Strengthening the climate resilience of small-scale farmers in Highland and South-Central Viet Nam (SACCR)

Feasibility Study

Developed by: Miguel Coulier, Independent Consultant - Community Resilience

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List of Acronyms

ACIS	Agro-Climate Information Services
ADB	Asian Development Bank
ARP	Agriculture Restructuring Plan
CBDRM	Community Based Disaster Risk Management
CCNPDC	Central Committee for Natural Disaster Prevention and Control
CCWG	Climate Change Working Group
CIP	Climate Innovation Platform
CEMA	Committee for Ethnic Minority Affairs
CGIAR	Consultative Group for International Agricultural Research
CRA	Climate Resilient Agriculture
DMHCC	Department of Meteorology, Hydrology and Climate Change
DMWG	Disaster Management Working Group
ENSO	El Niño Southern Oscillation
FAO	Food and Agricultural Organization
FbF	Forecast-based Financing
FFS	Farmer Field Schools
GALS	Gender Action Learning System
GoV	Government of Viet Nam
GSO	General Statistics Office
HA	Hectares
IFAD	International Fund for Agricultural Development
IMC	Irrigation Management Companies
IMHEN	Institute of Meteorology, Hydrology and Climate Change
INDC	Intended Nationally Determined Contribution
M&E	Monitoring and Evaluation
M/DARD	Ministry / Department of Agriculture and Rural Development
M/DONRE	Ministry/ Department of Natural Resources and Environment
M/DOLISA	Ministry/Department of Labor, Invalids and Social Affairs
M/DPI	Ministry/Department of Planning and Investment
N/AEC	National/ (local) Agricultural Extension Centre
NAMA	Nationally Appropriate Mitigation Actions
NCCC	National Committee on Climate Change
NCCS	National Climate Change Strategy
NCHMF	National Centre for Hydro-Meteorological Forecasting
NGO	Non-Governmental Organization
NTP NRD	National Targeted Program on New Rural Development
NTP SPR	National Targeted Program on Sustainable Poverty Reduction
NTP RCC	National Target Program to Respond to Climate Change
NSEP	National Strategy on Environment Protection
NWRS	National Water Resources Strategy
O&M	Operations and Maintenance
PPC	Party People's Committee
RCP	Representative Concentration Pathways
REDD+	Reduction of Greenhouse Gas Emissions through Efforts to Reduce Deforestation and Forest Degradation, Sustainable Management of Forest Resources, and Conservation and Enhancement of Forest Carbon Stocks
SCADA	Supervisory Control and Data Acquisition
SDGs	Sustainable Development Goals
SEDS	Socio-Economic Development Strategy
SEDP	Socio-Economic Development Plan
SP RCC	Support Program to Respond to Climate Change
TYM	Tao Yeu May
UN	United Nations

UNCDF	United Nations Capital Development Fund
VBARD	Vietnam Bank for Agricultural and Rural Development
VBSP	Viet Nam Bank for Social Policy
VGGS	Vietnam Green Growth Strategy
VWU	Vietnam Women's Union
WEIDAP	Water Efficiency Improvement in Drought Affected Provinces

Executive Summary

Across Viet Nam, climate change is already having a detrimental impact on communities, economies and local ecosystems. Rising temperatures, changing precipitation patterns, and more intense droughts, floods and other extreme weather events continue to devastate lives and livelihoods. **One of the most serious impacts of climate change for Viet Nam is its impact on water security and agriculture, in particular for the most vulnerable people, communities and regions that depend on agriculture but lack the necessary resources to adapt to climate change.**

Sustainable agriculture and water resources are indispensable to the livelihoods of the majority of people in the **Central Highlands**, especially of the 33% of its population categorized as ethnic minorities. Although they include four large rivers and enjoy medium annual rainfall with the greatest seasonal differentiation, the Central Highlands are susceptible to changes in water availability in the dry season when there is little rain and low river flow. Only about 28% of the agricultural land is irrigated, and farmers are forced to exploit groundwater for irrigation and domestic use. The Central Highlands region constitutes Vietnam's largest perennial crop zone, producing coffee, pepper, cashew, tea, and a variety of fruit, primarily destined for market. In addition, it produces a relatively small amount of rice, maize and cassava, mainly for local consumption, especially among the poor. Farmers in the region currently intercrop coffee with pepper, coffee and pepper with fruit trees, or combinations of perennial crops with annual crops as a strategy to mitigate the risk of drought and market price fluctuations. However, **under increasingly extreme climate change-induced drought, farmers' coping strategies are progressively less effective.** Groundwater levels continue to plunge throughout the region reaching 80-100 m in depth. Many households drill wells but are still unable to obtain sufficient water, intensifying their dependence on increasingly variable rainfall.

