

Table of contents

[1. Contribution of fisheries and aquaculture to food security in Indonesia 7](#_Toc474487624)

[Food insecurity and malnutrition in Indonesia 7](#_Toc474487625)

[Fisheries and aquaculture sector contribution to food security and incomes 9](#_Toc474487626)

[Government focus on food sovereignty 13](#_Toc474487627)

[2. Sustainable management of natural resources for future food security 14](#_Toc474487628)

[Environmental impact of seafood production 15](#_Toc474487629)

[Policies against illegal fishing 17](#_Toc474487630)

[Strengthening domestic fisheries management 19](#_Toc474487631)

[Towards more sustainable aquaculture production 22](#_Toc474487632)

[Vulnerability to climate change 25](#_Toc474487633)

[3. Increasing the incomes of fishers and aqua-farmers while improving consumer access to seafood 26](#_Toc474487634)

[Direct support: The need for decoupling 26](#_Toc474487635)

[Sustainable resource management for stable income growth 28](#_Toc474487636)

[Facilitating public support for infrastructure and R&D 30](#_Toc474487637)

[Trade and foreign investment restrictions: Support at the cost of higher prices for consumers 32](#_Toc474487638)

[4. The way forward: From food *sovereignty* to food *security* 33](#_Toc474487639)

**Tables**

[Table 1. Status of fisheries resources by major species category and Fishery Management Area (WPP), 2016 15](#_Toc473275089)

**Figures**

[Figure 1. Selected food insecurity indicators in Indonesia, 1991-2025 (projection) 7](#_Toc473280378)

[Figure 3 Fisheries and Aquaculture production, 1950-2014 9](#_Toc473280379)

[Figure 3 Composition of capture fisheries by main species (2014) 10](#_Toc473280380)

[Figure 4 Capture fisheries by fishing segment, 1950-2010 10](#_Toc473280381)

[Figure 5 Composition of aquaculture production by main species (2014) 11](#_Toc473280382)

[Figure 6 Projected fisheries and Aquaculture production, 2015-2024 12](#_Toc473280383)

[Figure 7.Budget allocation for the main entities of MMAF, 2014 and 2015 13](#_Toc473280384)

[Figure 8. Support to fisheries and aquaculture 2014-2015 26](#_Toc473280385)

**Boxes**

[Marine fisheries and aquaculture production in Indonesia 9](#_Toc473275097)

[Box 2. Designing rebuilding and management targets 19](#_Toc473275098)

[Box 3. Legitimate and acceptable governance 21](#_Toc473275099)

**Acknowledgements**

This study has been co-ordinated and drafted by Claire Delpeuch and Ingrid Kelling from the Natural Resources Policies Division of the Trade and Agriculture Directorate. Information and data on government programmes supporting the fisheries and aquaculture sectors was collected by Rohana Subasinghe, FutureFish, Sri Lanka. The authors would like to thank the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) and the Presidential Task Force to Combat Illegal Fishing of Indonesia for their kind co-operation and, in particular, Maskur Maskur for their help with the support data collection process; Rita Octafiani for organising in-country missions and visits; and Sonny Koeshendrajan, Naftalia Siregar and Achmad Santosa for sharing information. Ria Fitriana, Charles Darwin University; Abdullah Habibi, WWF Indonesia; Daniel Pauly, University of British Columbia; and Nhuong Tran, WorldFish kindly commented on earlier drafts. Statistical support was provided by Fabiana Cerasa, and the document was edited by Robert Akam and Clara Thompson-Lipponen.

**Abstract**

 *This chapter explores how fisheries and aquaculture policies in Indonesia can contribute to improved food security and nutrition. It takes stock of the challenges to food security in Indonesia, describes how fisheries and aquaculture contribute to nutritious food supplies and incomes, and outlines the strategy of the Government of Indonesia for the sector. Policies currently in place are then analysed, and alternative policy options are proposed, where relevant, in light of three main objectives: sustainable management of natural resources for the future, increased economic opportunities for fishers and aqua-farmers, and improved consumer access to seafood.*

**Key points**

* Food security has improved significantly in Indonesia since the early 1990s, but nearly 20 million people remain undernourished. Capture fisheries and aquaculture are important components of the Indonesian diet, and sustain livelihoods for about 20 million people.
* Seafood production in Indonesia is achieved at high cost to the country’s natural resources. These costs are compounded by harvest capacity support and trade and investment restrictions, which also place added pressure on consumer prices.
* The Indonesian government has taken significant measures to combat illegal fishing. These will improve both the resource base of fisheries and governmental controls over operators, but nevertheless need to be accompanied by increased regulation of the main domestic fisheries, notably with the implementation of long-term, measurable capture targets.
* Stricter regulation of the aquaculture sub-sector is also necessary. This should be accompanied by more comprehensive and regular impact assessment of large farm operations, and clearer allocation of monitoring responsibilities to improve monitoring efficiency.
* To enable efficiency improvements to the sector without increasing consumer prices or pressure on resources, governmental support should take the form of investment in R&D, transport and energy provision infrastructure, together with the provision of targeted social safety nets and training to enable the transition to more remunerative activities.

## 1. Contribution of fisheries and aquaculture to food security in Indonesia

 In Indonesia, as in most Southeast Asian countries, food security and nutrition remain key policy concerns. Despite significant economic development and reductions in poverty and undernourishment rates, the country still counts 19.4 million people as undernourished (FAO, 2015), the largest absolute number in the region. Indicators of observed malnutrition also remain at alarming levels: in 2014, more than a third of children under the age of five were stunted, while obesity is a growing concern, with around one in ten children under five considered to be overweight (WHO, 2015). The challenge of eliminating food insecurity is wide-ranging, multi-faceted and linked to other major policy agendas, including those of tackling poverty, using scarce natural resources sustainably, improving sanitation conditions, raising education levels and mitigating the effects of climate change. This report focuses on those aspects of the challenge that can directly be affected by fisheries and aquaculture policies.

 Capture fisheries and aquaculture already play a key role for food security in Indonesia. The sector supplies an important component of Indonesian diet and nutrition, and sustains livelihoods for about 20 million people, including those in poor and remote areas of the country. At the same time, the sector has potential to further contribute to food security, as the country is the world’s largest archipelago, three-quarters of its territory is marine environment, and it is home to some of the richest and most diverse marine resources. Indonesia recently became the world’s largest producer of seafood after the People’s Republic of China (FAO, 2016b).

 This first section summarises the food security situation in Indonesia; describes how fisheries and aquaculture contribute to nutritious food supplies and to incomes, especially for the poor; and analyses the Indonesian government strategy for the sector in light of OECD policy recommendations for food security.

### Food insecurity and malnutrition in Indonesia

 According to the FAO definition agreed at the 1996 World Food Summit, and expanded upon at the 2001 Summit, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.[[1]](#footnote-2) This definition gives rise to four dimensions of food security. It suggests that people will only be food secure when sufficient food is available, when they have access to this supply of food, and that it is well utilised, in a stable way, over time. Food insecurity may therefore arise from disruptions in food availability that can result from pest outbreaks, climatic events, conflicts or barriers to trade; problems in accessing food as a result of price or income shocks and volatility; or from inadequate use of food, notably in terms of diet composition, which is influenced by cultural, religious and social norms, as well as anticipation of future shocks. Nutritional outcomes also depend on wider determinants of health, including maternal and child care, water and sanitation, and health services (OECD, 2013).

 The multi-dimensional nature of food security means that several indicators are required to capture current and past levels of food security. The most commonly used indicator is the FAO prevalence of undernourishment, which compares estimated average calorie consumption with energy requirement norms and observed child growth indicators, using data reported by the WHO.

 In Indonesia, as in most ASEAN nations, the rate of undernourishment has improved significantly since the early 1990s, dropping from almost 20% to slightly more than 7%, although due to the 1997 Asian Financial Crisis, this decline has not been not linear (FAO, 2015)[[2]](#footnote-3). Indonesia has experienced steady economic growth, with overall poverty rates falling 7% from 2002 to just above 11% in 2014. Gross national income per capita rose from USD 720 to USD 3 600 over the same time period (Indonesia Investments, 2016b). This trend is foreseen to continue. Based on FAO projections for future food availability, the OECD projects that undernourishment will decline to just over 3% in 2025 (Figure 1).

 Selected food insecurity indicators in Indonesia, 1991-2025 (projection)

Source: OECD calculations based on FAO (2015).

 In spite of this progress, challenges remain. While nearly 20 million people are still undernourished (FAO, 2015), almost twice as many people are found to be at risk of *becoming* undernourished, as specified by the FAO indicator of food inadequacy.[[3]](#footnote-4) At the same time, the level of stunting (when children fail to reach their linear growth potential as a result of suboptimal health or nutritional conditions) is of serious concern, at over 36% among children under the age of five in 2014 (WHO, 2015). In addition, micronutrient deficiency – and in particular, iodine and vitamin A – is still a moderate public health concern, bordering on severe (ASEAN, 2016). This is believed to be due, in part, to inadequate diets, notably with insufficient intakes of protein and vitamins and excessive intakes of carbohydrates. Overall, about one-third of children below the age of two do not meet the minimum meal frequency; one-quarter do not achieve the minimum dietary diversity, and nearly half do not meet the recommended quality of diet (ASEAN, 2016). On the other hand, overweight is already a concern for about a quarter of the population and obesity is foreseen to become one for one in ten people by 2025 (Figure 1).

### Fisheries and aquaculture sector contribution to food security and incomes

 Seafood consumption in Indonesia has grown significantly since the early 1990s. According to the results of the Indonesian national socio-economic survey (MMAF, 2016), seafood consumption reached more than 41 kg per capita per annum in 2015, one of the world’s highest rates. Its contribution to protein intake increased to over half of the animal protein supply and 15% of the total protein supply in 2013 (FAO, 2015).

 The role of fisheries and aquaculture products in nutrition is particularly important for the poorest populations for whom fish is often the cheapest and most easily accessible source of protein, available year-round, including when other sources of protein are at a seasonal low (HLPE, 2014). Fish, especially when eaten whole, is an important source of essential fatty acids and micronutrients, which are critical complements to the predominantly carbohydrate-based diets of many poor people. These micronutrients include vitamins A, B and D as well as iodine, iron, zinc and calcium (IFPRI, 2014).

#####  At the same time, the fisheries and aquaculture sector contributes significantly to the Indonesian economy. It generated almost 4% of total GDP and earned USD 4.6 billion from seafood product exports in 2012 (MMAF, 2015). Most importantly, as 95% of fishing boats are small-scale artisanal vessels and aquaculture production is mainly artisanal (see Box 1), the sector is an important source of income generation. It accounted for an estimated 6.4 million direct jobs for Indonesians in 2014 (MMAF, 2016), of which 3.7 million on-farm jobs (MMAF, 2016) and 2.7 million fishers in 2014 (MMAF, 2015). In addition, it is estimated that as many people are indirectly employed in associated services and industries such that about 20 million Indonesians are believed to rely on fishing for their basic livelihoods (Koeshendrajana, 2016).

