Chapter 2. Droughts, floods, tropical storms and Southeast Asian agriculture: Building the case for improved disaster risk management

This chapter provides evidence on the high exposure and vulnerability to weather-related disasters of the agricultural sector of Southeast Asian countries. It then presents the relative importance of the agricultural sector in the economy of these countries. Finally, the chapter summarises the policy analysis framework used to review policy measures managing drought, flood and tropical storm risk in agriculture.

2.1. The threat posed by weather-related disasters to Southeast Asian agriculture

The agricultural sector's exposure and vulnerability to weather-related disasters is significant and increasing. The Food and Agriculture Organization of the United Nations (FAO) has estimated that 25% of all damage caused by such disasters in 48 developing countries between 2003 and 2013 affected the agricultural sector (FAO, 2015a). In particular, droughts, wild fires, cyclones, floods and cold waves led to agricultural land becoming temporarily unproductive, loss of livestock, a greater prevalence of pests, and reduced crop production. According to this same review, 84% of the economic impact of droughts was borne by agriculture during this same time period (FAO, 2015a). Another study estimated that severe droughts and extreme heat between 2000 and 2007 were responsible for crop losses equivalent to 6% of global cereal production (Lesk et al., 2016). Such losses are projected to increase as events become more frequent and severe, but also less predictable, due to climate change (Field et al., 2014). It is also likely that the impact of weather-related disasters will be concentrated in a limited number of geographical hotspots with potentially strong impacts on agriculture and world food security (OECD, 2017c).

Drought, flood and tropical storm risks[1] are of particular concern for the agricultural sectors of several countries in the Association of Southeast Asian Nations (ASEAN) (FAO, 2015a). According to the latest reports of the Global Climate Risk Index (2017) ranking countries based on the impact of past extreme-weather events like floods and heat waves in the past 20 years, Southeast Asia has been one of the most exposed regions to weather-related disasters. Four ASEAN countries rank among the most affected worldwide and will be given particular attention in this study: Myanmar (2nd worldwide), the Philippines (4th in 2016 and 5th in 2017), Viet Nam (7th in 2016 and 8th in 2017) and Thailand (9th in 2016 and 10th in 2017). The Global Water Partnership and OECD highlight similar trends. For instance, Myanmar, Thailand and Viet Nam are among the top ten countries for flood risk exposure (Sadoff et al., 2015). Moreover, meteorological data from Myanmar show strong evidence of the country's growing vulnerability to climate change with rising temperatures, shorter monsoon seasons, and more frequent episodes of intense rainfall and severe cyclones along the coastline (ADB, 2013; Raitzer et al., 2015). Given the key role of the agricultural sector in Southeast Asia, both for food security as well as for development (Box 1), a more comprehensive response to these weather-related disasters is needed. In ASEAN, recent major catastrophic events like the 2008 Nargis cyclone in Myanmar, the 2011 floods in the Central valley of Thailand, the 2013 typhoon Haiyan in the Philippines and the 2015-16 *El Niño* droughts in southern Viet Nam, have highlighted the impact of weather-related disasters on the agricultural sector. Table 3.1 provides evidence of the damages and losses to agriculture caused by these milestone disasters.

The agricultural sectors of Myanmar, the Philippines, Thailand and Viet Nam not only face a growing external threat from climate change, their resilience to catastrophic weather events has also been diminished by internal developments. For example, deforestation in the past century has made the region much more susceptible to floods and droughts; upland deforestation in Myanmar and Viet Nam continues to degrade watersheds (FAO, 2016). Should the People's Republic of China (hereafter "China") and the Lao People's Democratic Republic located upstream finalise all their plans for dams, the water supply to downstream Cambodia, Myanmar, Thailand and Viet Nam might be jeopardised. The Mekong River Commission has made an important contribution to

tackling this challenging issue, but there is still work to be done to ensure sustainable management of the Basin.

