result, an increase in food demand of 70 to 100 per cent compared to 2011. Given rising losses of tillable cropland, this food will have

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to be grown on the basis of the areas available today, if not on even less land. This will only be possible through a sustainable intensification of the use of natural resources, for example through a maximum recycling of existing organic resources.

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## ■ Recycling organic residues

This notion of recycling is now being taken up by an increasing number of scientists as well as the animal feed industry, who are developing research and development concepts for food waste recycling with the aid of insects and their larval stages. Research and industry are focusing in particular on five species and genera: the housefly (*Musca domestica*), the black soldier fly (*Hermetia illucens*), the mealworm (*Tenebrio molitor*), grasshoppers (*Locusta migratoria*, *Schistocerca gregaria*, *Oxya spec.*, etc.) and the silkworm (*Bombyx mori*, etc.). The black soldier fly (BSF) is particularly interesting because it has some crucial advantages in comparison to other species, such

as a short generation time and robustness towards diseases. Furthermore, the protein pattern of the larvae is very similar to that of fishmeal. The fly does not transmit any diseases, neither is it referred to as a “pest”. The larvae will eat virtually any type of organic substrate and are ideally suitable for the recycling of food waste. Drying, defatting and grinding of the larvae yields raw material for feed with a protein content of approx. 60 per cent and a raw fat content of 11 per cent (Maurer et al., 2015; Buser, 2014).

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## ■ Research: from a holistic approach ...

Especially in tropical and subtropical areas, the development of insect proteins on the basis of organic residues (market and household waste, by-products of food processing, etc.) is meeting with increasing interest since it also provides cheap access to animal feed for smallholders and subsistence peasants. In December 2013, Switzerland’s Research Insti-



tute of Organic Agriculture (FiBL), in close collaboration with the University of Ghana, the Biotechnology and Nuclear Agriculture Research Institute (BNARI) and other Ghanaian partners, launched a research and development project combining waste management, compost research, animal feed development and aquaculture. In addition to the supply of animal feed, the IBFFP (Insect-based Feed and Fertilizer Production via waste transformation for smallholders in Ghana) project aims to provide solutions for the areas of settlement waste, community hygiene and improvements in soil fertility. A stable breeding colony has since been established, and there are initial insights into how the composting processes can be designed with the aid of the insect larvae. Concrete results regarding composting time, maturing of compost and the formulation and performance of the fish feed from the larvae are reckoned with in the course of the year. Supporting socio-economic surveys are to establish what acceptance among the population is like and how effective these strategies are regarding improvements in income and poverty reduction.

**... to a practical feeding test.** The suitability of insect flours in poultry and fish feeding was recently tested at the FiBL in various studies focusing on the example of hermetia flour (Maurer et al., 2015; Stamer et al., 2014; Buser, 2014). During a three-week trial feeding of laying hens, the soy component of the feed was replaced 50 to 100 per cent by *Hermetia* flour. In comparison to the control feed, no significant differences in feed intake and laying performance of the animals were recorded. In all groups, the animals' health and plumage remained stable during



*Hermetia* larvae  
Photo: T. Alföldi, FiBL

the trial period and did not differ from one another. Also, in repeated studies of trout, it was demonstrated that fishmeal can be replaced approx. 50 per cent by *Hermetia* flour, without any significant drop in performance regarding growth over an up to seven-week trial period. In this context, an interesting insight was gained regarding the quality of insect flour. Mechanical partial defatting of the insect protein can result in better processing in the manufacture of concentrated feed and to a better digestibility in the fish. When the fish were later on tasted by an untrained test panel, no significant differences in quality (texture, taste, etc.) were ultimately noticed in the fish fillets between the *Hermetia*-fed animals and the control group fish.

#### ■ Practicable ...

Throughout the world, a number of firms are already stepping up the production of insect proteins on an industrial scale; the most important ones are AgriProtein from South Africa and Enterra from Canada. They produce larvae and their derived products of the species *Hermetia*, *Musca* and *Calliphora* on the basis of organic waste products. The goal of the companies is to achieve a respective an-

nual production of several thousand tons of insect flour per site. Also, both companies sell the residues of insect composting as fertiliser or soil conditioner and the extracted fat as "MagOil". Several small firms in Europe distribute insect flours and larvae for the pet food market.