 The potential of the sector to contribute to improved food security and nutrition is all the more important as many of the jobs provided are located in poor and remote areas of the country. Across low and lower-middle income countries, food insecurity is predominantly rural, and smallholder farmers are particularly afflicted (OECD, 2013). This pattern is repeated in Indonesia: about two-thirds of Indonesia’s poor live in coastal communities (BPS-Indonesia Statistik, 2008). A number of these communities are highly dependent on the sector. Fisheries also provide part-time and seasonal jobs that complement other activities. The number of fisheries jobs is likely to grow in the future. The number of people employed in capture fisheries increased by 84% between 2000 and 2010, while employment in fish farming increased by 156 % (FAO, 2012). By 2030, it is estimated that almost 9 million people will be directly employed in aquaculture, with another 6 million people indirectly dependent on the sub-sector (Phillips et al., 2015).

|  |
| --- |
| Box 1 Marine fisheries and aquaculture production in IndonesiaIndonesia has become the second-largest producer of fish, crustaceans and aquatic plants in the world by volume, after China, mainly thanks to a boom in aquaculture production: capture fisheries production reached 6.2 million tonnes and aquaculture 15.6 million tonnes in 2015. Fisheries and Aquaculture production, 1950-2014Source: FAO (2016a)Artisanal fishing boats comprise the vast majority of the Indonesian marine fleet. They target mainly near-shore species such as reef fishes (grouper and snapper) and demersal fishes (scabbardfishes and hairtails), as well as small pelagic fishes (scads, jacks and mackerel). The artisanal fleet accounts for somewhere between a quarter and a third of the total catch, depending on data sources. Larger industrial vessels mainly target tuna and shrimp, as well as demersal fish and reef fish to a lesser extent. While they comprise only about 5% of the fleet, they account for the remaining vast majority of the total catch (see Figures 4 and 5). Composition of capture fisheries (marine and inland) by main species (2014) Source: MMAF (2015) Capture fisheries by fishing segment, 1950-2010Reported catchSource: Pauly and Budimartono (2015)Aquaculture production takes place in a large number of ecosystems, including marine, brackish and freshwater, using nets, pens and ponds. By total volume, seaweed is the largest output, accounting for almost 50% of volume in 2014, although only a quarter of value (Figure 6). Omnivorous and herbivorous species account for the majority of animal production, with carnivorous species accounting for only about 15% of production in 2014 (MMAF, 2016, see Figure 6). Shrimp is the highest-value product, accounting for about a quarter of total value. Freshwater production in lakes and reservoirs is also significant, with tilapia and milkfish as its main products. While the bulk of aquaculture production originates in small-scale traditional farms, shrimp production is highly concentrated in large-scale production centers.  Composition of aquaculture production by main species (2014) Source: Tran et al. (forthcoming) |

 Over the past decade, aquaculture has become the main driver for fish supply growth in Indonesia, expanding at an average rate of over 23% per year between 2005 and 2014 (FAO, 2016b). As a result, the share of aquaculture in total seafood production volume in Indonesia rose from just over 10% in 1960 to almost 50% in 2014 (rising to almost 70% if seaweed production growth is taken into account) (FAO, 2016c). The value of Indonesia’s aquaculture production was USD 10.6 billion in 2014 (FAO 2016c), contributing over half the total value of seafood produced in the country (OECD, 2016a). According to the *OECD-FAO Outlook 2015-2024* projections, the strong growth of the aquaculture sector will be maintained in the coming decade, with production peaking at about 6 million tonnes by 2024 (excluding seaweed) while capture production, on the other hand, is expected to increase only marginally (Figure 4).

 Projected fisheries and Aquaculture production (excluding seaweed), 2015-2024

Source: OECD/FAO (2016).

### Government focus on food sovereignty

 Fisheries and aquaculture policies in Indonesia can be seen as the product of two main political orientations. First, like other governments in the ASEAN region, Indonesia has approached the problem of food security and nutrition primarily from the perspective of increasing the volumes of food available, coupled with the objective of relying on domestically-produced commodities as much as possible (OECD, 2016a).[[4]](#footnote-5) In this context, the main objective for the fisheries and aquaculture sector is to increase domestic production in order to increase the availability of seafood in the country, as well as to support the livelihoods of artisanal fishers and aquaculture producers.

 Second, President Joko Widodo, known as President Jokowi, who was elected in July 2014, has announced his intention to position Indonesia as a regional maritime power, making maritime and fisheries policy a central priority for his administration.[[5]](#footnote-6) In 2015, the budget of the Ministry of Marine Affairs and Fisheries (MMAF) was almost doubled, and unprecedented powers were given to its minister, Susi Pujiastuti, who is both in charge of maritime and fisheries policies and head of the newly created Presidential Task Force to Combat Illegal Fishing. Territorial issues feature prominently on the presidential political agenda, with implications for fisheries ranging from increased support for economic activities in the outer islands bordering neighbouring countries, to the promotion of a domestic ship-building industry.

 The MMAF Strategic Plan 2015-2019, which provides strategic direction on the main issues facing the sector, embodies these political aims. While the plan describes the governmental strategy as being organised around three pillars: sovereignty, sustainability and prosperity, it focuses mainly on increasing domestic seafood production and contains annual production and revenue generation targets.

 Under the Strategic Plan, government action will focus on the following:

* A strong and unprecedented stance against illegal fishing, which involved an increase of the budget allocated to surveillance by 130% between 2014 and 2015 (Figure 7);
* The prioritisation of artisanal fishing, by closing Indonesian waters to all foreign-built industrial vessels and providing support to modernise the artisanal fleet;
* The provision of support to artisanal aquaculture expansion, by creating artisanal co-operatives and developing the production of feed with locally-sourced ingredients, in line with objectives pursued by the previous administration’s Blue Economy programme initiated in 2014;
* The introduction of restrictive trade and investment policies, notably in the shipping industry, to protect domestic industries, producers and fishers from competition.

 Budget allocation for the main entities of MMAF, 2014 and 2015



Source: MMAF (2016).

## 2. Sustainable management of natural resources for future food security

 Sections 2 and 3 consider the policies that are currently in place in Indonesia in light of the priorities identified by the OECD as key for improving food security, with a view to improving the potential of Indonesian fisheries and aquaculture policies to contribute sustainably to food security and nutrition.

 OECD work on food security (OECD, 2013; Brooks and Matthews, 2015) and sustainable fisheries management (OECD, 2015) has highlighted three important policy pathways to improve food security and nutrition through better fisheries and aquaculture policies:

* First, ensuring the sustainability of resources on which the sector relies is a pre-requisite to any future contribution of the sector to food security and nutrition.
* Second, as the principal cause of food insecurity remains poverty, rather than insufficient food availability, income growth is central to lasting reductions in hunger. Governments should aim to unlock the potential of aquaculture and fisheries to sustainably generate the *incomes* needed to ensure food security, rather than support domestic food production.
* Finally, the role of trade in increasing the availability of seafood and lowering its price for consumers needs to be better recognised and supported, as the benefits of protection for fishers and aquaculture producers are too rarely compared with their cost for consumers and their effects on the food security of the poorest.

 Fisheries and aquaculture policies in Indonesia can thus contribute to improved food security and nutrition if they focus on three key objectives: sustainable management of natural resources for the future, increased economic opportunities for fishers and aqua-farmers, and improved consumer access to seafood. This section focuses on the sustainability objective, while Section 3 addresses socio-economic objectives related to income generation and access to food.

### Environmental impact of seafood production

 Seafood production in Indonesia is achieved at high cost to the country’s natural resources, creating risk that future production cannot be sustained. This is an area of concern, as ensuring the sustainability of the natural resources on which the sector relies is a prerequisite for any future contribution of the sector to food security and nutrition. Improving the health of fish stocks and coastal and inland water ecosystems has the potential to improve food availability, lower prices for consumers and increase incomes of fishers and aqua-farmers after transitional adjustments.

#### Fully-exploited and over-exploited fish stocks

 Increased demand for seafood from a growing population, as well as the development of industrial fisheries, trawling in particular – which started in the early 1960s and grew rapidly – are responsible for a strong increase in pressure on Indonesian marine fishery resources in recent decades (Pauly and Budimartono, 2015). According to the findings of the Indonesia National Committee on Assessment of Fisheries Resources, the vast majority of Indonesian fisheries are defined as fully-exploited or over-exploited (Table 1) (MMAF, 2016). The highest rate of over-exploitation is found for shrimp species, Indonesia’s most valuable catch. Signs of declining catch per unit of effort (CPUE) have been reported for tunas, small pelagics, shrimp and coastal reef fish (DAFF, 2011), which indicates that the resource base is already affected. Exploitation rates vary across the waters of Indonesia, and some opportunity for expansion of catches in the eastern part of the country may exist, notably for small pelagics. Of all large tuna species, only skipjack remains somewhat underexploited (DAFF, 2011). According to calculations, only 15% of Indonesian landings come from under-exploited stocks. Another 32 % of landings come from unassessed stocks, while 40% come from fully-exploited stocks and 11% from stocks in poor condition (CEA, 2014).

Table 1. Status of fisheries resources by major species category and Fishery Management Area (WPP), 2016

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| WPP | Shrimp | Demersal | Small pelagic | Large tuna species | Squid |
| *Indian Ocean* |
| 571 | O | O | O | F | F |
| 572 | O | F | F | O | U |
| 573 | O | F | F | F | O |
| *Pacific Ocean* |
| 711 | O | F | O | U | O |
| 712 | O | F | F | O | O |
| 713 | O | O | F | F | O |
| 714 | F | F | F | F | F |
| 715 | O | F | O | O | O |
| 716 | F | U | U | F | O |
| 717 | U | U | F | F | F |
| 718 | O | O | F | F | F |

*Notes:* Status is coded as follows: U = under-exploited, F = fully exploited, O = over-exploited. WPPs are numbered from West to East.

*Source:* MMAF (2016).

#### Threatened ecosystems

 Indonesia’s coral reef and mangrove ecosystems are also threatened by seafood production. The Indonesian coast is home to around one-fifth of global coral reefs and more than half of global coral species, as well as 3 million hectares of mangrove forests, representing almost a quarter of mangrove forests in the world with the greatest diversity of mangroves and sea grasses. Indonesian marine and brackish ecosystems offer a unique range of services, both to capture and aquaculture activities and many other sectors of activities. The vast majority of capture fisheries production comes from marine fisheries (Tran et al., forthcoming) and 80% of aquaculture production is from coastal areas (MMAF, 2016).[[6]](#footnote-7) The coral reef ecosystem, apart from its function as marine biota, is also a carbon absorber, sea wave breaker and fish producer. The mangroves offer an important breeding ground for thousands of species as well as numerous products and ecosystem services, including firewood, recreation and tourism, erosion control, climate regulation, and protection against extreme weather events (Tran et al., forthcoming).