Building on the OECD's past work on risk management of droughts and floods in the agricultural sector (OECD, 2016b), this report analyses drought, flood and tropical storm risk management policies and producer strategies in a selected number of ASEAN countries with high risk exposure: Myanmar, the Philippines, Thailand and Viet Nam. As such, this report provides useful information and lessons for other parts of the world facing similar risks.

Box 2.1. Agriculture remains an important economic sector in Southeast Asian countries

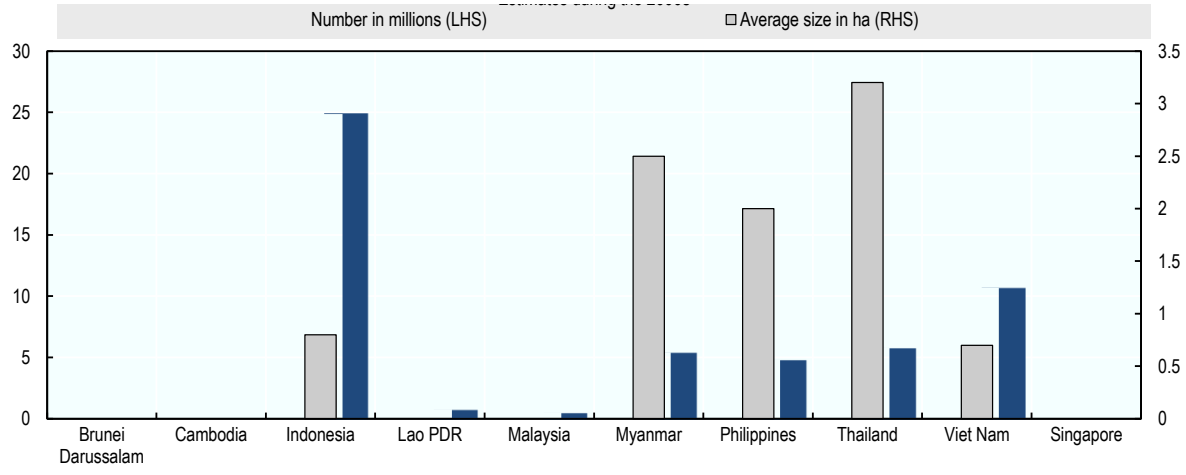
As a net exporter of agricultural commodities and food products, the Association of Southeast Asian Nations (ASEAN) has become an important global player in agricultural production, thereby contributing to global food security. Myanmar, Thailand and Viet Nam are the top three regional rice exporters. Other key agricultural exports for Myanmar, the Philippines, Thailand and Viet Nam are fresh horticultural produce, nuts and meat. Perennial crops, such as coffee and rubber, are also important agricultural commodities in Thailand and Viet Nam.

The structure of the agricultural sector in ASEAN countries is dominated by small land holdings managed by households. Accordingly, the number of agricultural holdings in ASEAN countries is higher than that in comparable OECD countries. Likewise, the average farm size is much smaller: between 2 and 3.2 ha per farm in Myanmar, the Philippines and Thailand, and only 0.7 ha per farm in Viet Nam.

The agricultural sector still accounts for a large share of employment in some ASEAN countries, though its contribution to gross domestic product (GDP) is typically much lower. In 2014 agriculture employed 30-47% of the labour force in the Philippines, Thailand and Viet Nam. At the same time, contributions to GDP ranged from 10% to 18% in the same countries. Agriculture holds a bigger share of Myanmar's economy: 70% of the labour force and 37.8% of GDP (FAO-MM, 2017). Agriculture is thus an important priority sector for development and poverty reduction measures in the region.