Around 48% of the people in the **South-Central Coast** region rely on agriculture for their livelihoods, and sufficient, reliable water sources are particularly critical as the South-Central Coast is the driest area of the country with a long dry season, the lowest rainfall, and a relatively small river system. Two rivers of the Central Highlands have been used to transfer water directly to Ninh Thuan and Binh Thuan provinces in the South-Central Coast. Still only around 30% of agricultural land is irrigated and many farmers are reliant on rainfall. Farmers in the region grow a variety of crops, including mango, dragon fruit, rice, or maize. In some upland areas of Binh Thuan, perennial crops such as coffee, cashew, and pepper are grown, and in Ninh Thuan livestock, primarily goats and cattle, are raised. While rice and maize are grown mainly for subsistence, the fruit crops and livestock are destined for market. Farmers often forego cultivation in the dry season or during drought and migrate elsewhere to work. **Under climate change, droughts in the region are becoming more extreme, and it's anticipated that many of the poor and near-poor are likely to face increasing poverty.**

In response to these challenges, the Government of Viet Nam, with support from the United Nations Development Program, is preparing a proposal to the Green Climate Fund. The project is targeting small-scale farmers in five provinces in the Central Highlands and South-Central Coast regions of Viet Nam, which were severely affected by the extreme drought in 2015-2016. **The project aims to respond to climate variability and extreme weather by facilitating a transformation of existing value chains towards climate resilient, inclusive and market-oriented agricultural systems via targeted interventions in water security, agriculture and agro-climate information.** The project is complementing a large-scale investment by the Government to modernize irrigation systems, through an ADB loan.

This feasibility study supports the well-informed design of appropriate project interventions by assessing the major climate risks and impacts for the target provinces, and the gaps and barriers to improving water availability and agricultural resilience for small-scale farmers. It also provides an in-depth overview of Viet Nam's relevant policy and institutional framework, and a mapping and analysis of past and on-going efforts, good practice and lessons learned by the Government and development partners for replication and/or upscaling in the project.

Based on the in-depth analysis of the country's and regions' risk profile, Viet Nam's policy priorities and existing initiatives and good practices, **the following interventions are recommended**:

- To ensure **last-mile connectivity** to the Government-ADB project to modernize irrigation systems, the GCF project should support the most vulnerable people such as poor and near-poor households, ethnic minorities and female headed households with a combination of locally available mobile pipes, pumps, water meters, shifting valves and small-scale on-farm water storage for last-mile connection to the Government-ADB invested irrigation schemes ensuring reliable water supply during drought periods;
- In areas with agricultural land that are primarily rainfed and out-of-reach of irrigation systems, the project should support **on-farm bio-engineered water storage systems** for collecting rainwater or surface water. These storage facilities or ponds will help farmers to accumulate and store water in the wet season for use at critical times during the dry season and extreme droughts;
- The project should apply a holistic approach to on-farm water management and support farmers with affordable climate resilient **on-farm water efficiency technologies**. This will lower water demand and increase water productivity and enable agricultural systems to withstand drought shocks and stresses;
- Given the impacts of changing weather patterns, social vulnerabilities and future estimated needs for increased agricultural production in Viet Nam, an integrated agro-ecological approach to addressing agricultural productivity, community resilience and climate change is critical;
- To advance such an agro-ecological approach to agricultural resilience, the project should replicate and adapt a global good practice by establishing **Climate Innovation Platforms**. These multi-stakeholder platforms should create space for relevant project and non-project partners to collaboratively discuss the challenges of climate change and its impact on water resources and agricultural productivity in their locality and to pool and promote innovative solutions towards resilient agricultural systems and value chains;
- To strengthen the resilience and productivity of cropping systems and value chains and increase access to and use of information, technical support and other resources and services on climate resilient agriculture technologies and practices, the project should implement a large **Farmer Field School program**;
- The Farmer Field School program should focus on the **promotion of Climate Resilient Agriculture (CRA) packages** customized per location and for the target beneficiaries. These packages have been identified and developed based on an in-depth analysis of current and projected climate risks and impacts on water and agricultural productivity, baseline perennial and annual crop or tree systems, soil types, extent of rainfed or irrigated agriculture, local Government priorities, and existing farmer good practices. All CRA packages are also suitable for the most vulnerable farmers to apply, in particular poor and near poor, ethnic minorities and women farmers;
- To incentivize the full adoption and application of the Climate Resilient Agriculture packages, a conditional and **performance-based voucher system** should be set up and integrated within the Farmer Field Schools to support poor and near poor farmers with financial incentives to participate in and complete the training program, using the acquired resources to invest in the inputs and technologies for CRA on their own plots;
- To further encourage lasting and impactful investment in climate resilient agriculture by smallholder farmers, the project should organize farmer-level agricultural credit information sessions, farmer trade fairs and an online interactive farmer-learning platform;
- To enable improved access to seasonal climate forecasts, understanding and interpretation of the forecasts and associated uncertainty into locally relevant information that is useful in decision making, and planning for agriculture and climate resilience, the project should support **Participatory Scenario Planning and the co-development of seasonal agro-climate advisories**, integrating farmers' valuable information;