 However, these ecosystems’ resources are being damaged by fishing techniques and overfishing, aquaculture environmental externalities, waste disposal, sea sand mining, and other destructive practices. In 2007, only a quarter of reefs were in healthy or excellent condition, with about a third in bad or very bad condition and the remaining in moderate condition (Burke et al., 2011). Between 1975 and 2005, Indonesia lost 40% of mangroves due to conversion into fish ponds, salt production, pollution or palm plantation for oil production (Adhuri, 2016). In particular, 95% of the mangrove forests and estuarine creeks that once lined the coast of Java have been developed into aquaculture ponds (Inside Indonesia, n.d.). Inland water bodies are also at risk, notably due to eutrophication around cage and pen farms. In some areas of Java, aquaculture in lakes is competing with freshwater for human use in urban areas (Rimmer et al., 2013).

### Policies against illegal fishing

 The Government of Indonesia has identified illegal, unregulated and unreported (IUU) fishing as the most serious challenge to fisheries sustainability, as well as a key economic and maritime security issue, as IUU fishing has both created a major strain on fish availability and remuneration from fishing and caused breaches of sea sovereignty.

 IUU fishing places marine resources under significant pressure in Indonesia, where the practice is thought to account for up to a third of total catches. Reconstructing catch data for Central and Eastern Indonesia from 1950 to 2010 by combining official data with published and anecdotal knowledge on IUU fishing into coherent time series, Pauly and Budimartono (2015) find a total catch that is 39% larger than that reported by the FAO on behalf of Indonesia. They suggest that, in addition to illegal fishing, notably by foreign vessels, non-reported catches by domestic trawlers may also be significant, particularly in remote eastern regions, where numerous small landing sites mean that a large proportion of the catch is not included in official statistics. Eliminating IUU fishing could thus substantially reduce the pressure on resources, providing that IUU fishing is not entirely replaced by legal fishing.

 In 2014, a Presidential Taskforce to Prevent and Combat IUU Fishing (hereafter Taskforce) was established by President Jokowi to lead efforts to combat IUU. The Taskforce focuses on illegal fishing and associated crimes, as well as under-reported fishing, but is not concerned with unregulated fishing, which in fact encompasses much of the artisanal fishing activities over which MMAF has not yet implemented controls and restrictions. The Taskforce built institutional co-operation by bringing together the navy, the police, tax authorities, the maritime authority and the Attorney General’s office under the responsibility of the Taskforce’s Minister Pudjiastuti. The budget allocated to surveillance of marine and fisheries resources was increased by more than 30% between 2014 and 2015, using funds previously allocated to fuel subsidies for the sector which had been reduced in late 2014 (CEA, 2016). This budget increase was the strongest across all budget spending categories of MMAF, which on average saw its allocation increase by over 60 % between 2014 and 2015 (Figure 7).

 Soon after the Taskforce was established, MMAF decided to close Indonesian waters to industrial fishing boats. The ministry took this decision after observing that the vast majority of industrial vessels fishing in the Indonesian exclusive economic zone (EEZ) operated in fraudulent circumstances, and closing the EEZ would permit it to perform an in-depth audit of the situation at sea. Regulation 56/2014 introduced both a permanent moratorium on fishing by ex-foreign vessels operating within the EEZ – effectively shutting down access to the EEZ by the largest vessels, as most of these were foreign-built as well as operated by foreign companies and crews – and a six-month moratorium on fishing licences for all boats measuring more than 30 gross tonnage (GT). This second restriction was later extended until the end of 2015, with Regulation 10/2015. The compliance audit performed by the Taskforce in 2015 found that all of the 1 132 industrial vessels that were licenced in 2015 (all ex-foreign vessels) violated Indonesian laws and regulations in some way. Double flagging was a serious problem, as was marking down the gross tonnage of vessels. The government also estimated that between 5 000 and 10 000 vessels operating in Indonesian waters were using fraudulently copied licences; in some cases, one licence was being used by up to ten different vessels.

 In addition, the Taskforce found that smuggling and other illegal activities, including human rights abuses and trafficking, occurred regularly (Santosa, 2016). A lack of compliance regarding logbook reporting was also noted – with less than 5% of the 245 fish ports integrated with logbook information systems – as well as the use of non-designated fish landing ports to land catch in violation of fishing licence requirements. Many falsified data entries for fish capture were also found. On this basis, by August 2016, 236 vessels were seized and sunk, resulting in extensive media coverage.

 Furthermore, the Taskforce noted that government officials were limited in their ability to detect, respond and punish violations, particularly due to a lack of vessel monitoring system (VMS) transmitters, on-board observers and patrol boats that covered the EEZ. Corruption meant that inspectors could also too easily be dissuaded from registering problems, meaning that sanctions were not acting as an effective deterrent. In addition, corporate criminal liability was rarely imposed, and serious violations were subject only to administrative sanctions (Santosa, 2016).

 The Taskforce therefore concluded that post-landing regulations, such as those of the FAO Port State Measures Agreement, which Indonesia has ratified through Presidential Decree 43/2016, were not sufficient, as most illegal activities took place at sea.

 The Indonesian government has decided to re-authorise industrial fishing, but – in order to prevent IUU – under more restrictive conditions than had been in place previously. First, Regulation 57/2014 prohibits all transhipment at sea. Second, since December 2015, all boats above 30 GT have to use VMS (Ministerial Regulation 23/2014), and VMS data is shared with Global Fishing Watch, a data-processing system developed in partnership by Google, SkyTruth and Oceana, which will help to monitor commercial fishing activity (and make information public). Third, MMAF is working to improve the vessel registration and fisheries licence system (Ministerial Regulation 30/2012 is currently being revised), while improving catch reporting documentation. With the new regulation in preparation, licences will be delivered to domestically-built vessels of up to 200 GT, for one-year, after a due-diligence procedure.

 According to Minister Pujiastuti, the establishment of a “one-roof” enforcement system, with the creation of the Taskforce, backed up by strong political will from the President as well as a strong communications strategy, have proved decisive in tackling the corruption that pervaded the sector and the political system, and allowing the adoption of policies that effectively closed Indonesian seas to a significant section of the fleet.

 The government’s efforts have been successful at making illegal fishing an inherently riskier activity in Indonesia, but the impact on food security remains uncertain. Neighbouring countries are considering implementing similar policies because illegal fishers have relocated their activities to their waters after leaving Indonesian waters. The actual extent of progress is, however, still difficult to estimate. Joint work between the sustainable fisheries group at UC Santa Barbara and MMAF estimates that the measures taken in 2015 led to a reduction of fishing effort of about 35%. However, this effort is believed to have since started to recover (MMAF, 2016). Minister Pujiastuti often refers to anecdotal indications that the availability and size of fish caught by artisanal fishers has increased that suggest that stock health and fish availability is improving for these producers. Evidence is still scarce to support these assertions, but simulations indicate that there is potential. Catch of skipjack tuna could, for example, increase by 25% by 2035, if policies against IUU fishing were efficient and coupled with effective management of domestic fisheries, compared with an expected *decrease* by 81% in the absence of such measures (MMAF, 2016).

 While the continued fight against IUU fishing is likely to be more effective at protecting those Indonesian fisheries more often exploited by industrial boats, domestic artisanal fisheries will need to be better monitored and regulated to ensure the sustainability of a broader range of fisheries. The direct link drawn between a decrease in IUU fishing activities and the increased availability of fish for artisanal fishers in coastal areas may indeed only be true for certain species. Coastal and territorial waters are connected, and some species, like shrimp, spawn in the deep sea but are caught in coastal waters by both artisanal and industrial vessels. However, tuna, for example, spawns in Indonesian archipelagic waters before migrating to the Pacific, where they are caught by industrial ships. Reef fish such as groupers and snappers, which are mainly caught by small-scale boats, stay in archipelagic waters and do not swim beyond a few kilometres of the shore. Reef fish stock health and the availability of large tunas in coastal waters are thus unlikely to substantially increase with the measures taken to abolish industrial illegal fishing.

### Strengthening domestic fisheries management

#### An overly open existing management system

 The current system of controls in effect permits relatively open access to Indonesia’s fisheries, and will need to be strengthened. The Indonesian government recognises that the existing framework is insufficient for the sustainable management of domestic fisheries. Minister Pujiastuti has announced that the fight against illegal fishing was only a first step, and that the government now needs to tackle the politically and practically more difficult challenge of addressing unreported and unregulated fishing.

 The controls on fishing activities in Indonesia are insufficient, mainly relating to the granting of licences to fishing vessels and to restrictions placed on fishing practices, such as fishing seasons or minimum size requirements. This insufficient regulation of fishing activities is both due to the fact that a) a large share of the artisanal fleet is not subject to any control and monitoring, and b) the types of restrictions used to manage the fleet under licence are not appropriate to ensure the sustainable management of fisheries.

 Natural resources are managed jointly by the central government, the provinces and districts. Since the adoption of Law No 23/2014 on local governance, responsibilities for resource management have been decentralised according to geography and types of operations. MMAF is directly responsible for managing archipelagic and EEZ water resources, the 33 provincial authorities manage territorial water resources, and the 250 district authorities manage coastal resources within 4 miles of the coast. With respect to boat licences, vessels between 5 and 30 GT can thus obtain a licence from provincial authorities, while those of more than 30 GT and ex-foreign vessels of any size require a licence issued by the central government (the latter will no longer be granted licences under current rules).

 This licencing system is insufficient to manage fishing, as the Indonesian fleet is largely dominated by small-scale boats of under 5 GT operating within four nautical miles of the coast. More than 500 000 such boats account for approximately 35-40% of landings (DAFF, 2011). These boats do not require a licence, and continue to expand in number, reaching about 30% more in 2012 than in the early 2000s (Stobutzki et al., 2014). Putting in place a simple and inexpensive system for registering such boats and monitoring their catch is a priority.

 In addition, Law No 45/2009, which amends Law No 31/2004 on fisheries, defines the policy instruments that can be used to regulate fisheries resources. These include minimum size requirements – the latest of which, Ministerial Regulation 01/2015, concerns lobsters and crabs, which were harvested for cultivation in aquaculture facilities – as well as restrictions on allowable gear, the most recent being the moratorium on the use of seine nets and trawls imposed by Ministerial Regulation 02/2015. Particular areas are also closed to fishing, such as the Banda Sea, where fishing was banned by Ministerial Regulation 04/2015.[[7]](#footnote-8)

 In practice, however, there are few obligations attached to the licences, particularly with regard to limiting the quantities fished, and fishing regulations can be loosely implemented, with limited policy efforts in place to rectify this situation. This is a significant policy challenge, as there are about 50 000 vessels of between 20 and 30 GT that operate in territorial waters and account for 25-35% of the catch, and a further 10 000 vessels above 30 GT that operate in archipelagic or EEZ waters, comprising 20-30% of the catch. No output controls such as total allowable catch limits (TACs) or quotas are currently in use.