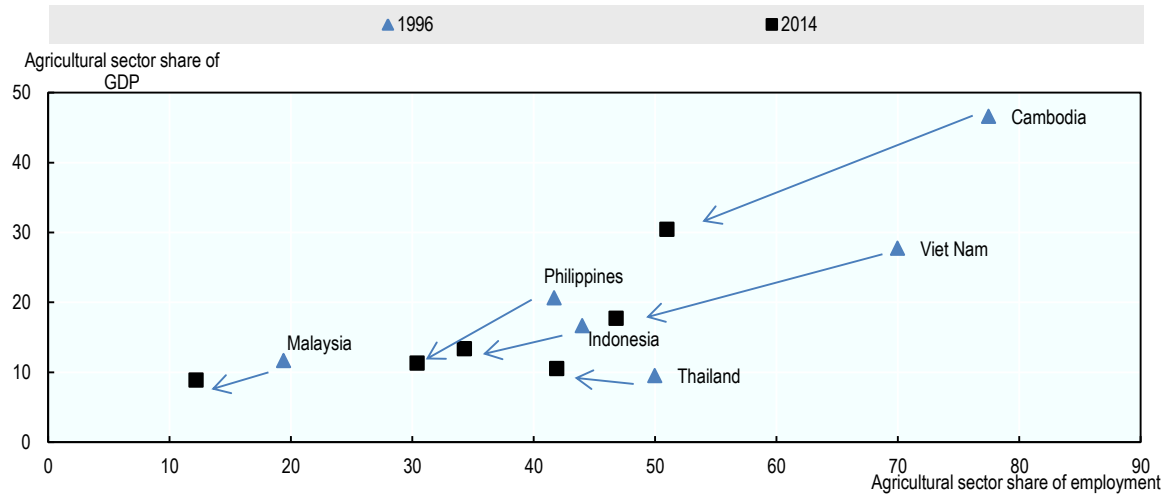
Figure 2.1. Number of agricultural holdings and average size

Estimates during the 2000.



Note: Estimates for each country relate to data collected during the 2000s. Specifically, Indonesia (2003), Malaysia (2005), Myanmar (2010), the Philippines (2002), Thailand (2003) and Viet Nam (2001)..
Source: Lowder et al. (2014)..

Figure 2.2. Agricultural sector share of employment and GDP (%)



Note: Data for Cambodia are for 1998 and 2012, and data for employment share are for 2013 for Thailand and Viet Nam.
Source: World Bank (2016), World Development Indicators, http://databank.worldbank.org/data/.

2.2. A policy analysis framework for mitigating weather-related risks

A growing recognition and momentum has emerged in the international community about the importance of managing the risk of weather-related disasters. Building upon the good practices in disaster risk management of various countries, the Sendai Framework for Disaster Risk Reduction 2015-30, for instance, aims to steer countries towards increased resilience to risks linked to disasters, including weather-related ones like droughts, floods and storms (UN, 2015). The new sustainable development agenda is similarly aligned; sustainable development goal 13 aspires "to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries" (Alano and Lee, 2016). Moreover, the signatories of the Paris Agreement from the Conference of the Parties' 21st Session recognised "the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change". They called for enhanced exchange of information, experiences, and good practices amongst Parties to raise their resilience to the impacts of climate change (UNFCCC, 2015). OECD countries have also issued *Recommendations on the Governance of Critical Risks*, which set global policy guidelines to identify, assess, reduce risks and boost preparedness, emergency response and rehabilitation (OECD, 2014). Furthermore, although not targeted to the agricultural sector, the OECD *Recommendation on Disaster Risk Financing Strategies* (OECD, 2017b) provides guidance on the financial management of disaster risks, including on creating an enabling environment for risk transfer and the management of public exposures to disaster risks.

Managing such risks in the agricultural sector requires a comprehensive and targeted set of anticipatory (*ex ante*) and post-crisis (*ex post*) policies (OECD, 2016b; OECD, 2009; UNISDR and CRED, 2015). After having identified the hazards and risks related to weather-related disasters facing the agricultural sector, *ex ante* policy tools include: (i) prevention and mitigation measures to reduce risk exposure and (ii) preparedness

measures to cope with risks that cannot be eliminated. *Ex post* tools include: (iii) response measures to minimise effects in the short term and (iv) recovery measures to facilitate "bouncing back" in the long-term. As illustrated in Box 2.2, a range of measures are available across these areas and require varied degrees of government involvement depending on the level of risk (OECD, 2016b; OECD, 2009).