In conclusion, with the anticipated continued increase in climate variability and change, Vietnam's current coping strategies for the agriculture and water sectors are becoming increasingly ineffective, necessitating transformational adaptation investments to achieve lasting climate resilience among smallholder farming households. A paradigm shift in addressing adaptation needs among smallholder farmers in the Central Highlands and South-Central Coast regions lies in implementing an integrated approach to agriculture and water management that enables access to sufficient reliable water supplies, maximizes water productivity, enables smallholders to adopt climate-resilient agricultural practices and systems and sustain their

application over time, and facilitates access to actionable ago-climatic information for greater efficiency and security in agricultural and water planning and management.

1. CLIMATE RISK PROFILE

1.1 Topography and geography [1]

1. Viet Nam is located in the eastern part of the Southeast-Asian peninsula, bordered by China in the north, the East Sea in the east and south, the Gulf of Thailand in the southwest, and Cambodia and Lao People's Democratic Republic in the west. The total area of the country is 330,967km^2, including 21,140km^2 of water. The land border is 4,616km long and the coastline (excluding islands) 3,444km. The narrowest point is only 50km. The country has two major deltas, the Red River Delta in the North and the Mekong Delta in the South. Together with the coastal areas, these deltas have the largest concentration of people and arable land. Mountains, hills and plateaus cover more than three-quarters of the country, although over 70 percent of the country lies below 500m above sea level. About 25 percent of the total land area is covered by lowlands or plains.

2. Administratively, the country is divided into 63 provinces including the capital Hanoi and the main economic hubs of Ho Chi Minh City, Hai Phong, Da Nang and Can Tho. Based on topographic, climatic and socio-economic conditions, the country is sub-divided into eight regions: North-West, North-East, Red River Delta, North Central Coast, South-Central Coast, Central Highlands, the South-East and the Mekong River Delta (figure 1). Each of these has its distinct climate, agro-ecological and socio-economic profile, with large spatial differences.

3. 30.9 percent of the total land or 102,317km^2 is agricultural production land for annual crops like rice, and perennial and other crops; 40.4 percent or 137,965km^2 is forestry land (with 101,002km^2 natural forest and 36,963km^2 planted forest) and 3.2 percent or 10,682km^2 are rivers and water bodies. Most agricultural land is located in the two major deltas, coastal areas and the Central Highlands plateaus.

4. Project target areas are focused on five provinces in two regions: the Central Highlands and the South-Central Coast (figure 1). The Central Highlands consists of five provinces, including Dak Lak, Dak Nong, Gia Lai, Kon Tum and Lam Dong – with the project targeting Dak Lak and Dak Nong. The total land area of the Highlands region is 54,659.6km^2, and of the two provinces 1,954km^2. In terms of topography, the region forms the eastern part of a series of contiguous plateaus located 500m up to 1,500m above sea level, expanding to the south of Lao People's Democratic Republic and north-east of Cambodia. The plateaus are surrounded by the South Annamite mountain range. Around 44.4 percent of the land is agricultural land, with Gia Lai and Dak Lak having the largest agricultural land area. Around 45.8 percent of the total land area is forestry land.