 MMAF has indicated that a roadmap is being developed by the government to introduce quotas, capacity rules, closed seasons and zoning laws. However, the MMAF Strategic Plan 2015-2019 lacks precision as to how this will be undertaken. Although the document was issued as a Ministerial Decree, which makes it legally binding, policy implications remain uncertain, as no clear definitions or binding indicators are attached to key objectives, notably in terms of sustainability (CEA, 2014).

*Measurable longer-term objectives needed*

 A varied set of controls based on effort and restrictions on the areas where fishing is permitted, such as those currently used in Indonesia, leads to opacity and high transaction costs. Alternatively, the management of resources should be shifted towards fisheries management and rebuilding plans – built around medium- to long-term horizon measurable objectives – that first target overfished species (see Box 2).

Box 2. Designing rebuilding and management targets

A key issue for any system of regulation is whether fishers have an incentive to conserve fish stocks if they have no guarantee that other fishers will do the same. To be considered acceptable, regulations therefore need to be both clear so that fishers can be confident that institutions in charge can, and will, enforce regulations.

Understanding the complexity of tasks and the time horizons required to measure the success of programmes is therefore key; this makes clarity regarding the objectives pursued crucial. There are many examples of rebuilding programmes that have failed to reach targets, and it is vital that programmes include options in the event that the stock does not respond in the way predicted. Sometimes, this is a result of data deficiencies, changes in understanding of the biological characteristics of the stock, refinements in the models used to predict rebuilding pathways, or just broader environmental changes such as climate change. The lesson learned in most cases is that plans are likely to take longer than originally anticipated. Communication on these difficulties is important for fisheries policy-making institutions in order not to lose credibility.

Traditionally, fisheries managers and scientists providing advice on stocks have focused on the maximum sustainable yield (MSY) as an appropriate management target. While stock management is a necessary objective of fisheries policy makers, maximising social welfare is the ultimate goal. Addressing risk and uncertainties should also be explicitly considered when designing management plans. Stock status targets other than MSY are thus increasingly being used, for example, to maximise profits instead of production under stock conservation constraints. Alternatively, policies may aim to rebuild stocks, reduce the risk of collapse or impose particular social or environmental norms.

In addition, rebuilding and management plans should not only be based on biological targets but incorporate social and economic principles throughout the design and implementation process in an integrated fashion, as opposed to sequentially or in isolation (OECD, 2014). Plans ideally need to address direct fisheries adjustment, local employment (including those in the processing and marketing sectors), regional impacts or the need for alternative employment and livelihood opportunities, as well as food security.

The OECD also calls for the adoption of the now globally recognised Ecosystem Approach to Fisheries (EAF), as far as possible. The EAF is defined as “striv[ing] to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions, and applying an integrated approach within ecological meaningful boundaries” (FAO, 2003). This approach implies that decisions are made using a comprehensive, inclusive framework for all living resources, rather than reacting to the status of a single stock of fish. The main obstacle to implementing the EAF is that it substantially increases the level of information and analysis required, and this level of information is not yet available in Indonesia.

 Law No 31/2004 paved the way for the development of fisheries management plans on the basis of 11 fisheries management areas. Plan development is the responsibility of the central government, while their implementation falls in part on provinces and districts. To date, however, only three plans have been adopted, and 12 years later the remaining eight are still at the drafting stage. According to Sutinen (2013), despite aiming to follow FAO recommendations to use an ecosystem-based approach to management, the plans are not tailored to protect or rebuild specific stocks, largely because no quotas or TACs have been adopted.

 A major constraint on the use of output-based management instruments in Indonesia is the lack of accurate data on which biomass and optimal capacity calculations depend, particularly catch data. While stock status assessments should be undertaken annually in the 11 management areas by MMAF and associated research centres and universities, stocks were not evaluated between 2011 and 2016.

 The task of producing up-to-date and accurate data is particularly difficult in the Indonesian context: catches are extremely diverse, with each family or other higher tax on in the reconstructed catch representing dozens of species, and each species representing hundreds of stocks scattered over thousands of kilometres of complex geography. Therefore, a stock-by-stock or even species-by-species study of these catch data is complicated, except for a few species of tuna, while multispecies stock assessments have proven notoriously difficult (Pauly and Budimartono, 2015). Alternatively, assessment of multispecies fish stocks should focus on changes in catch levels and composition, with rapid changes of these indicators providing strong evidence of a lack of sustainability (Pauly and Budimartono, 2015). Tracking catch levels and compositions in turn requires accurate catch data from all fisheries, including from small-scale boats, illegal fisheries, and discards, which are usually not included in catch statistics. The fact that most artisanal boats do not need a licence (if they are under 5 GT), and that MMAF does not receive information from provincial authorities on the number of boats between 5 and 30 GT that they licence, is a major constraint to adequate catch monitoring. Scientific data gathering could be complemented by the collection of fishers’ knowledge on the health of stocks at district and provincial levels. In addition to providing a low-cost means of information gathering, the use of fishers’ knowledge also has the potential to increase the acceptability of policy decisions.

 Designing comprehensive management and rebuilding plans, with a view to adopting the Ecosystem Approach to Fisheries (EAF) in the longer term, also requires integrating biological information with information on the socio-economic characteristics of fisheries. Matching socio-economic information on fisheries with biological information on resources would be useful for identifying overfished stocks of greatest significance in terms of income, employment or food consumption in order to better target rebuilding efforts. In this perspective, the government is currently working jointly with the World Bank on the creation of a centralised data collection system which would replace the more than 200 datasets that are currently in use at MMAF.

 Setting up transparent and inclusive decision-making processes to set TACs and quotas is also important to avoid conflicts of interest among users and policy makers while limiting transaction costs. Making clear how scientific information will be collected, how it will be used in the decision-making process, and making this information public, for example, can help build accountability and trust and in the system. Working on the governance of the sector should also be a priority in order to build faith in the management system so that fishers – and stakeholders more generally – will understand that regulation is in their best interest, and that it will be enforced (see Box 3). This would help to create confidence among investors that management policies will be effective in the long term and that the sector is a sustainable market to invest in.

Box 3. Legitimate and acceptable governance

Governance of fisheries and aquaculture, and conservation of the ecosystems that sustain them, can be understood as a process through which institutions, governments, and stakeholders in the sector elaborate, adopt and implement policies and management strategies.

The impact of governance on fisheries and aquaculture management, and ultimately on their performance, is increasingly recognised. Governance has an impact on both the nature of policy decisions and their acceptability to different stakeholders. The OECD Council Recommendation on Rebuilding, for example, underscores how good governance is a key element to ensuring the success of rebuilding plans. While there is no optimal arrangement for fisheries governance frameworks, a few characteristics are important ingredients for success, notably legitimacy and acceptability.

Legitimacy relates to the characteristics of the institutional arrangements through which policies are elaborated and implemented: the transparency of procedures in the decision-making process, mechanisms guaranteeing the accountability of institutions with respect to decisions made, and room for scientific information and advice.

Acceptability has to do with the perception by stakeholders of the institutional arrangements’ capacity to deliver fair decisions. Acceptability relates to: the degree of delegation in decision-making processes; the space for stakeholders to share available information, express various positions including dissent, and be confident that these voices are explicitly part of the decision-making process; the capacity to integrate or change the norms and beliefs of stakeholders; and the existence of mechanisms of appeal. Building inclusive institutional arrangements oriented towards raising broad consensus is a key to acceptability.

### Towards more sustainable aquaculture production

 Limiting environmental externalities of aquaculture production to preserve both the ecosystems on which the sector relies, and the services that these systems supply to many other sectors, requires both adequate regulation and public support to encourage adoption of best practices. In a report on green growth in fisheries and aquaculture, the OECD highlights that the best response to externalities depends on the direction of the externalities caused by aquaculture production (OECD, 2015). While self-interest should lead producers to respond to externalities that affect their own production (local water pollution harming productivity, for example), the more the externality impacts other aqua-farmers or other ecosystem users, the more that public regulation is necessary, as well as, potentially, support to facilitate the transition to sustainable practices. The industry indeed has an interest in addressing externalities, as the negative effects reduce profitability and demand in the long run (Asche, 2011). In Indonesia, however, this will mostly hold true for intensive systems where production must meet the standards expected by export markets and where sufficient capital exists to invest in improvements. Extensive production systems, on the other hand, supply local markets where quality is less an issue, and which are operated by agents with limited resources and, sometimes, limited capacity to switch to more sustainable production methods.

#### Aquaculture production externalities

 Environmental externalities related to aquaculture production fall into two main categories:

* Establishment impacts, which arise from the conversion of one type of land to another, such as from agricultural land or coastal habitats to ponds; and
* Operational impacts, which arise from the day-to-day running of an aquaculture business.

 The extensive nature of most aquaculture production in Indonesia means that, to date, Indonesia has mostly suffered from establishment impacts, which include the removal of pre-existing habitat as well as long-term impacts on water and land quality. Indeed, traditional farms, where extensive production is practiced, have relatively few operational impacts, as there is little water exchange and almost no use of fertilisers or feed inputs due to their prohibitive cost for small-scale aqua-farmers. However, clusters of small farms can have a significant impact within a watershed or enclosed waterbody, when concentration levels exceed the carrying capacity of the ecosystem.

 On the other hand, most of Indonesia’s shrimp production – its most valuable seafood export – comes from modernised farms. Semi-intensive or intensive farms have greater operational impacts, such as disease and nutrient release from aquaculture ponds and eutrophication near cages due to limited water circulation, possibly with implications for other sectors such as tourism in coastal areas or agriculture inland (Rimmer et al., 2013). Pellet feed and aeration are indeed necessary to support high stocking densities, as are fertiliser, chemical and probiotic use to limit disease. These interventions produce high levels of organic waste, and may have around twice the environmental impact per shrimp than those grown using less-intensive methods (Cao et al., 2011). Further operational impacts include the health and environmental effects of antibiotic use. Although antibiotics are usually given to prevent or combat disease, their use poses risks due to the high stocking density in intensive systems, which can result in leeching into local water supplies or residues found in the finished product. As intensity increases, Indonesia will become more vulnerable to both an abrupt shock – such as disease – and a slower degradation of the environment, leading to an ecosystem collapse. Getting aquaculture right at the policy level is therefore critical for the sustainability of future production.

 Foreseen further growth of shrimp production also raises concerns for the sustainability of forage fish stocks. Carnivorous species such as shrimp are very demanding in fish meal and oil when raised in intensive conditions. Feed accounts for over 50% of production costs in some cases (Rana, Siriwardena and Hasan, 2009). Given the insufficient regulation of capture fisheries, this has the potential to have negative effects on stocks and on the production of edible supplies from marine capture fisheries. Substitutes for fish meal and oil are needed as the sub-sector expands, requiring research and innovation.

*Strengthening aquaculture management*

 The regulation of aquaculture production is a shared responsibility of MMAF and the Ministry of Environment and Forestry, which is responsible for aquaculture environmental impact control. Three main policies are used: mandatory ex-ante impact assessment, spatial limitations and restrictions on production practices.