#### ... but many open questions remain.

The University of Wageningen in The Netherlands ought to be mentioned as one of the most important and premier research centres in the field of entomophagy – the eating of insects – and the use of insects as animal feed and food. In May 2014, more than 600 scientists and industrial representatives gathered at the "Insects to feed the world" conference to discuss the entire range of topics and problems in the branch. But although there is enough enthusiasm at workshops and congresses, some problems still remain unsolved. In this context, legislation in Europe is of particular importance since it does not allow insect flours to be fed to livestock animals, including fishes. Neither do regulations for the feed basis for the feeding of the insect larvae exist that are satisfactory for this young branch of industry. Food waste graded as potentially risky (so-called K3 material, which is of animal origin) may not be used as livestock feed in the European Union (EU). This applies to insects as well, for they too are regarded as livestock. Neither may animals that have been fed with insect flour be imported. These restrictions are not in force on the Asian, South American and African markets nor in Europe outside the EU (e.g. in Turkey). Swiss authorities are currently assessing the authorisation of *Hermetia* flour as a fish feed additive.

Furthermore, a number of technical problems still have to be tackled. As yet, there is no proof of the efficiency levels in the production and processing of insects and insect flours yielding a return of invest within a minimum of time. There are still considerable economic risks. It can only be hoped that both at European level and worldwide, political decisions will be taken as soon as possible facilitating a further development of the branch.

#### Research at EU level

In addition to production technologies for the breeding of *Musca domestica* and *H. il-lucens*, an EU research project called "PROteINSECT" focuses its activities on the safety and quality of products and on environmental aspects. A further European venture has been initiated in France by research and industrial partners. The project, named "DESIRABLE", deals with the development of production methods for various insect species in the context of a so-called bio-refinery. Different products (proteins, fats, functional biomolecules, chitin/chitosan) are to be produced on an industrial scale. The project also concentrates on the development of insect-based feed for fish and poultry. For references and further reading, see > [www.rural21.com](http://www.rural21.com)

# Hot topics in aquaculture research

Experts agree that the rising demand for fish for human consumption cannot be met without a major expansion and sustainable intensification of aquaculture. Our WorldFish authors describe the areas in which research plays a particularly important role in this context.

Meeting the future demand for supply of fish for human consumption will require the expansion and intensification of aquaculture, whilst maintaining growth within ecological limits. Future fish supply-demand scenarios suggest that farming of fish and other aquatic animals will need to double production by 2030 to meet growing global demand (World Bank, 2014). Given that production of fish from fisheries is projected to decline or remain at current levels under optimistic projections, the vast majority of future growth will need to come from aquaculture. Aquaculture now provides around half of the fish eaten by humans, and recent analyses (OECD/FAO, 2015) suggest that aquaculture supply will overtake capture fisheries within the next decade. The shifting consumption from wild to farmed fish has important nutritional, environmental, and economic implications. Aquaculture is already the world's fastest growing food production sector, growing at approximately 8 per cent per year, and the relative youth of the sector in many parts of the world offers opportunities for research to identify models that maximise different types of benefits for humans and the environment. This article highlights five "hot topics" for attention, with special reference to aquaculture development in Africa and Asia. We focus first on nutrition, a key area for



A woman cleaning fish at her house in Jessore, Bangladesh.  
Photo: Y. Tushar

the future, followed by four other topics for attention.

## ■ The role of fish in improving nutrition and health outcomes

The world faces multiple challenges to sustainably meet the food and nutritional requirements of a population that is projected to reach over nine billion people by 2050. While challenges of undernutrition, including micronutrient deficiencies, and infectious diseases continue to be the main focus of attention for low – and middle-income countries, problems of overnutrition and non-communicable diseases are rapidly rising in prevalence and placing an increasing burden on health systems. Addressing this "double burden" of malnutrition will require a significant shift in current approaches to food systems to increase production and consumption of the foods known to benefit human health, including fruits and veg-

etables, nuts and seeds, whole grains, and fish. Indeed, low consumption of each of these foods are important contributors to global death and disability (Ezzati 2013).

Fish and other aquatic animal products are a commodity of key significance in global diets. Food balance sheet data suggest that at least one billion people depend on fish as the main source of animal food, and three billion people rely on fish for at least a fifth of their intake of animal source foods, though these figures are subject to great uncertainty. For rural inland poor populations in Asia and Africa, dried fish is a particularly important food; such fish are often small, and consumed whole. As a result, they contain higher levels of nutrients including calcium, zinc, iron, and vitamin A than normally are available in larger fish. Fish is also an important source of vitamin B12, which is only found naturally in animal source foods and plays an important role in the

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function of the brain and nervous system. Fish also contains a factor, sometimes called the “meat factor”, which enables greater absorption of micronutrients from other parts of the diet.