Building on the OECD's past work on risk management of droughts and floods in the agricultural sector (OECD, 2016b), this study analyses drought, flood and tropical storm risk management policies and producer strategies in a selected number of ASEAN countries with high risk exposure: Myanmar, the Philippines, Thailand and Viet Nam. The main objectives of this report are to:

- Explore the drought, flood and tropical storm risk exposure of selected ASEAN countries and its possible implications for their agricultural development and food security

- Assess current national policy approaches to address drought, flood and tropical storm risk in the agricultural sector and compare them with OECD recommendations and good practices

- Develop policy recommendations for ASEAN and its member countries to improve the management of drought, flood and tropical storm risk in agriculture.

The evidence gathered for this study came from a literature review of publications from international organisations offering guidelines and policy recommendations, project reports and scientific articles on the subject of droughts, floods and tropical storms in Southeast Asia, with a special focus on policy measures to tackle these risks in Myanmar, the Philippines, Thailand and Viet Nam. A data collection and validation exercise was undertaken through interviews with government stakeholders, international organisations and research institutes in Myanmar, Thailand and Viet Nam in February 2017. The Philippines was not included in the field visit because it was already well covered by the disaster risk management (DRM) literature reviewed.

The next section of this study gathers evidence from the literature on the risk exposure of the agricultural sector from the three weather-related disasters of droughts, floods and tropical storms in Southeast Asia. The following section reviews the policy measures and producer strategies in place in different ASEAN countries to mitigate and respond effectively to these weather-related disaster risks in light of the good practices identified in OECD countries, and with a focus on Myanmar, the Philippines, Thailand, and Viet Nam. In each section, the policies and practices implemented to address all three types of weather-related risks are described together rather than attempting to classify policies and practices according to a type of risk. Indeed, the analysis showed that the four countries studied had focused their efforts on responding to all of the three types of weather-related disasters in an indiscriminate way. Evidence of specific policy strategies targeting drought, floods or tropical storms was sparse.[2]

Box 2.2. Examples of policy measures to manage drought, flood and tropical storm risk in agriculture

While individual actions by farmers and their communities are essential, a co-ordinated set of public policies are needed to ensure the efficient allocation and prevention of risks by individuals, the market and governments (OECD, 2016b). OECD (2016b) developed a detailed list of actions to be implemented, at the individual and collective levels, to manage the risks linked to droughts and floods in the agricultural sector of OECD countries. Building on this framework and on other frameworks and policy documents, a selected list of *ex ante* and *ex post* measures are described below to illustrate the broad range of risk management tools that may be relevant in the context of the Association of Southeast Asian Nations (ASEAN) (ASEAN, 2016; Aye, 2014; Carter, 2008; CFE-DMHA, 2015; Chariyaphan, 2012; IFRC and UNDP, 2014; Myanmar, 2012; OECD, 2016a; OECD, 2009; Ortega, 2014; UNISDR and CRED, 2015). While a useful tool, these categories and classifications are not necessarily mutually exclusive and some policy tools can offer synergies across multiple policy objectives.

Examples of *ex ante* measures

Prevention and mitigation

Infrastructure: Hydrological infrastructure such as irrigation systems and dams are key to reducing weather-related disasters risk.

Information campaigns: Raising awareness about weather-related disasters risk (for example, through targeted extension services) can encourage shifts in on-farm strategies to reduce risk exposure.

Regulations: Water allocation rights that reflect water availability is a prerequisite to managing drought risk for the agricultural sector. Regulations prohibiting water pollution can also reduce water stress in the event of a drought. Moreover, spatial planning regulations to prohibit production in high-risk zones can reduce flood and tropical storm risks.

Incentive schemes: Some subsidies can be used to encourage risk-reducing investments (for instance, when market prices discourage farmers from investing in more efficient water systems such as drip irrigation, government subsidies to co-fund such investments can nudge farmers towards their adoption and thus reduce the impact of future droughts).