5. The South-Central Coast consists of one major city, Da Nang, and seven provinces, including Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan – with the project targeting the latter three provinces which form the most southern part of this region. The total land area of the region is 44,367km^2, with the total for the three provinces 1,643.7km^2. This region has a complex topography with meandering upland and lowland areas, forests, dunes, and sandy and rocky soils. The highest mountains in the southern part of this region, bordering the Central Highlands, can reach up to 1000m. Around 24.9 percent of the land in the entire region is agricultural land, with Binh Thuan having the largest agricultural land area. Around 53.3 percent of the total land area is forestry land.[2]

1.2 Weather and climate

6. Viet Nam is characterized by a humid subtropical climate with four separate seasons – spring, summer, autumn and winter – in the north, and a tropical savanna climate with only two seasons – dry and wet – in the south. The climate is strongly affected by two monsoons, the North-East 'winter' monsoon (December-March) and the South-West 'summer' monsoon (June-September) (figure 2), bringing strong winds, enhanced precipitation and heavy rainfall events.

[1] Data source: General Statistics Office (GSO) of Viet Nam. Statistical Yearbook 2015. http://www.gso.gov.vn.

[2] From this section forward, when discussing the South-Central Coast, the analysis will focus on the southern section, with the three target provinces.

7. The complex topography results in strong spatial variations in temperature and rainfall, particularly during the monsoon seasons. Average annual precipitation is around 1,820mm. It varies from an average 1,600-2,200mm in the midlands and plains to 2,000-2,500mm in the mountainous areas. The rainy season lasts from April-May to October-November. The dry season lasts either from December to February or from January to March depending on the specific location. The driest area is in the southern region of the South-Central Coast (figure 3). Average temperature varies from 15°C in winter to 25°C in summer. Temperature during the hottest days is 38-40°C and during the coldest days 11-14°C, in the north. Humidity level varies from 80 to 100 percent.

Figure 1: Regions of Viet Nam – indicating target provinces3

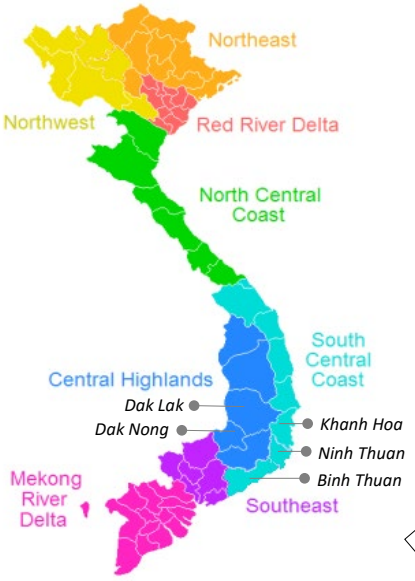


Figure 2: Climate zones in Viet Nam[4]

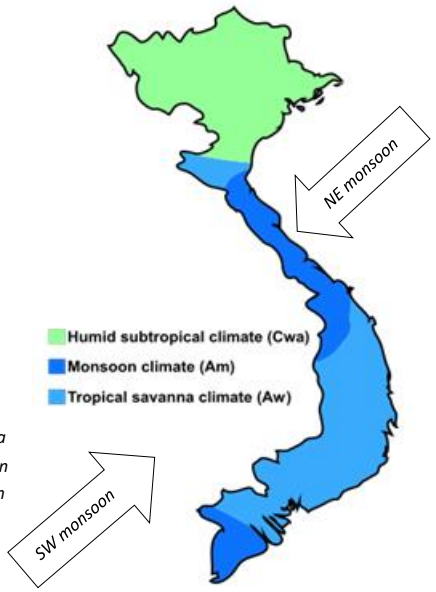
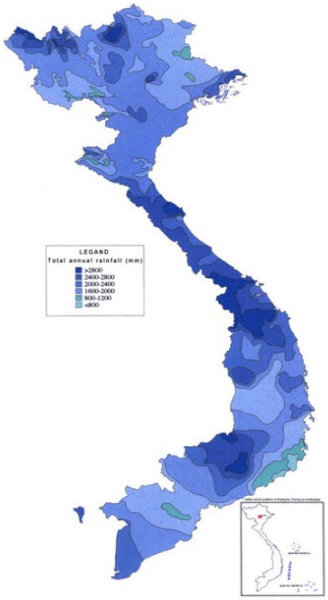