While the micronutrient profile of many fish species remarkably fills many of the same gaps that are limiting in the cereal-based diets of the rural poor, the public health world recognises fish largely for its rich content of omega-3 fatty acids, including EPA and DHA. It has been estimated that a quarter of all disability-adjusted life years lost (DALY's) due to ischemic heart disease and one per cent of all worldwide DALY's are due to low intake of these nutrients. Recent analyses revealed that 80 per cent of the world's population had mean intakes of less than 250 mg/day, with extremely low levels (<100 mg/day) prevalent in sub-Saharan Africa, South America, and Asian mainland nations (Micha et al., 2014). These results led the authors of the study, published in the British Medical Journal, to call for “concerted public health and policy initiatives ... to increase both supply and consumption.”

Increasing the impact of fish on human nutrition in a food system changing from wild to farmed production systems represents a special challenge and opportunity for aquaculture, with more “nutrition sensitive” approaches required. Whilst it can be argued that increasing supplies of a nutrient rich product – fish – is in itself a nutrition-sensitive action, there are further positive measures that can be taken to secure improved nutritional outcomes from aquaculture. Some key areas of attention for research include:

(1) The development of aquaculture farming systems that **increase the supply and access of nutritious fish to poor consumers**. The introduction of micronutrient-rich fish into home-stead pond polyculture systems in Bangladesh for home consumption and sale provides one example (see Thilsted, 2012), but further research on enhancing nutritional outcomes from aquaculture, such as through optimisation of fish species combina-

tions, pond management and harvesting systems, across the developing world is necessary.

(2) The development of feeding systems that **increase the nutritional value of fish**. Whilst there has been some research around enhancement of omega-3 fatty acids in Atlantic salmon through feed ingredients and fish feeding systems, very limited work has been done on developing country aquaculture species such as tilapia, carps and catfishes. The manipulation of fish diets, and feeding and fertilisation systems, where possible through use of locally available feed and fertilisers, is an area of research with much potential for increasing the nutritional value of fish.

(3) **Harnessing fish to meet nutritional needs during the first 1,000 days of life**. Evidence, largely from developed countries, suggests that fish consumption during pregnancy is particularly beneficial, and is associated with reduced risk of preterm delivery and higher performance on multiple tests of brain development by children. As a rich source of multiple micronutrients including zinc and iron, fish can also play an important role in meeting the considerable micronutrient needs of children aged 6–12 months, who are growing rapidly but have limited gastric capacity. Yet evidence from multiple settings in Africa and Asia suggests that animal source foods are often withheld from the diets of young children and women. Behaviour change communication and food processing technologies can play an important role in overcoming the barriers inhibiting these sub-populations from benefiting from fish.

(4) **Improvements in preservation and food safety of fish to ensure greater access for poor people**. As a perishable commodity, fish is believed to be highly subject to waste and food safety issues. Yet little reliable evidence exists to document the extent of such problems, or the burden that they place on human health. There is an important need to build evidence and to put in place thoughtful interventions that can reduce waste from both fisheries

and aquaculture, improve fish safety, but at the same time keep fish affordable for poor populations.

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## ■ Improving technologies

Aquaculture is a young industry – growing fast, yet still behind livestock in many aspects of technology, such as the **development of improved breeds, feeds and farming systems**. Improvements in breeding technology, disease control, feeds and nutrition, and low-ecological impact production systems are all interlinked areas where research can complement traditional knowledge to improve efficiency and productivity of aquaculture. Increases in agricultural productivity have been achieved through the integration of technologies designed to improve productivity and efficiency. In comparison, the global aquaculture industry has developed intensive production systems for only a few species. As one indicator of the immaturity of the sector, improved breeds contribute just ten per cent of aquaculture production systems worldwide (Olesen et al., 2015). Biotechnical research needs to be combined with analysis of market and supply chains to identify key enablers in upgrading value chains and a policy environment for investment and sustainable growth. These sorts of innovation – whether led by farmers, research institutions, companies, or governments – have been behind productivity gains across the world and need to be further supported in growing aquaculture sustainably into the future.