 The Environment and Forestry Law 23/2009 requires environmental impact assessments to be performed for the creation of any aquaculture development with an area of 50 ha or more for shrimp ponds, more than 500 floating net cages on lakes or reservoirs, or floating net cage installations in sea water covering more than 5 ha or consisting of over 1 000 cages. For smaller-scale farms, installation is regulated by the obligation, for all aqua-farmers, to request an aquaculture business licence directly from the ministry or from regional authorities, depending on the scale of the production unit. Nevertheless, a major weakness of this system is that, while the impact assessment of big aquaculture plants should be followed by regular monitoring, further evaluation is currently only completed in the case of a complaint from the local community.

 In addition, a number of spatial limitations apply to all producers. The main regulations include Ministerial Decree KEP 28/MEN/2004, which regulates shrimp culture in brackish water ponds; Regulation 5/2014 on water quality standard of effluents for aquaculture ponds; and Law 26/2007 concerning spatial planning of land use. These regulations require for example that brackish water farms are not permitted within a 100-metre green belt adjacent to coastal waterways to protect mangroves (Rimmer et al., 2013).

 However, spatial planning measures are undermined by lack of data. While careful site selection and spatial restrictions should be based on estimation of the carrying capacity of the environment in order to ensure that production does not exceed what the local ecosystem can support (Santosa, 2013), in practice, carrying capacities are administratively stipulated on the basis of poor information. This is because the reliable data necessary for trustworthy modelling output is lacking. Since spatial planning on both land and at sea has been decentralised to provincial and district levels (with Laws 54/2003 and 32/2004), no clear mandate for information gathering and monitoring has been given. As a result, neither the national government nor the local governments appear to be collecting information on the location of activities and monitoring of their impacts and performance or on the use and performance of spatial planning at the local level. Such lack of information also means that best practices in terms of sustainability cannot be adequately identified and disseminated by extension services. Clear allocation of responsibilities between the central, provincial and district authorities, and improved co-operation and information sharing between these administrations would greatly improve the capacity of public authorities to promote the sustainable use of resources and help limit the cost of public action.

 Finally, to address operational impact, the use of fish drugs is regulated by Ministerial Decrees 52/KEPMEN-KP/2014 (drug classification) and Ministerial Regulation PER.04/MEN/2012 (registration for use). The government has also recently established, with the support of the European Commission, a National Plan for Residue Monitoring to control the presence of antibiotics and other contaminants (on the basis of Ministerial Regulation 39/PERMEN-KP/2015). Presence of contaminants, notably chemical residues, has been a major issue for the export of Indonesian seafood, notably to the United States, where they have faced high rejection rates. Following a recommendation of the World Animal Health Organisation (OIE), the government is currently developing a programme for monitoring water quality and antimicrobial resistance in fish and water ecosystems.

 Fish disease monitoring and prevention has been relatively successful to date. Unlike other Asian countries such as Thailand or Vietnam, Indonesia has not experienced the wholesale decimation of the domestic aquaculture industry from disease. This is largely thanks to the amount of extensive production. The fish disease monitoring programme, based on Directorate Decrees 163/2014 and 11/2016, includes both zoning restrictions and controls, and communicates information on these online. Import restrictions on live and frozen shrimp from countries affected by MAS (*aeronomas hydrophila*) also apply in accordance with the prescriptions of the OIE.

*Certification schemes for greener production*

 The Indonesian government uses certification schemes to promote greener production processes and standardise inputs and practices for supply chain management by disseminating technical practices to producers in a structured and formalised fashion (Kusumawati and Bush, 2015). Sustainable seafood certification is indeed a useful means of communication about the sustainability of production practices of both capture and farmed seafood. Through the creation of market demand for sustainable practices, it creates additional incentives for investment in improved fishing and aquaculture practices (Potts et al, 2016).

 The Indonesian government has introduced its own certification scheme, IndoGAP, based on biosafety, food safety and the environment. The standard certifies farmed carps, catfish and tilapia, brackish water shrimp and the marine farming of seabass, groupers and seaweed. MMAF spent over USD 580 000 in 2015 on providing assistance to certify hatcheries, and around USD 50 000 to assist freshwater and brackishwater farms certification. In the future, MMAF will need to outsource auditing to an independent third party in order to be fully compliant with international norms (FAO, 2011).

 Private sustainability standards and certification schemes also operate in Indonesia and have greater breadth and depth than national schemes, particularly for shrimp aquaculture (Gutierrez et al., 2016). Certified products include extensively-farmed organic shrimp, farmed tilapia and feed certified by private organisations such as the Aquaculture Stewardship Council (ASC) and Sustainable Fisheries Partnership. The tuna pole and line fishery is currently part of a Fishery Improvement Project (FIP) that will eventually lead to its certification by the Marine Stewardship Council (MSC). However, there is no market data on the percentage of total seafood products in Indonesia that are certified.

 Private sustainability standards and certification schemes may be favourable for governments, because participating in these projects a good image of responsible governance. However, the main challenges associated with such schemes are that they may change power relationships between actors involved in seafood trade (Wijaya and Glasbergen, 2016) and make market access more difficult for non-certified exporters, especially smallholders (Wijaya and Glasbergen, 2016). When possible, evidence suggests that the simplest approach may be for the government to contribute to the costs for a fishery to obtain private certification, rather than create additional certification schemes (OECD, 2011).

### Vulnerability to climate change

 Indonesia faces high risks due to multiple hazards directly linked to climate change, such as tsunamis, floods, landslides, and droughts, alongside the effects of sea-level rise on coastal areas (MER, 2015). Indirect effects of climate change occur through impacts on feed, seed, freshwater and other inputs (FAO, 2016b). The World Bank estimates that by 2100, climate change impacts will cost Indonesia 2.5-7% of its GDP and disproportionately affect poor, coastal communities that depend on agriculture, fishery and forestry for their livelihoods (World Bank, 2017). Food security and water availability will be increasingly affected by unpredictable rainfall, temperature and salinity increases, which could have an impact on fish migratory routes, stock abundance, biodiversity and water quality. This could in turn reduce catches, cause physical destruction of aquaculture facilities, spread diseases and, ultimately, reduce the availability and affordability of seafood (de Silva and Soto, 2009).

 The World Bank also estimates that Indonesia is relatively unready to cope with climate change impacts (World Bank, 2017). In fact, the country has a very developed national institutional policy framework to tackle climate change mitigation.[[8]](#footnote-9) However, planning for adaptation is still a work in progress. The fisheries and aquaculture sectors will have to adapt to future changes in climate and ocean conditions. Adaptation strategies require marine science and technology, spatial planning, technical coastal adaptation, and adjustment of cultured and capture fishery management. At the level of regulation, climate change forecasting should be taken into consideration when setting fishing pressure limits to sustainable levels while weather-related risks should be considered when defining locations suitable for aquaculture (De Silva and Soto, 2009). Other adaptation measures include aquaculture relocating to less-exposed areas, fish health management, water recycling, feed efficiencies, developing better-adapted seed stock, improved monitoring and early warning systems and improving value-addition (FAO, 2016b).

 Investment in research in these areas will prove crucial. Promising areas, which have shown success in other countries, include domesticating species resistant to higher salinity and temperatures (Shelton, 2014) and identifying preventative treatments for new diseases, animal physiology, better feeds and feeding practices, and technology transfers, especially to small-scale farmers (De Silva and Soto, 2009). Coastal management and capacity building can also help indirectly. Restoration of mangroves, for example, can buffer coastal communities from storm surges or erosion, while disaster risk management and early warning systems may help fishers and aqua-farmers cope with disruptions in production.

 Finally, aquaculture insurance or disaster-linked cash transfers can help limit bankruptcies resulting from losses caused by climatic events. As mandated by Law No. 19/2013, the government must develop agricultural insurance to cushion farmers from financial loss due to natural calamities, but there are as yet no provisions for fishers or aquaculture farmers.

## 3. Increasing the incomes of fishers and aqua-farmers while improving consumer access to seafood

 Continued production growth under a business as usual scenario is not an option: as shown in Section 1, most fish stocks cannot absorb further increases in catch effort, and expansion of aquaculture production will only be sustainable if it consumes less land and water resources and if externalities are better controlled to avoid degradation of the ecosystems on which it depends. Increasing the economic returns to capture and aquaculture production is thus the key to improving the incomes of fishers and aqua-farmers and thus their access to food and their resilience to food security risks in the long run.

### Direct support: The need for decoupling

 In an effort to improve the incomes of fishers and aqua-farmers, the Government of Indonesia subsidises fuel for the sector as well as the renewal of the artisanal fleet. The government also invests in artisanal aquaculture plants creation and supports the development of cheaper feed production based on locally-sourced ingredients. Direct support to fishers and aquaculture producers, which consists of fuel tax concessions and subsidies for vessels and equipment, or equipment and inputs for aquaculture, totalled more than two-thirds of government support to fisheries and more than three-quarters of government support to aquaculture in 2014 and 2015 (Figure 8).

 Of these, fuel tax concessions (available to artisanal fishers and small-scale aqua-farmers only) cost more than 150 USD million in 2015 – equating to more than half of total support, despite a significant reduction from previous years (Figure 8).

 Support to fisheries and aquaculture 2014-2015

Fisheries

 Aquaculture

**49%**

**58%**

Source: OECD (2017), *Fisheries Support Estimate*, <https://stats.oecd.org/Index.aspx?DataSetCode=FISH_FSE>.

 Most of the remaining direct support is allocated to aquaculture production equipment and the distribution of fishing boats. On the aquaculture side, floating cage construction received USD 450 000 dollars in 2015 and almost double this in 2016, while over USD 2.5 million were allocated to fish feed production and transport machinery and infrastructure in 2016. With respect to fisheries, a budget of over USD 200 million was allocated to the construction of 3 450 new fishing boats in 2016 (95% of which will be under 10 GT). These fishing boats will be distributed to fisher co-operatives, which primarily consist of artisanal fishers. At the same time, the government is investing in the modernisation of the artisanal fleet. A separate budget of almost USD 450 000 was provided in 2015 for the purchase of machines, gear, solar cells, submersible lamps and other equipment. Grant aid was also provided to assist fishermen and their livelihoods in the border areas of Indonesian territory by securing boats, purchasing gear and equipment (OECD, 2017).

 Allocation of these subsidies is likely to be costly – given the transaction costs associated with selecting a small number of recipients among very large numbers of fishers and aqua-farmers – and to create incentives for corruption.

 For fisheries, productive support is more problematic. While investments have the potential to increase the incomes of recipients, they also increase fishing effort in a context of insufficient management of resources (Section 3), leading to the common problem of declining productivity. This support is based on the assumption that policies on illegal fishing have improved fish stocks and will continue to do so, hence increasing the availability of fish that can be caught by artisanal fishermen. However, as revealed in Section 2, the direct link between a decrease in IUU activities and the increased availability of fish for artisanal fishers in coastal areas may only be true for certain species. In addition, in the absence of effective controls on domestic artisanal fisheries, stocks remain prone to overfishing.