Figure 3: Average annual precipitation in Viet Nam[5]

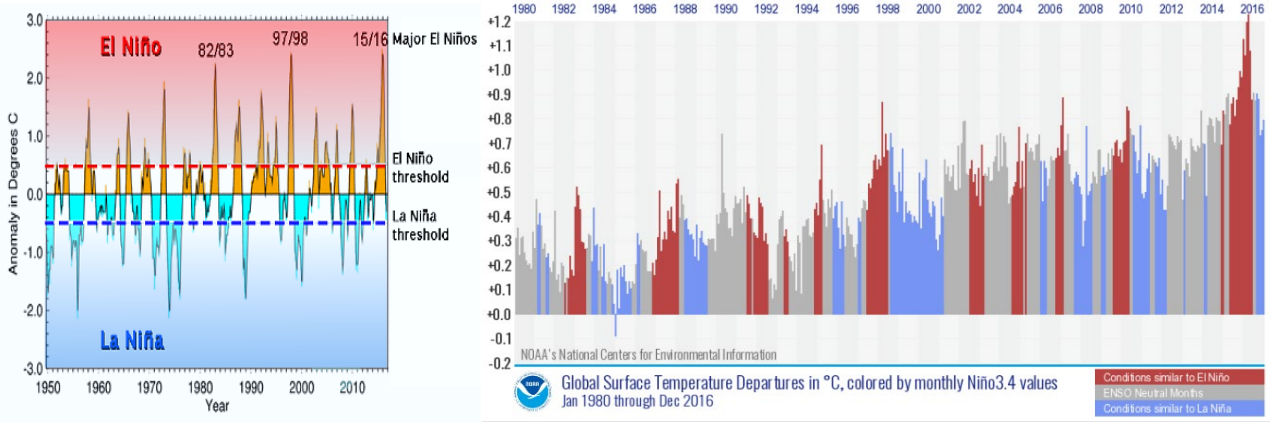


8. Viet Nam's weather and climate are also influenced by the El Niño Southern Oscillation (ENSO) climate system. During El Niño years, the North-East monsoon influence weakens and the central and southern regions of Viet Nam deal with 10 to 30 percent less rainfall than usual and an increased drought risk. Conversely, during La Niña years the North-East monsoon is strengthened and the total rainfall for the same regions increases by about 10 percent compared to usual, increasing flood and landslide risks.[6] In addition, storm frequency and intensity increases in the year after an El Niño as oceans have warmed up more than usual. The strongest El Niño episodes so far – in order of intensity - have been in 2015-16, 1997-98 and 1982-83, while the strongest La Niña episodes in 1973-74, 1988-89 and 1975-76.[7]

9. There is currently no scientific consensus yet on how global warming is affecting El Niño, except that ENSO will continue to occur at the same time as global surface temperatures are increasing.[8]

[3] Map based on GSO classification: https://commons.wikimedia.org/wiki/File:VietnameseRegions.png.
[4] https://commons.wikimedia.org/wiki/File:Vietnam_map_of_K%C3%B6ppen_climate_classification.svg.
[5] http://www.apipnm.org/swlwpnr/reports/y_ta/z_vn/vnmp131.htm.
[6] Thang V. V., Hieu T. N., ea. (2015). Effects of ENSO on Autumn Rainfall in Central Vietnam; and Thang V. V. (2016). Characteristics of moisture transport in ENSO events in Vietnam. Vietnam Institute of Meteorology, Hydrology and Climate Change, Ministry of Natural Resources and Environment.
[7] El Niño Theme Page, https://www.pmel.noaa.gov/elnino/status.
[8] El Niño and Global Warming - what is the connection? (February 2016), http://blogs.ei.columbia.edu/2016/02/02/el-nino-and-global-warming-whats-the-connection/

Figure 4: Historical ENSO occurrence, indicating El Niño and La Niña peaks (left), and global surface temperature anomalies overlaid with El Niño and La Niña conditions, 1980-present (right).