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## ■ Jumpstarting a Blue Revolution in Africa

Africa represents a region of special challenges for aquaculture. While fish is an important source of nutrients for many populations, particularly those near the Great Lakes and the coastal regions, the vast majority of these fish come from wild fisheries, many of which are experiencing declining productivity. World Bank projections of future fish supply predict Africa as the only region with declining per capita

fish consumption, from an already low consumption, declining at an annual rate of one per cent to 5.6 kilograms/person/year by 2030, with serious implications for nutritional security within the continent. Egypt is the region's largest aquaculture producer, with strong growth that now supplies one fish per week for all Egyptians, yet development of aquaculture at the scale needed has been fairly limited to date throughout sub-Saharan Africa. Aquaculture has been growing fast in some countries in sub-Saharan Africa, such as Nigeria and Ghana, but this growth is from a low base, and a substantial boost in supply will be required to meet future demand. An enabling environment appears essential for successful scaling of aquaculture technologies within the region, and a strong market-oriented approach is emerging as a condition for successful stimulation of commercially-oriented development and investment. Aquaculture expansion in Africa appears to occur only when functional value chains supply quality inputs and market incentives allow investments in profitable commercially-oriented aquaculture production, and where enabling policies are in place. Research is needed on what the enabling conditions are for aquaculture expansion in sub-Saharan Africa and where the priority value chains are for investment in aquaculture growth.

## ■ A greener aquaculture

The necessary doubling of aquaculture production across the developing world in the next few years will face significant environmental constraints (WRI, 2014). Recent WRI/WorldFish research has examined aquaculture's environmental footprint today and explores various scenarios of aquaculture growth to 2050. On average, fish convert feed to food as efficiently as poultry, making them an attractive option for expanding the global animal protein supply. However, as with all forms of food production, aquaculture isn't without its environmental impacts, and the sector needs to be well prepared for climate change. As aquaculture began to boom in the



*A hatchery worker holds Abbassa Nile tilapia grown at a hatchery in Egypt.*

*Photo: H. El-Begawi*

1990s, several concerns emerged, such as the clearing of mangroves to make way for shrimp farms in Asia and Latin America, increased use of fishmeal and fish oil made from wild marine fish, and the generation of water pollution and shrimp and fish diseases. The aquaculture industry has greatly improved performance since the 1990s, producing more farmed fish per unit of land and water, lowering the share of fishmeal and fish oil in many aquaculture feeds and reducing carbon footprints and impacts of mangrove conversion. Implementing improvement across the sector through widespread adoption of current best practices will be needed to significantly reduce its environmental impacts and increase its resilience to climate change. Research on improvements in land and water use efficiencies, reducing greenhouse gas emissions and new developments in feed will be required to reduce the footprint of aquaculture's growth. Reducing reliance on marine resources such as fish meal and oil for fish feeds, a key ecological footprint of aquaculture, will also be essential to increase the positive impact of aquaculture on global fish supply.



*A farmer feeding fish in her household pond in Bagerhat, Bangladesh.*

*Photo: M. Rahaman*

## ■ Engaging the private sector

Aquaculture's growth, focused largely on the developing world, provides multiple new employment opportunities in fish production, marketing and processing, with private investment as a major engine of growth. Improving collaboration between the research community and both private and public sectors will be important to ensure that research creates impact and supports an inclusive and sustainable growth of aquaculture in the future.

Across the developing world, special attention needs to be paid to the many small and medium-scale (SME) aquaculture enterprises, which represent by far the majority of aquaculture producers. Many SMEs lack access to the credit and technology needed to succeed and grow sustainably. Commercial interest in aquaculture investment is probably at an all-time high, yet much commercial investment presently misses small-scale enterprises, a sector that can create significant employment across the developing world, with proper attention. WorldFish has developed an Incubator facility to connect research with SMEs and support the early start-up of scalable small and medium-sized aquaculture enterprises, cooperatives and farmer organisations, which have potential for high positive economic, social and environmental impact. Its primary purpose is to help bridge the current divide between research, aquaculture SMEs in the developing world and investors seeking scalable, high-impact, triple-bottom-line investments in the aquaculture and the seafood business. Due attention to this key component of the aquaculture sector across the developing world provides opportunities for researchers, policy makers and the investment community to accelerate the growth of an inclusive aquaculture sector, creating food, nutrition and employment for many.