 Offering direct support for livelihood diversification would be a better investment policy instead of support that risked encouraging new entrants to the sector. The development of alternative livelihood options for fishing and aqua-farming communities – notably through investment in the provision of new skills – can be a long process, however, and initial training may be needed to overcome traditional and conservative attitudes. Alongside primary services such as health care, clean water and sanitation, micro-enterprise programmes, vocational training such as teacher training, and support for trading in non-farm items such as handicrafts can be supported through the provision of capital assets, market information, credit facilities and education. Indonesia is experienced in implementing conditional cash transfers aimed at increasing participation in health and education services (USAID, 2013).

### Sustainable resource management for stable income growth

 While direct support is necessary in the short run to support the livelihoods of poor fishers and aqua-farmers, in the medium to long run, investing in the sustainable management of resources and the ecosystem would ensure more stable and increasing economic returns to stakeholders that depend on those resources. Improving the health of fish stocks is not only important for their survival – it also means that more fish can be caught and reduces the cost per catch. The composition of the fish caught can also change, to contain more high-value fish, thereby increasing the average price of the catch. Research conducted jointly by the World Bank and the FAO (Arnason, 2009) as well as Costello et al. (2016) demonstrate the huge potential of good resource management to increase the productivity of capture fisheries, with tens of billions of USD to be gained annually worldwide. Costello et al. also show that the time horizons involved are not so long, with stock recovery targets predicted to be reached within less than ten years in half of the fisheries considered by their model. MMAF is currently working with Costello and his team to evaluate the gains associated with the elimination of IUU fishing and better management of domestic fisheries in Indonesia, with the objective of creating incentives for stakeholders and policy makers to fully engage in better management.

 Setting total catch limits could have additional economic benefits, if associated with restrictions on access to resources or the allocation of fishing rights aimed at reducing overcapacity, which could further increase the catch per unit of effort and thus the returns of fishing. Such restrictions are currently incompatible with Indonesian legislation. Article 33 (paragraph 3) of the Constitution specifies that land, water, air and natural resources are controlled by the State, and responsibility for these resources cannot be transferred to individuals. On the basis of this article, the provision of the Coastal Management and Small Islands Act (No. 27/2007), that would have permitted user rights up to 12 miles from shore, was rejected by the High Court (16 June 2011 Decree). However, an important step towards the legal possibility to restrict access to resources has been taken by the government with the preparation of a law or regulation that will allow the use of rights or privileges in fisheries once approved by the Parliament.

 Setting up good governance processes to allocate fishing rights or deliver access to fisheries is an important step to ensure that any changes are socially acceptable and durable. First, rights and access should be assigned as unambiguously as possible to avoid conflicts, bargaining and politicisation. Additionally, transparent rules regarding the allocation of fishing rights or access to individuals, co-operatives or communities ideally have to be discussed extensively ex-ante with these stakeholders, who also participate in the decision-making process on the basis of such rules. Community-based quota management should particularly be considered for the management of fisheries that are operated exclusively by small-scale fishers in areas that are both geographically diffuse and difficult to access, making it impossible to regulate these fisheries through individual quotas or rights as management and surveillance costs would be excessive. Because it is often difficult to implement user privileges when fishers have traditionally fished freely, MMAF will also need to plan a public education campaign and public hearings to explain the benefits of rights-based management to secure widespread support and compliance (Sutinen, 2013).

 Better regulation of environmental externalities and the adoption of sustainable production practices also have the potential to increase the economic returns of aqua-farms in the medium to long term. Improved biosecurity measures in aquaculture reduce mortality while increasing the quality of products delivered for export as well as reducing needs for drugs and hence production costs. Well-managed certification schemes can also create economic premiums on the final product that enhance the economic benefits for participating fisheries and farms.

 Transitioning to a rights-based fishing system – or to more sustainable aquaculture production modes – will not be easy, and requires flanking measures. Transitional costs are to be expected, and the careful anticipation of impacts and design of adaptive strategies will be necessary to avoid income disruptions. The profitability of the aquaculture sector is for example currently affected by some of the new fishing management measures. Harvest restrictions on baby crabs and lobster have interrupted their cultivation[[9]](#footnote-10), while the export of live mariculture products (notably grouper) has been complicated by the measures taken to counter IUU fishing, as their transport was largely undertaken by ex-foreign vessels now prohibited from operating in Indonesian waters. Similarly, restrictions to access fishing resources and tighter regulations inevitably create winners and losers and require stakeholders to trust that new policies will lead to a better future that is worth the transition costs – namely reduced catches, in the short term, as well as potential exits of the sector. In countries such as Indonesia, where the fishing sector is an important source of livelihoods for the poor, focusing on finding the highest-value use of the resource is particularly difficult and desirable only to the extent that, in the short term, the human costs of the transition can be addressed by complementary policies. Providing assistance with the costs and process of adjustment with so-called flanking measures can, however, be effective, as can providing direct livelihood assistance to those who lose out from reform.

### Facilitating public support for infrastructure and R&D

 Public support can also help the transition to greater economic returns by establishing an enabling environment that is conducive to sustainable productivity growth. Two key aspects of such an enabling environment, directly under the responsibility of fisheries and aquaculture authorities, are infrastructure and research and development (R&D).

 Efficient and well-developed transport, communication and energy provision infrastructure plays an important role in connecting fishers and aqua-farmers to market opportunities and knowledge, as well as specialised support services, thus reducing the cost of doing business and stimulating value creation (Waite et al., 2014). Transport infrastructure, such as suitable roads, waterways, railways, ports, wharf and landing docks; and energy infrastructure, which is important for light and cold-chain storage, are particularly critical given that fish is a perishable commodity and production centres may be located far from transport hubs for export as well as urban markets where the majority of seafood is consumed (75% of aquaculture production is still consumed domestically according to Indonesia Investments [2014]). In addition, with a strategy focused on supporting artisanal fishing in national waters, leaving the industrial fleet to operate only in the high seas, a big challenge for the Indonesian government is to connect artisanal fishers with processors and distributors to substitute supply from industrial vessels with supply from artisanal fishers.

 OECD work on agricultural productivity shows that investments in R&D, technology transfer and extension services can yield great returns (OECD, 2013). New techniques and innovations can spur growth through improvements in quality and quantity, by reducing costs of production or by creating increased private and social benefits. Ideally, innovation can enable more value to be derived from the same level of natural resources while reducing negative impacts on the environment. Technological innovations have played an important role for growth in every aspect of aquaculture operations, particularly in the development of efficient feed, bio-secure seed and disease reduction. Innovations have also led to the creation of new high-value products from capture fisheries waste, hence increasing the total value of fisheries production.

 By making domestic seafood production more profitable, investment in infrastructure and R&D also increases the competitiveness of domestic products compared to imports, and promotes food self-sufficiency – a key objective of the Jokowi administration. However, unlike import restrictions, investment in infrastructure and R&D also benefit net consumers of seafood with lower prices, hence also improving food security.

#### Infrastructure to address high transport costs

 Transport infrastructure is particularly expensive, as Indonesia is made up of 6 000 inhabited islands spread across 5 000 km from east to west, making it difficult to efficiently connect products and people to markets. High inter-island transport costs contribute to large inter-regional price differences. Shipping costs within Indonesia are found to be more expensive than the costs of importing from Singapore or China (Tabor, 2015). Shipping Law 17/2008, which introduced cabotage principles limiting the movement of cargo between Indonesian ports to Indonesian-flagged vessels, added to inter-island transport costs.

 According to data published by the Indonesian Chamber of Commerce and Industry (Kadin Indonesia), around 17% of a company’s total expenditure in Indonesia is absorbed by logistics costs (Indonesia Investments, 2016a). In peer regional economies, this number is much lower: 5% in Japan, 8% in Malaysia, 10% in Thailand and 12.5% in China. According to the World Economic Forum Global Competitiveness Index 2015, since 2013, every transport category has receded in quality, indicating that Indonesia is not keeping up with the rest of the world in terms of transport development (World Economic Forum, 2015). Quality of port infrastructure was the lowest-rated category. Problems include a lack of equipment, low port efficiency and poor road access.

 Energy infrastructure also requires critical improvement. Energy services and consumption are oriented disproportionately toward Indonesia’s economic growth centres, and large expanses of remote areas still lack access to basic energy services (Tabor, 2015). In addition, demand is outstripping supply capacities in many parts of the national grid, due to electricity theft, underinvestment and infrastructure needs related to transmission and distribution.

 The government is conscious of the need to prioritise infrastructure investments. President Jokowi announced that infrastructure spending will increase throughout his first term, peaking at around 7.7% of GDP in 2017 with the biggest investment in maritime infrastructure. The government intends to build 24 new sea ports and 15 new airports by 2019. By 2014, over USD 19.2 million had been spent on the development of facilities at fishing ports as part of a three-year development programme (2011-2014) (OECD, 2017). The investment targets improvements to clean water supply, the expansion of landing areas and facilities, better transportation to and from the port, renewable energy sources and solar panels. In 2015, a further USD 23.9 million was spent on developing fishing ports in Indonesia’s outermost regions, while USD 666 000 was also spent on the installation of solar cells in fishing ports (OECD, 2017). Together, infrastructure projects accounted for 9-10% of government support in fisheries and aquaculture in 2014 and 2015 (Figure 8). Infrastructure needs can understandably place a huge burden on government budgets and, in future, Indonesia may wish to consider private sector participation through public-private partnerships (PPP).

#### Encouraging research and development

 An important strategy for the Indonesian government would be to create the conditions for the R&D that enables innovation to take place. In the OECD context, an industry-wide approach to innovation activities – through industry organisations, producer organisations and specialised university laboratories – has been found to be conducive to better research outcomes (OECD, 2013). Facilitating PPPs can also enable the development of innovations (Subasinghe et al., 2000). However, private sector investment tends to be orientated towards larger enterprises (OECD, 2013). Finally, in Indonesia, small-scale aqua-farmers and fishers form the majority of producers. While small businesses can pioneer new systems, species, products and technologies, they often lack resources to innovate on their own. Public policy can thus be used to kick-start the required R&D.

 Potential areas for innovation investment include research areas related to on-farm activity, such as water quality management, better feed efficiency and innovative production systems; longer-term research programmes on the use of genetics, for example; and reliable data collection and analysis to better inform management decision-making. Developing a strategy for the diffusion of innovation results can also bring broad benefits. In developing countries in particular, government investment is important to scale up good aquaculture and management practices so that they become industry norms (Ross et al., 2013). Providing simple skills and technologies to small-scale aquaculture can strengthen their innovative and learning capacities.