Insurance: With careful design, risk transfer tools such as insurance can support both prevention and preparedness. By raising awareness about risk exposure, certain insurance products can encourage risk-reducing behaviour on the farm. Insurance can also help farmers financially prepare for part of the remaining risk of weather-related disasters by transferring risk to the insurer.

Preparedness

Weather and hydrological information systems: Information systems help farmers adapt their production plan at the beginning of the cropping season. Early warning systems are also key to initiating emergency response processes in a timely manner.

Precautionary savings: Household savings are a useful financial tool to cope with liquidity constraints when weather-related disasters occur.

Examples of *ex post* measures

Response

Crisis management procedures: Clearly defined emergency response procedures can help mitigate the costs of water shortages or excesses.

Social protection: Cash payments (for instance, via disaster-linked cash transfer programmes) are sometimes provided to supplement revenue after severe natural disasters.

Recovery

Inputs or equipment: The provision of inputs and equipment can help farmers prepare for subsequent seasons. In some cases, payments are provided for the purchase of specific inputs or equipment.

Debt rescheduling: Loans schedules can be adjusted after a disaster occurs to ease liquidity constraints and the long-term impacts of income shocks.

Source: Australian Government Productivity Commission (2009); FAO (2015b); OECD (2009; 2016b; 2017a); UNISDR and CRED (2015); Sadoff et al. (2015).

Notes

[1] From now on, the phrase "weather-related disasters" will cover extreme droughts, floods and tropical storms that have an impact on human activity. Annex 2.A documents established definitions for the weather-related disasters covered by this report.

[2] Furthermore, the dichotomy of weather-related risks (droughts and floods on the one hand, and storms on the other), which can be relevant for OECD countries, did not match the situation for Southeast Asia. In the four countries studied, tropical storms and floods often come together following short-term meteorological events while droughts are separate long-term climatic events (Annex 2.A for definitions).

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Annex 2.A.

Definitions of weather-related hazards and extreme events

According to the UNISDR, a *hazard* is "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" (UNISDR, 2009). In its own commentary of this definition, the UNISDR explains that hazards that are relevant to disaster risk reduction are "hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of sources: geological (earthquakes), climatological (droughts), meteorological (storms), hydrological (floods), oceanic (storm surge), biological (epidemic), and technological (plane crashes) (UNISDR and CRED, 2015). Several hazards can sometimes act in combination; this is particularly the case for heavy storms, which can cause floods. Hazards can be described quantitatively by the likelihood of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

Extreme events are a special case of hazard and they can also be defined by the frequency of an observed variable. Extreme events are the most infrequent forms of hazard characterised by a probability of reoccurrence of 1 in 10 000 years (OECD, 2011). The IPCC defines an *extreme weather event* as the "occurrence of a weather variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values and variables" (IPCC (2012), as quoted in OECD, 2016b).

Some weather-related disasters are cyclical and recurrent. Monsoon rainstorms and floods typically happen every year while the rainstorms and droughts caused by the *El Niño* southern oscillation occur every three to seven years. The term *El Niño* describes the abnormal warming of ocean water resulting from the oscillation of the ocean current in the South Pacific, usually accompanied by heavy rainfall in the coastal region of Peru and Chile, and reduction of rainfall in equatorial Africa and Australia (EM-DAT, 2017). With time, agricultural production systems have learned to adapt to annual weather cycles by making the best use of their cyclical conditions. However, the agricultural sector still struggles to deal with the effects of large *El Niño* southern oscillation events (FAO, 2015b). For example, the latest *El Niño* southern oscillation event (2015-2016) has affected 144 083 ha of Filipino farms, leading to losses in crops worth USD 70.8 million (FAO, 2015b). Another FAO study found that *El Niño* cycles were associated with more global agricultural area affected by extreme heat and drought conditions; these extreme conditions were particularly manifest in Asia (Alano and Lee, 2016).