You can find out more about the work of WorldFish at: [www.worldfishcenter.org](http://www.worldfishcenter.org). A full list of references is available at [www.rural21.com](http://www.rural21.com)





The dung produced by the animals flows into a brick-built fermenter set in the ground, rendered with grey cement, and from here a gas pipe runs into the kitchen.

Photo: M. Egbert

## Simple technology with a major impact

Biogas in Vietnam is chiefly the story of the success of small domestic digesters. However, a feed-in tariff for electricity generated by biogas plants could soon lead to larger scale use of the technology, and so provide new sources of income for farmers.

Le Thi Thanh Thuy stands among woks, pots and pans on her tiled kitchen floor and points to the pressure gauge on her little biogas digester. The simplicity of the technology is fascinating. A wooden board, a transparent plastic tube full of water and a few markings. "When the pressure in the digester gets too high I have to cook." If she doesn't use the biogas it can escape from the fermenter via a pressure release valve. "But that almost never happens because we always need it all", adds the farmer, who lives in Khanh An village in An Giang province in the Mekong Delta.

Every day Le Thi Thanh Thuy cooks three meals for the family in the kitchen, which also contains beds for her three children. She often looks after her sister's children as well. Yet she never needs to worry that the biogas

will run out. Behind the family's house are four zebu and twenty pigs, which produce around 75 kilos of dung every day, enough to run a biogas plant of almost ten cubic metres. The plant is connected to a pipe running directly from the small cowshed. The dung flows into a brick-built fermenter set in the ground, rendered with grey cement, and from here a gas pipe runs into the kitchen.

The family has not needed to buy gas for the last three years, so saving the equivalent of 150 euros a year. For this they only have to pay back forty euros a year on the loan that they took out for the four hundred euro plant, and have already paid off a third of it. Le Thi Thanh Thuy's husband takes care of the plant's maintenance, but at the moment he is away selling blocks of ice that he has bought from a factory to shops, homes and restaurants. "The income is crucial to supplement our livestock farming", explains Le Thi Thanh Thuy. A saving of around one hundred euros a year from running the little digester is therefore significant for the family.

### ■ 145,000 digesters installed with government support

"Even really small-scale farmers with two cows or six pigs have enough manure to run a digester that meets their own energy needs", says Pham Thi Hoa, President of the An Giang Bioenergy and Sustainability Association (ABSA). She receives us in the conference room at the Ministry of Agriculture of the delta province of An Giang, together with Nguyen Minh Trang, General Secretary of ABSA. The domestic digesters are being built as part of a government programme with substantial support from the Dutch development organisation SNV. With the aid of grants and low-interest microloans farmers can buy domestic digesters of between six and almost ten cubic metres. To date the programme has enabled 145,000 digesters to be installed in more than forty provinces. One plant helps to save over six tonnes of CO<sub>2</sub> annually. Less firewood is harvested, and contamination of the environment by untreated dung and the use of artificial fertilisers is reduced. That is because the farmers

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can use the fermentation residues to fertilise their fields and gardens.

ABSA has installed 1,350 of these plants in An Giang province alone. To this end the organisation employs a team of 35 tradesmen. Under the programme only spherical brick fermenters are built, although there are other completely different designs as well. A neighbour of Le Thi Thanh Thuy has one of these. The path to Ha Nguyen Vu's home crosses a rickety bridge over one of the countless canals in the Mekong Delta. The pressure gauge on Ha Nguyen Vu's biogas plant is of even simpler construction: it consists of a plastic bottle filled with water and a short piece of tubing. If the pressure in his biogas tank gets too high the water in the bottle starts to bubble. "Tank" is perhaps something of a misnomer: to be more accurate, it is two clear plastic bags shaped like sausages hanging beneath Ha Nguyen Vu's wooden hut, which is mounted on stilts. The methane in the bags is fed in from a pit, draped with the same plastic sheeting, beside his pigsty. In this way, five cubic metres of dung, all produced by the ten pigs that are dozing in the heat in the shady sty, are fermenting down in the middle of the little garden. A gas pipe runs from the pit through forage grass and sugar cane to the two tanks beneath the house. "The tanks are needed to build up enough pressure", explains the smallholder, who also works as a portrait photographer as well as repairing watches and sunglasses for his neighbours. As someone who enjoys making things, he built the biogas plant himself. "I copied what other people were doing." The materials for the plant cost just the equivalent of forty euros, and in fact the only problems he has are with the plastic covering the pit. "I have to replace it every year; either the mice eat it or a hen pecks a hole in it." Ha Nguyen Vu grins and draws on his cigarette.