 In Indonesia, spending on R&D accounted for less than 2% of support to fisheries and less than 5% of support to aquaculture in 2014 and 2015, a relatively low figure compared with levels observed in many OECD countries (OECD, 2016a). One key area identified by the government is feed. As mentioned in Section 3, fish feed accounts for the largest percentage of aquaculture operating costs, and reducing these costs would contribute to improved productivity. Research programmes therefore receive public funding to conduct experiments with local ingredients and test alternative protein sources such as seaweed and palm oil.

 However, investment in research will only boost productivity to the extent that it does not lead to the substitution of imports with domestically-produced goods that are only competitive thanks to trade restrictions (USAID, 2013). Using research to develop products that can be more profitably sourced from other countries would effectively mean that public funds are used to create rents for input producers at the expense of both seafood producers and consumers.

### Trade and foreign investment restrictions: Support at the cost of higher prices for consumers

 Countries of Southeast Asia often use trade restrictions to increase the demand for domestically-produced food products with the dual objective of increasing producer incomes and becoming more self-sufficient in food production (OECD, 2016b). To this end, the Indonesian Food Law of October 2012 expanded the ways and means by which the government might influence domestic food markets, and extended coverage beyond rice. Applied tariff rates for seafood products range between 0 and 10%, but bound tariffs average 40%. Indonesia also restricts imports of most seafood species on the basis of quality control and food safety reasons according to Regulation 46/2014. As a result, imports remain very limited, and have followed a much slower growth path than exports (Figure 8).

 Indonesian imports and exports by value, 2014



Source: UN DESA (2016), *UN Comtrade*, <https://comtrade.un.org/>.

 Restricting imports raises the producer price and encourages more domestic production, which boosts the welfare of net sellers of the protected product – fishers and aquaculture producers. However, the benefits accrue mainly to the largest producers, who are the least likely to be food-insecure. At the same time, higher prices lower the welfare of net buyers – food consumers – as well as their access to food and ultimately their food security and nutrition. As the poorest and most food-insecure spend the highest proportion of their income on food, they are hurt the most. Such restrictions thus contradict the government’s stated objective to encourage fish consumption in the coming years.

 Protection also reduces incentives to improve domestic productivity with a view to competing with foreign producers, and hence tend to lock domestic production systems into expensive forms of production. Moreover, as far as overfished capture species are concerned, restrictions on imports increase the demand for domestically-caught fish, hence worsening pressures on endangered stocks.

 Restrictions on investment by foreign investors can have similar effects. The most recent Negative Investment List adopted by the government (Regulation 44/2015) limits the share of foreign investment in certain sectors of the economy. In capture fisheries, foreign capital is entirely prohibited. Because large vessels are not currently produced in Indonesia, this means that not many large fishing vessels will operate in Indonesian waters in the near to medium term. The Indonesian government aims to ensure that the artisanal sector catches the fish that would have otherwise been caught by the industrial fleet, hence increasing artisanal incomes. However, as mentioned in Section 2, the artisanal and industrial fleet partially target different species.

 In addition, implications of these restrictions for national food security are ambiguous. Indeed, the processing sector may be unable to source from artisanal fishers the fish that they previously sourced from the industrial fleet, at least in the short run, resulting in potential job and income losses in the processing sector. In addition, to the extent that the industrial fleet was more cost-efficient than the artisanal fleet, the consumer price for fish caught by artisanal fishers could be higher than if it had been caught by industrial vessels. Restrictions on investment would consequently have distributional effects similar to those of import restrictions.

 Investigating these issues in more detail, and trying to estimate the impacts of trade and investment restrictions for particular groups of producers or consumers, requires both detailed price data and household level data on production and consumption. The Government of Indonesia is currently improving its fisheries and aquaculture data collection system. Once the necessary data becomes available, investment in the abovementioned impact analysis would be a welcome priority.

## 4. The way forward: From food *sovereignty* to food *security*

 Fisheries and aquaculture policies in Indonesia have the potential to improve food security and nutrition if they are focused on three key, closely-intertwined objectives: the sustainable management of natural resources for the future, sustainable increases to economic opportunities for fishers and aqua-farmers, and improved consumer access to seafood.

 The sustainable exploitation of resources and ecosystems can both reduce the risks associated with the sector’s contribution to food security and increase incomes for fishers and aqua-farmers in the long run. To transition to more sustainable seafood production, this report recommends complementing the government’s efforts to combat illegal fishing with better management of domestic fisheries, notably by adopting long-term measurable management targets for the main fisheries. Government efforts to improve catch data monitoring and centralise the data collection system of MMAF are an important prerequisite to better fisheries management. The challenge will be to also include small-scale fisheries in the data collection process. Establishing a legitimate and acceptable governance system that involves both stakeholders and scientists in target-setting and access allocation is the second key stepping-stone towards sustainable fisheries management. The report also identifies scope for better regulation of the aquaculture sub-sector, accompanied by more comprehensive impact assessment of large farm operations, more regular controls, and the clearer allocation of monitoring and information-gathering responsibilities between different government levels.

 Further improvements to the incomes of fishers and aqua-farmers will predominantly have to come from increases in the value of seafood produced as well as reductions in production cost. The direct support currently provided by the government to individual fishers and aqua-farmers – mainly in the form of subsidies for fuel and vessel or productive equipment – with a view to increasing their incomes or reducing their costs biases production incentives and increases pressure on resources. To prevent this, it is recommended – particularly during periods of transition to more sustainable production practices – that the government instead directly support livelihoods via the provision of social safety nets that are targeted at vulnerable households, and help the conversion to more remunerative activities by means of education and training. Directing public support to R&D and infrastructure would also favour greater value creation, while at the same time reducing prices for consumers – thus improving access to food, the third key objective – and increasing food availability. Reliance on restrictive trade and investment barriers, on the other hand, supports incomes at the expense of reduced consumer access to seafood products, and therefore has the potential to be counterproductive to food security in the long run.

References

Adhuri, D. (2016), “Combining resource management and livelihood development: Some reflections from East Flores and Lombok”, in *Proceedings of the Eighteenth Conference of the International Institute of Fisheries Economics and Trade, July 11-15 2016, Aberdeen, Scotland: Challenging New Frontiers in the Global Seafood Sector: A Northern Enlightenment*, A. L. Shriver (eds.), International Institute of Fisheries Economics and Trade (IIFET), Corvallis, Oregon, United States of America.

Arnason, R., K. Kelleher, and R. Willmann (2009), *The Sunken Billions: The Economic Justification for Fisheries Reform,* The International Bank for Reconstruction and Development / The World Bank, Washington, D.C.

Asche, F. (2011), *Green Growth in Fisheries and Aquaculture Production and Trade*, OECD internal document, Paris, [www.oecd.org/tad/fisheries/green-growth-fisheries-aquaculture-production-trade-report.pdf](http://www.oecd.org/tad/fisheries/green-growth-fisheries-aquaculture-production-trade-report.pdf) (accessed on 17 November 2016).

ASEAN (2016), *Regional Report on Nutrition Security in ASEAN: Volume 1*, ASEAN Secretariat, Jakarta, and United Nations Children’s Fund, Bangkok.

BPS-Indonesia Statistik (2008), *Badan Pusat Statistik* (database), Statistics Indonesia, Jakarta, <https://www.bps.go.id/> (accessed on 12 September 2016).

Brooks, J. and A. Matthews (2015), "Trade dimensions of food security", OECD Food, Agriculture and Fisheries Papers, No. 77, OECD Publishing, Paris, <http://dx.doi.org/10.1787/5js65xn790nv-en>.

Burke, L., K. Reytar, M. Spalding and A. Perry (2011), *Reefs at Risk Revisited*, World Resources Institute, Washington D.C.

Cao, L., J.S. Diana, G.A. Keoleian and Q. Lai (2011), “Life cycle assessment of Chinese shrimp farming systems targeted for export and domestic sales”, *Environmental Science and Technology*, Vol. 45/15, ASC Publications, Washington D.C., pp. 6531–6538.

CEA (2014), “Indonesia” in *Country Scoping Project*, California Environmental Associates, San Francisco, United States of America.

Costello, C., D. Ovando, T. Clavelle, C.K. Strauss, R. Hilborn, M.C. Melnychuk, T.A. Branch, S.D. Gaines, C.S. Szuwalski, R.B. Cabral, D.N. Rader and A. Leland (2016), “Global fishery prospects under contrasting management regimes”, *PNAS*, Vol. 113/18, Proceedings of the National Academy of Sciences of the United States of America, Washington D.C, pp. 5125-5129.

DAFF (2011), *Net Returns: A Human Capacity Development Framework for Marine Capture Fisheries Management in South East Asia*, Department of Agriculture, Fisheries and Forestry, Canberra.

De Silva, S.S. and D. Soto (2009), “Climate change and aquaculture: Potential impacts, adaptation and mitigation”, in K. Cochrane, C. De Young, D. Soto and T. Bahri (eds). *Climate Change Implications for Fisheries and Aquaculture: Overview of Current Scientific Knowledge*, FAO Fisheries and Aquaculture Technical Paper No. 530, Food and Agriculture Organization, Rome.

FAO (2016a), *Food Balance Sheet Indonesia* (database), Food and Agriculture Organization, Rome, <http://faostat.fao.org/default.aspx> (accessed on 19 September 2016).

FAO (2016b), *The State of World Fisheries and Aquaculture 2016: Contributing to Food Security and Nutrition for All*, Food and Agriculture Organization, Rome.

FAO (2016c), *FAOSTAT* (database), <http://faostat3.fao.org/home/E> (accessed on 19 September 2016).

FAO (2015), *Regional Overview of Food Insecurity Asia and the Pacific: Towards a Food Secure Asia and the Pacific*, Food and Agriculture Organization, Bangkok.

FAO (2011), *Technical Guidelines on Aquaculture Certification*, Food and Agriculture Organization, Rome.

FAO (2003), *Fisheries Management. 2. The ecosystem approach to fisheries*, FAO Technical Guidelines for Responsible Fisheries, Vol. 4, Suppl. 2 Food and Agriculture Organization, Rome.

Gutierrez, N.L., O. Defeo, S.R. Bush, D.S. Butterworth, C.A. Roheim and A.E Punt (2016), “The current situation and prospects of fisheries certification and ecolabelling”, *Fisheries Research*, Vol. 182, pp. 1-6.

HLPE (2014), *Food Losses and Waste in the Context of Sustainable Food Systems: A Report by the High Level Panel of Experts on Food Security and Nutrition*, High Level Panel of Experts on Food Security and Nutrition,Committee on World Food Security, Rome.

 Inside Indonesia (no date), *Aquaculture in Adversity* (webpage) Jakarta, <http://www.insideindonesia.org/aquaculture-in-adversity> (accessed 12 September 2016).

IFPRI (2014), *Global Hunger Index: The challenge of Hidden Hunger*, International Food Policy Research Institute, Welthungerhilfe, and Concern Worldwide, Bonn, Washington DC and Dublin.

Indonesia Investments (2016a), *Infrastructure Development in Indonesia* (webpage), [www.indonesia-investments.com/business/risks/infrastructure/item381](http://www.indonesia-investments.com/business/risks/infrastructure/item381) (accessed on 10 October 2016).