Central Highlands and South-Central Coast

10. Both the Central Highlands and South-Central Coast are located in the tropical savanna climate zone, but have several local sub-climate zones due to the varied topography: upland or mountainous areas are on average wetter, lowland and coastal areas are drier, and the plateau regions of the Highlands are in between.[9]

11. The annual rainfall in the Central Highlands ranges from 1400mm to 2000mm. Monthly rainfall is highest from May to October, accounting for about 80 percent of the annual amount. The average monthly rainfall during the rainy season exceeds 200mm and reaches its peak in August and September. The air temperature is lower in comparison with other regions, ranging from 21°C to 24°C. The maximum temperatures are in April and May and can reach up to 27°C to 31°C.

Figure 5: Average monthly temperature and rainfall over the period 1901-2015, Krong Buk Ha reservoir, Krong Pak district, Dak Lak province [10]

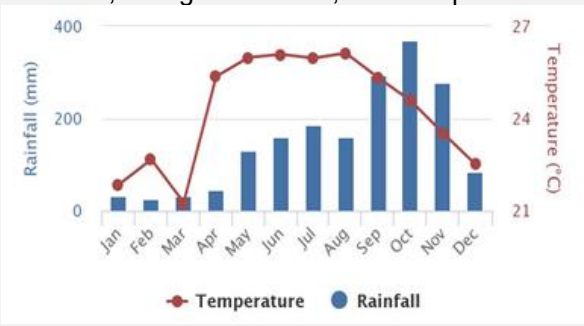
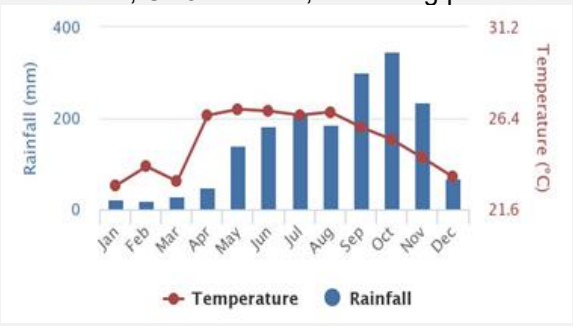


Figure 6: Average monthly temperature and rainfall over the period 1901-2015, Dak Rong reservoir, Cu Jut district, Dak Nong province



12. The annual rainfall in the South-Central Coast ranges from 700 to 800mm in the lowlands to 1,300mm in the upland areas, with 90 percent of it provided during the wet season. The most northern part of the region is one of the wettest in Viet Nam, while the southern part – with Khanh Hoa, Ninh Thuan and Binh Thuan – the driest. Monthly rainfall in the three provinces is highest from May to November. The

[9] United Nations FAO (2016). Viet Nam Country Profile.
[10] Source for all temperature and rainfall graphs: World Bank Climate Change Knowledge Portal, http://sdwebx.worldbank.org/climateportal/.

average monthly rainfall during the rainy season is around 200-350mm and reaches its peak in September-October. Some of the driest areas having six to nine dry months a year with less than 500mm annual rainfall. The average air temperature is between 22°C and 26°C, with highest in April and May, from 26°C to 28°C.

Figure 7*: Average monthly temperature and rainfall over the period 1901-2015, Duc Linh district, Binh Thuan province*

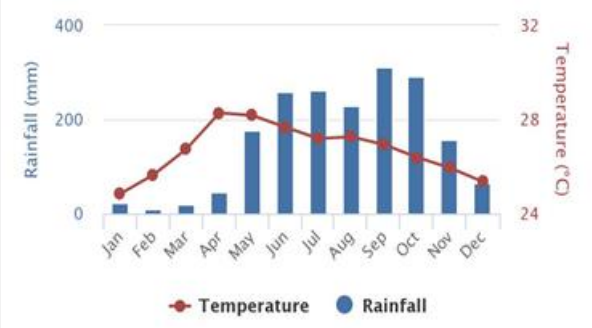


Figure 8: Average monthly temperature and rainfall over the period 1901-2015, southern part of Bac Ai district, Ninh Thuan province