## ■ Securing the substrate

Nguyen Vo Chau Ngan from Can Tho University is familiar with problems of this kind. However, the clear plastic "storage sausage" of his pilot



*The students at Can Tho University are carrying out research into suitable substrates.*

*Photo: M. Egbert*

plant on the campus at Can Tho, the largest city in the Mekong Delta, just droops limply. Fortunately he has students: they laugh as they compress the methane in the tube, so that Nguyen Vo Chau Ngan can still demonstrate how well the biogas burns in the little stove. Yet the scientist and his team are studying far more than this. After all, biogas has been the subject of research in Vietnam since the 1960s. Although this research was halted after the USA's full-scale intervention in the war in 1965, it resumed in 1975, immediately the war was over.

The scientists at Can Tho University have developed a wide range of different designs for domestic digesters, tested them and evaluated their performance in the field. They are also carrying out research into suitable substrates. As well as animal manure, the intensively farmed delta region can provide many other substrates, most notably rice straw and the water hyacinths that proliferate on almost all water bodies. These have to be removed every year to keep the shipping routes and fishponds clear. "Although a lot of households keep pigs or cattle, many only have very few and these are mostly sold for the New Year celebrations", explains Nguyen Vo Chau Ngan, "but then they have no more dung to run the biogas plant." That is why models that can also run on other substrates are needed. However, water hyacinths have to be turned in the digester more often and more thoroughly than dung, for example. And they require a fermenter with a larger capacity. "On the plus side,

the productivity of plants is higher with mixed substrates." If pig manure is mixed with rice straw or water hyacinths the plant produces almost twice as much methane, plus there is an improvement in the quality of the residues used as fertiliser on the fields or as feed in fish and shrimp farming. "We have to make it clearer to people that a biogas digester won't only save them the money for fuel." With suitable microgenerators at the larger microplants electricity could be generated as well.

## ■ Planning for tomorrow's energy supply

However, electrical energy could be produced by larger biogas plants in Vietnam as well. It is not only in the Mekong Delta that the farmland of Vietnam offers huge potential for animal waste and residues of sugar cane, rice and starch production. In addition to these there is organic waste from the growing landfill sites in the cities and sewage from water treatment works. Ten billion cubic metres of methane could be captured annually from all these sources combined – and the country needs new sources of energy. Vietnam has demonstrated significant economic growth for a number of years: even immediately after the global economic crisis of 2008 it was running at almost six per cent. However, neither the infrastructure nor the energy supply can keep pace with this growth. By 2020 energy consumption is forecast to rise to 330 billion kilowatt-hours per year, representing a threefold increase within ten years. This is in contrast to an installed capacity of 21,542 megawatts. Hydroelectric power provides forty per cent of this. Electricity shortages and power cuts are everyday occurrences in the dry season, and Vietnam will soon have to import fuel to run its coal-fired power stations.

According to the Vietnamese government's 2011 master plan for the national energy supply, 1,700 megawatts would actually need to be added each year to meet the growing demand. Renewables are to play an increasing part in this. By 2020 they



should generate 5.6 percent of the energy supply, which is almost double the 2010 share. The government aims to expand biogas and biomass to 500 megawatts. Despite this, experts estimate the number of larger-scale biogas plants at fewer than twenty. Of these, only a small minority generate electricity. That includes even the state-owned flagship Go Cat Power Plant with its three 2.4 megawatt generators. Most of the time it stands idle and, moreover, the landfill in Ho Chi Minh City that supplies it is set to close.

Many operators simply burn the methane because it is produced during the mandatory treatment of their waste, while others use it to generate process heat, for example in cassava processing and piglet rearing.

## ■ Cash for energy

Despite all the potential, what the country has lacked until now have been feed-in regulations with payments that make the operation of a biogas plant economically viable. Recently, however, things have changed. Since the middle of 2014 there has at least been a payment scheme for electricity from landfill gas. Although the 7.28 US cents per kilowatt-hour does not altogether meet expectations in the region for the return on capital, any more than the tariffs for wind power or solid biomass, it is at least a start. A feed-in tariff for electricity from digesters at farms and food processing plants is also due to follow shortly. "These initial steps are right and important. We are convinced that there will now be steady market development", says Tobias Cossen from GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), which was involved in designing the scheme. "There are plenty of examples from other countries where over-promotion has led first to a boom and then to the collapse of the market."