Indonesia Investments (2016b), *Poverty in Indonesia* (webpage), [www.indonesia-investments.com/finance/macroeconomic-indicators/poverty/item301](http://www.indonesia-investments.com/finance/macroeconomic-indicators/poverty/item301) (accessed on 8 November 2016).

Indonesia Investments (2014), *Export Target of Indonesia’s Fishery Sector Revised on Weak Demand* (webpage), 28 March 2014, [www.indonesia-investments.com/news/todays-headlines/export-target-of-indonesias-fishery-sector-revised-on-weak-global-demand/item1816K](http://www.indonesia-investments.com/news/todays-headlines/export-target-of-indonesias-fishery-sector-revised-on-weak-global-demand/item1816K.%28accessed) (accessed on 10 October 2016).

Koeshendrajana, S. (2016), *Profiles of Indonesian Fisheries: Future Supply and Demand Scenarios of Fish in ASEAN Region*, Stakeholder Workshop, Penang, 7-8 June 2016, WorldFish, Penang, Malaysia.

Kusumawati, R. and S.R. Bush (2015), “Co-producing better management practice standards for shrimp aquaculture in Indonesia”, *Maritime Studies*, Vol. 14/21, Springer, London.

MMAF (2016), Information received from Ministry of Marine Affairs and Fisheries, Jakarta.

MMAF (2015), *Statistik Perikanan Tangkap Indonesia Menurut Provinsi 2015: Capture Fisheries Statistics of Indonesia by Province,* Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries, Jakarta.

Noegroho A. (2016), *Improving Traceability and Chain of Custody to Meet Market and Export Requirement*, Second Bali Tuna Conference, Denpasar, Indonesia, 19 May 2016.

OECD (2017), “Fisheries Support Estimate”, *Economic Indicators for Agriculture and Fisheries* (database), <https://stats.oecd.org/Index.aspx?DataSetCode=FISH_FSE> (data will be accessible in Q2 2017).

OECD (2016a), *Indonesia Country Study, Review of Fisheries 2015*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/rev_fish_stat_en-2015-en>.

OECD (2016b), *Managing Food Security Through Agriculture-Related Policies: A Stocktake of Measures Applied in ASEAN*, OECD internal document, TAD/CA/APM/WP(2015)31/FINAL.

OECD (2015), *Green Growth in Fisheries and Aquaculture*, OECD Green Growth Studies, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264232143-en>.

OECD (2014), *Fishing for Development – Background Paper for Session 2: Rebuilding*. Joint meeting of the OECD Fisheries and Development Assistance Committees, the Food and Agriculture Organization of the United Nations and the World Bank, OECD, Paris, 10-11 April, 2014.

OECD (2013), Global Food Security: Challenges for the Food and Agricultural System*,* OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264195363>.

OECD (2011), Fisheries and Aquaculture Certification, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264119680-en>

OECD/FAO (2016), *OECD-FAO Agricultural Outlook 2016-2025*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/agr_outlook-2016-en>.

Pauly, D. and V. Budimartono (eds.) (2015), *Marine Fisheries Catches of Western, Central and Eastern Indonesia, 1950-2010*, Working Paper No. 2015-61, University of British Columbia, Vancouver, Canada.

Phillips, M., P.J.G. Henriksson, N. Tran, C.Y. Chan, C.V. Mohan, U-P. Rodriquez, S. Suri, S. Hall, and S. Koeshendrajana (2015), *Program Report: 2015-39*, WorldFish, Penang, Malaysia.

Potts, J., A. Wilkings, M. Lynch, S. McFatridge (2016), *State of Sustainability Initiatives Review: Standards and the Blue Economy*, International Institute for Sustainable Development (IISD), Manitoba, Canada.

Rana, K.J. S. Siriwardena and M.R. Hasan, (2009), *Impact of Rising Feed Ingredient Prices on Aquafeeds and Aquaculture Production*, Fisheries and Aquaculture Technical Paper No. 541, Food and Agriculture Organization, Rome.

Rimmer, M.A., K. Sugama, D. Rakhmawati, R. Rofiq and R.H. Habgood (2013), “A review and SWOT analysis of aquaculture development in Indonesia”, *Aquaculture*, Vol. 5/4, pp. 255-279.

Ross, L.G., T.C. Telfer, L. Falconer, D. Soto and J. Aguilar-Manjarrez (eds.) (2013), "Site selection and carrying capacities for inland and coastal aquaculture: FAO/Institute of Aquaculture, University of Stirling, Expert Workshop, 6-8 December 2010”, *FAO Fisheries and Aquaculture Proceedings No. 21*, Food and Agriculture Organization, Rome.

Santosa, M.A., (2016), *Indonesia’s Approach to Tackling IUU Fishing: Strategy on the Prevention and Eradication of IUU Fishing & Post-Moratorium Policies*, presentation to WorldFish, Penang, Malaysia.

Shelton, C., (2014), “Climate change adaptation in fisheries and aquaculture: Compilation of initial examples”, *FAO Fisheries and Aquaculture Circular No. 1088*, Food and Agriculture Organization, Rome.

Stobutzki, I., M. Stephan and K. Mazur (2014), *Overview of Indonesia’s Capture Fisheries, 2013*, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Subasinghe, R.P., P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery, and J.R. Arthur (eds.) (2000), *Aquaculture Development: Financing and Institutional Support*, Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25 February 2000, pp. 259-263, Network of Aquaculture Centres in Asia-Pacific, Bangkok, and Food and Agriculture Organization, Rome.

Sutinen J.G., (2013), *Final Report on Indonesian Fisheries Policy*, United States Agency for International Development, Washington D.C.

Tabor, S.R. (2015), “Constraints to Indonesia’s economic growth”, *ADB Papers on Indonesia No. 10*, Asian Development Bank, Manila.

Tran, N., U-P. Rodriguez, C.Y. Chan, M.J. Phillips, C.V. Mohan, P. J.G. Henriksson, S. Koeshendrajana, S. Suri and S. Hall (forthcoming), Indonesian Aquaculture Futures. Part 1: An analysis of fish supply and demand in Indonesia to 2010 and role of aquaculture using the AisaFish Model.

UN DESA (2016), *UN Comtrade* (database), United Nations Department of Economic and Social Affairs, <https://comtrade.un.org/> (accessed on 14 November 2016).

 USAID (2013), *Indonesia’s Food Law of 2012, Prospective Impact on Domestic Markets and Food Security*, United States Agency for International Development, Washington D.C.

Waite, R., M. Beveridge, R. Brummett, S. Castine, N. Chaiyawannakarn, S. Kaushik, R. Mungkung, S. Nawapakpilai and M. Phillips (2014), “Improving productivity and environmental performance of aquaculture performance”, *World Resources Institute Working Paper*, World Resources Institute, Washington D.C.

WHO (2015), *Global Database on Child Growth and Malnutrition* (database), UNICEF-WHO-The World Bank Group, [www.who.int/nutgrowthdb/estimates2014/en/](http://www.who.int/nutgrowthdb/estimates2014/en/) (accessed on 8 November 2016).

Wijaya, A. and P. Glasbergen (2016), “Toward a new scenario in agricultural sustainability certification? The response of the Indonesian national government to private certification”*, The Journal of Environment & Development*, Vol. 25/ 2, pp. 219-246.

World Bank (2017), *Indonesia Dashboard*, The World Bank Group, <http://sdwebx.worldbank.org/climateportalb/home.cfm?page=country_profile&CCode=IDN> (accessed on 9 February 2017).

World Economic Forum (2015), *The Global Competitiveness Report 2015-2016*, World Economic Forum, Geneva.

1. Indonesia’s Law No. 18/2012 defines food security in a way that is very much in line with the FAO theoretical framework. It is described as the condition in which all people, in all households, at all times have sufficient food in both quantity and quality to enable them to live healthy, active, productive and sustainable lives, and that the food is safe, diverse, nutritious, equitably distributed and affordable, and does not conflict with religion, beliefs or culture (OECD, 2016a). [↑](#footnote-ref-2)
2. Using a range of indicators, the companion paper *Stocktake of Food Security Policies* ([TAD/CA/APM/WP(2016)20](http://www2.oecd.org/oecdinfo/info.aspx?app=OLIScoteEN&Ref=TAD/CA/APM/WP(2016)20) – hereafter OECD, 2016b) provides a snapshot of the food security situation in the ASEAN region, and in comparison to the rest of the world. [↑](#footnote-ref-3)
3. The FAO prevalence of food inadequacy index measures the percentage of the population that is at risk of not meeting the food intake requirements associated with normal physical activity, and therefore also includes those who, although they cannot be considered chronically undernourished, are likely to be conditioned in their economic activity by insufficient food. [↑](#footnote-ref-4)
4. The National Food Law, adopted in Indonesia in October 2012, expanded the ways and means by which the government might influence domestic food markets. The key objectives of the law are to increase food production and self-sufficiency; improve the welfare of farmers, fishers and food processors and their competitiveness; ease consumer access to food, especially for the food insecure; and improve nutrition outcomes by promoting more diversity in food consumption. Among the policy tools introduced are import and export restrictions; investment in research and development (R&D) and rural infrastructure; better management of land and water resources; as well as promotion of consumer knowledge of the nutritional benefits of an adequate diet (USAID, 2013). [↑](#footnote-ref-5)
5. On October 20, 2014, President Jokowi declared “We have to work as hard as we can to restore Indonesia as a maritime power. The oceans, the seas, the straits and the bays are the future of our civilisation.” (Noegroho, 2016) [↑](#footnote-ref-6)
6. It is estimated that inland fisheries account for about 6% of the total catch volume and 9% of catch value (Tran et al., forthcoming). About 200 000 boats operate in inland waters, mostly without engines (FAO, 2012). Due to lack of available data, this report does not cover policies for inland water fishing. [↑](#footnote-ref-7)
7. Indonesia is also committed to establishing marine protected areas: over 20 million hectares by 2020 and 30 million hectares by 2030. In February 2016, Marine Protected Areas (MPAs) already covered over 17 million hectares. They are managed jointly by MMAF and the Ministry of Environment and Forestry. MPA policies are beyond the scope of this paper. [↑](#footnote-ref-8)
8. Indonesia has signed the UN Convention on Biological Diversity (CBD), the Convention to Combat Desertification (CCD), the Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. In addition, National Communications on Climate Change were adopted in 1999 and 2011, the National Commission on Clean Development Mechanisms was established in 2005, the National Action Plan on Climate Change Adaptation was adopted in 2007 and the Indonesian Climate Change Sectoral Roadmap was defined in 2010. [↑](#footnote-ref-9)
9. Artificial breeding for crabs is technically feasible, but in the absence of control mechanisms allowing differentiation between wild and cultured crabs, hatcheries have not yet been authorised. Lobster breeding, on the other hand, is not yet technically operational. [↑](#footnote-ref-10)