Droughts

The main difference between meteorological and climatological disasters is their time scale. Climate-related extreme events are hazards "caused by long-lived, meso-to-macroscale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability" (EM-DAT, 2017). EM-DAT classifies droughts as climatological disasters because they occur over a long period of months to years.

The geography course at the University of Colorado defines drought as "an extended period (months, years) that a region experiences a deficiency in water supply, generally because of reduced precipitation" (University of Colorado, 2016). It goes on to characterise three basic sequences of drought and associated impacts:

- Meteorological drought: "deficit in precipitation, often (not always) accompanied by above average temperatures, high winds, low humidity and high solar radiation."
- Agricultural drought: "continued precipitation deficit, leading to a soil water deficit, hindering agriculture and natural plant growth."
- Hydrological drought: "the precipitation deficit continues, and stream discharge, lake wetland and reservoir levels drop, with impacts on wildlife habitat."

This definition of drought starts to introduce the complexity of weather phenomena, which are often associated or lead to one another. FAO (2015a) uses a two-step definition where meteorological drought can lead to environmental drought, which combines agricultural and hydrological drought from the University of Colorado definition. OECD (2016b) defines drought as a "temporary decrease of water availability in a given water system, caused by prolonged deviations from average levels precipitation" so also uses the two-step definition where meteorological drought leads to environmental drought. The rest of the OECD (2016b) report on floods and droughts is in line with the EM-DAT definition of drought in that droughts are made more complex by the possible interaction of human activities and water supply demands with the physical lack of water. EM-DAT (2017) thus mentions that in parallel with the conceptual definition of a drought, operational definitions specifying the level of precipitation that qualifies as a drought vary according to locality, climate and environmental sector.

Floods

According to the open-access geography course of the University of Colorado, "floods occur when a drainage basin experiences an unusually intense or prolonged water input. Flood is usually viewed as an event in which the streamflow exceeds the channel capacity, resulting in overland flow […], but the term is also often applied more generally to unusually high discharge events" (University of Colorado, 2016).

OECD relates floods to the change in water level, using the following definition: "rise, usually brief, in the water level of a stream or water body to a peak from which the water level recedes at a slower rate" (OECD, 2016a). The main types of flood risk that affect agriculture are: riverine floods, flash floods and coastal floods linked to storm surges (EM-DAT, 2017).

- A riverine flood is an overflow of water from a stream channel onto normally dry land in the floodplain.

- A flash flood is a rapid inland flood due to intense rainfall. A flash flood describes sudden flooding with short duration. In sloped terrain the water flows rapidly with a high destruction potential. In flat terrain the rain water cannot infiltrate into the ground or run off (due to small slope) as quickly as it falls. Flash floods typically are associated with thunder storms. A flash flood can occur at virtually any place.
- Coastal floods are characterised by higher-than-normal water levels along the coast caused by tidal changes or thunder storms that result in flooding, which can last from days to weeks.

Typhoon and cyclone tropical storms

Meteorological disasters are "events caused by short-lived or small-to-mesoscale atmospheric processes" lasting from minutes to days (EM-DAT, 2017). The meteorological disasters that are most likely to impact on agriculture are storms (tropical storms, thunder storms, hail storms, strong winds) and extreme temperatures (freeze, frost, heat waves and cold spells).

In tropical Southeast Asia, the most common meteorological disaster is a tropical storm. A tropical storm originates over tropical or subtropical waters. It is characterised by a warm-core, non-frontal synoptic-scale cyclone with a low pressure centre, spiral rain bands and strong winds. Depending on their location, tropical storms are referred to as hurricanes (Atlantic, North-East Pacific), cyclones (South Pacific and Indian Ocean, including Myanmar), or typhoons (North-West Pacific, and thus the other Southeast Asian countries covered by this report). The observed increase in sea surface temperatures is likely to lead to higher frequencies of tropical storms and heightened storm surges. The concomitant rise of global sea levels will also lead to higher storm surges (Alano and Lee, 2016). The English term "typhoon" derives from the Cantonese "taiphoong", or big wind.