Greco Farm's biogas plant is already generating electrical energy. Do Minh Luan takes a run-up and leaps up onto the fermenter. Although the

black plastic sags as he strides over it, it is bulging with enough methane to bear the farm manager's weight – just like a bouncy castle at a children's party. Do Minh Luan slides back down and grins with pleasure. "The plastic can take that." Quite an achievement, considering that it covers a pit 1,800 square metres in area, six metres deep and containing up to 8,000 cubic metres of pig manure. But the farmer is not only pleased with the construction of his biogas plant. "In only two more years we will have recouped two thirds of our investment."

## ■ Investment quickly repaid

Greco Farm in An Trach Dong in Bac Lieu province in South Vietnam is a family concern, run by Do Minh Nha, the manager's brother. The family only went into business a few years ago with a small shrimp farm. Three years ago they switched to pig fattening, and now keep 4,500 pigs. Most of these are sold to a dealer who transports them to Ho Chi Minh City, so producing a quick profit for Greco Farm.

That is why the family was able to finance most of the cost of the fermenter, equivalent to around 40,000 euros, itself. Second-hand generators manufactured in Japan and America clatter away in the power plant. "So far they have been reliable – they had only been used for 1,500 hours when we bought them", Do Minh Luan shouts above the noise and wipes the

sweat from his brow. With an electricity output of around 600 kilowatts in total the generators ensure rapid repayment of the investment. They operate for approximately ten hours a day, supplying not only the pig farm but more importantly a twenty-hectare shrimp farm nearby. It needs electricity to drive the propellers that oxygenate the densely stocked breeding ponds. "We don't have power cuts like the public grid", says Do Minh Luan. The environment benefits too: Greco Farm used to just tip their manure into a pit and sterilise it with calcium carbonate. Now they can sell the solid residues from the fermentation process as fertiliser.

Greco Farm is soon to expand its electricity generation from biogas. "We are building two more sheds for 3,000 pigs in all." Do Minh Luan, the manager, points to the unfinished buildings, where sacks of cement render are just being delivered. When they are completed there will be enough methane from the pig manure to run the three generators almost round the clock. Already they could be producing energy for eighteen hours a day, but where would it go? The feed-in system into the public grid is still in its infancy, and would require massive investment in the technology. The Do Minh family has other plans. They want to use the methane to drive ice machines directly without having to generate electricity first. That might be their next success story, because the Vietnamese people's favourite drink is beer with ice.



*Ha Nguyen Vu's biogas plant is fed in from a pit beside his pigsty. The plastic covering the pit is often nibbled away by the mice.*

*Photo: M. Egbert*





Extracting seeds from tomatoes in the field.



Tomato dealer at Arusha's main tomato market.

Photos: AVRDC

## Processing tomatoes in Tanzania: a tale of seeds and ketchup

An ingenious combination of plant breeding, contract farming and processing has enabled smallholder tomato growers to tap new markets in Tanzania's Arusha Region. Two improved tomato cultivars released from AVRDC lines are at the centre of this success story.

Just like in many other African regions, it was not easy for the tomato producers in Tanzania's Arusha region to find a market for their produce for a long time. A major portion of the highly perishable fruit ended up on the rubbish tip because it had gone bad during storage or transportation or no buyers could be found. Or the farmers had to underprice their goods. But since a young entrepreneur set up a processing factory in the late 1990s, the entire sector has been in the ascendant.

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### ■ Looking for the perfect tomato

The origins of this success story go back to the early 1990s. This was when AVRDC – The World Vegetable Center embarked on a project to develop tropical tomatoes for Africa with resistance to viruses, late blight and other diseases. These disease-resistant lines would need to tolerate hot, humid conditions; yield well; and have improved shipping qualities and shelf life to survive transport on rough roads.

By 1997, AVRDC had developed two open-pollinated tomato lines that were released by the Tanzanian Horticultural Research and Training Institute (HORTI-Tengeru) under the commercial names 'Tanya' and 'Tengeru 97'. The new cultivars produced full-fleshed, juicy fruit suitable for eating fresh or cooked. The tomatoes had thicker skins than conventional cultivars, which allowed the fruit to last up to three weeks at room temperature, unlike the commonly grown but poorly adapted hybrid cultivars.