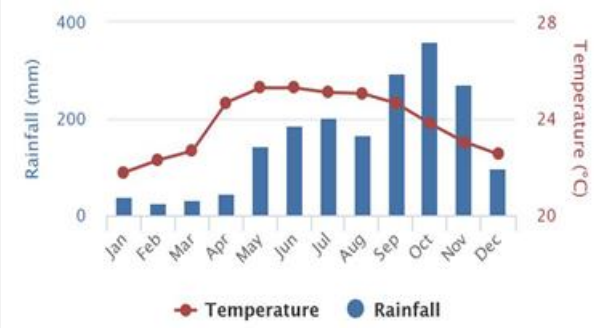
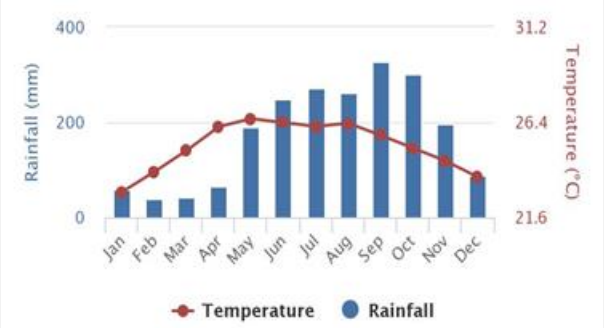


Figure 9: Average monthly temperature and rainfall over the period 1901-2015, Cam Ranh district, Khanh Hoa province



1.3 Observed and projected climate variability and change

1.3.1 Viet Nam

13. Viet Nam is one of the countries in the world most at risk of damage and loss from weather-related hazards. Germanwatch's Global Climate Risk Index 2018 identifies Viet Nam as the eighth most affected country based on loss from weather-related events from 1997 to 2016.[11] Every year the country is affected by a range of hydro-meteorological and climatological hazards: droughts and forest fires during January-April; (tropical, hail and wind) storms, (coastal, riverine, flash) floods, heavy rainfall and landslides in June-December and extreme temperatures (cold and heat waves) throughout the year.[12]

14. According to the Government of Viet Nam's (GoV) Central Committee for Natural Disaster Prevention and Control (CCNDPC), disasters such as floods, storms and droughts have caused an average of 313 deaths, 1.7 million affected people and US$872 million in economic losses per year over the past decade. Overall, the number of deaths is decreasing while the economic losses from disasters is increasing

[11] An aggregate of 4 indicators with the following weight composes the index, for the period 1996-2015: number of death (1/6); number of deaths per 100,000 inhabitants (1/3); sum of losses in USD in purchasing power parity (PPP) (1/6); and losses per GDP unit (1/3). See: Eckstein D., Kunzel V., Schafer L. (November 2017). Global Climate Risk Index 2018. Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2016 and 1997 to 2016. Briefing Paper. www.germanwatch.org/en/cri.

[12] Classification by the Centre for Research on the Epidemiology of Disasters's Emergency Events Database, http://www.emdat.be/classification.

but with large spatial and inter-annual variability. Increased exposure of people and economic assets has been the major cause of long-term increases in economic losses from weather- and climate-related disasters.[13]

15. The year 2016 was particularly severe, with an acute El Niño-induced drought and saline intrusion affecting a third of the country, followed by a sequence of typhoons, tropical depressions and heavy rainfall events causing flooding in the North and South-Central Coast and Central Highlands regions. In 2016 alone, more than 2.2 million people were affected, 230 people lost their lives, and an estimated US$1.7 billion of damage and loss occurred, or approximately 0.83 percent of the country's Gross Domestic Product.[14]

16. In 2017, Viet Nam was affected by a number of tropical storms, floods (riverine and flash), heavy rainfall, landslides, and a heatwave, resulting in more than 5 million people affected, 400 deaths and 650 people injured, 558,000 houses damaged, flooded or destroyed and 350,000ha of crops affected. Typhoon Damrey in November 2017 caused the most damage, with 4.3 million people in 15 provinces in Central Viet Nam estimated to being affected, 123 people who lost their lives, and 305,254 houses damaged, flooded or destroyed. [15]

17. Viet Nam is also particularly vulnerable to climate change and already impacted by more irregular and intense climate variability and change and more extreme weather events. When considering climate change exposure, sensitivity and the capacity to adapt, the country is consistently classified as under 'very high risk' or 'extreme risk'.[16]