AVRDC, in collaboration with HORTI-Tengeru, produced breeder and foundation seed of the two cultivars. A mechanical seed extractor imported from Taiwan significantly improved the efficiency of seed extraction. The two institutions trained farmers in improved cultivation practices, and distributed seed kits for on-farm testing and demonstration. This activity generated interest in the new tomatoes and demand for seed among more farmers in Tanzania. However, it is the local seed companies that ultimately made the improved cultivars available, when they began to scale up production to meet the rising demand. One of those companies was Alpha Seed, based in Moshi, Tanzania, who were the first to commercialise the two varieties. Owners Hussein and Mariam Mongi promoted the advantages of 'Tanya' and 'Tengeru 97' to farmers: the new cultivars produced a 36 per cent higher yield than old cultivars, and, thanks to less fertiliser/pesticides needed, had 17 per cent lower production costs. These advantages resulted in a 39 per cent increase in income. In addition,



it quickly became apparent that the tomato went down well with the consumers thanks to its good flavour.

## ■ Spotting a market niche

At the same time when 'Tanya' and 'Tengeru' were slowly starting to energise the tomato market in and around Arusha, Darsh Industries launched its activities. The company, founded in the industrial area of the city of Arusha in Northern Tanzania in 1990, had discovered a market niche and was the first enterprise to introduce tomato ketchup and paste processed from the two cultivars to the Tanzanian markets. With its firmness, taste and long shelf life, the cultivar 'Tanya' had exactly the right characteristics for processing.

In order to procure the raw materials it requires, the company operates as part of a joint venture with several local seed companies. The seed companies use farmer outgrowers in and around Arusha, which produce mainly 'Tanya' under contract. The tomatoes are collected in recyclable plastic crates and shipped off to the Darsh processing plant in Arusha, where the pulp is separated from the seeds. Extracted seed is passed on to the local seed companies, while the pulp becomes a 'Red Gold' product. Today Darsh is the country's biggest tomato processor, producing between 50 and 100 tons per day of tomato ketchup and paste. More than 60 dealers throughout all of Tanzania's regions distribute the products under the label 'Red Gold', which is a very familiar sight on most restaurant and home kitchen tables. Also, juice jams, pickles

and canned fruits are sold under the brand.

## ■ Further research required

In order to source enough tomatoes to keep its production lines open, Darsh Industries is obliged to import 70 per cent of its tomato pulp from China. One way to step up local production would be to improve crop tolerance to flooding during the hot-wet season in Tanzania. For this purpose, AVRDC is working to promote grafting tomatoes onto resistant or tolerant tomato and eggplant rootstock lines in order to minimise problems caused by soil-borne diseases and flooding. It is looking for the right scion-rootstock combination that will allow farmers to grow 'Tanya' or other processing and fresh type commercial tomato cultivars during wet periods or in areas otherwise not possible. Success in countries like Korea, Japan, Taiwan and Vietnam give cause to be optimistic about the implementation of grafting in Tanzania and other countries to increase farmers' income and job opportunities.

In November 2013, Darsh Industries began to establish a new tomato processing facility in Iringa, located in central Tanzania. The new plant is to double the company's production capacity. To supply the new facility, Darsh Industries plans to source the cultivar 'Tanya' grown by approximately 3,800 smallholder farmers – 40 per cent of whom are women – in the irrigated land of Tanzania's Babab ecozone. The hope is that in a couple of years, tomatoes that make up 'Red Gold' will be sourced entirely from Tanzania's farmers.

## A boost for the regional economy

Today, Arusha is a hub for seed companies, and most of them sell 'Tanya' and 'Tengeru 97' throughout the region, and also market the cultivars in Malawi, Zambia, Mozambique, South Sudan, and Zimbabwe. In 2012, East African Seed Co. produced about nine tons of seed of each cultivar. Alpha Seed Company produced and sold 3–4 tons of seed of each tomato. Africasia Seed, Company, only established in November 2012, produced 2.5 tons of 'Tanya' and 4.5 tons of 'Tengeru 97' in their first year. By April 2014, they estimated sales in 2013–14 at 5 tons, and project that sales will double in 2015. At a sowing rate of 150 g of seeds per hectare, combined sales of these three seed companies alone translates to approximately 130,000 to 150,000 hectares of land in Eastern and Southern Africa planted with the cultivars developed from AVRDC lines.

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