18. The most recent GoV Climate Change and Sea Level Rise Scenarios, developed by the Ministry of Natural Resources and Environment (MoNRE), describe the **already observed changes** in climate and weather-related events as follows, based on historical observations and records: [17]

TEMPERATURE INCREASE

- Average annual temperatures increased by 0.62°C in the period 1958-2014, with temperatures increased by 0.38°C in the last 20 years compared to the period 1981-1990. Warming is less for coastal areas than for inland areas. Greater warming occurs in winter months than in summer and the southern regions are warming faster than the northern regions.
- Extreme temperatures (days with maximum temperature above 35°C) increased, but maximum temperatures decreased in some weather stations in the South. The number of hot days increased, especially in the North-East, Northern Delta and the Central Highlands, but decreased in the North-West, South-Central Coast and the Southern regions.

CHANGING PRECIPITATION PATTERNS

- Annual and extreme rainfall decreased in the North, while annual rainfall increased in the South and Central regions, and extreme rainfall increased considerably in the South-Central Coast and Central Highlands. Annual rainfall increases are more pronounced in the coastal regions compared to inland (Figure 10). Extreme rainfall mainly occurred from April to July, though somewhat earlier in the North and later in the South.

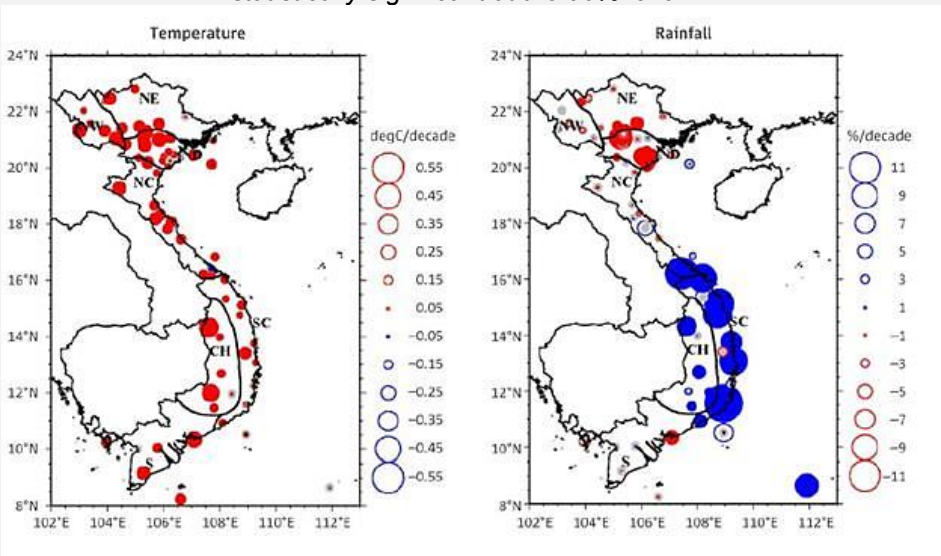
[13] Institute of Meteorology, Hydrology and Climate Change (IMHEN) and UNDP (February 2015). Viet Nam Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Summary for Policymakers.
[14] Central Committee for Natural Disaster Prevention and Control (2017). Annual Disaster Report 2016.
[15] Source: Ministry of Natural Resources and Environment
[16] The World Risk Index ranks Viet Nam as 18th most at-risk in the world, under the category of 'very high risk', see: Alliance Development Works, United Nations University Institute for Environment and Human Security (2016). World Risk Report 2016. Focus: Logistics and Infrastructure. www.WorldRiskReport.org. The Climate Change Vulnerability Index ranks Viet Nam 13th, under the category of 'extreme risk', see: Maplecroft (2011). Climate Change Risk Atlas 2011. maplecroft.com/about/news/ccvi.html.
[17] MoNRE (2016). Climate Change and Sea Level Rise Scenarios for Viet Nam. Summary for Policy Makers. Triangulated with: IMHEN, UNDP (Ibid), and Katzfey J. J., McGregor J. L., and Suppiah R. (2014). High-resolution Climate Projections for Vietnam. Technical Report. IMHEN, CSIRO.

- Based on historical observations, ENSO seems to have an increased negative impact on the weather and climate in Viet Nam, however long-term projections on the link between ENSO and climate change are lacking (also see section 1.2).

DISASTER RISK

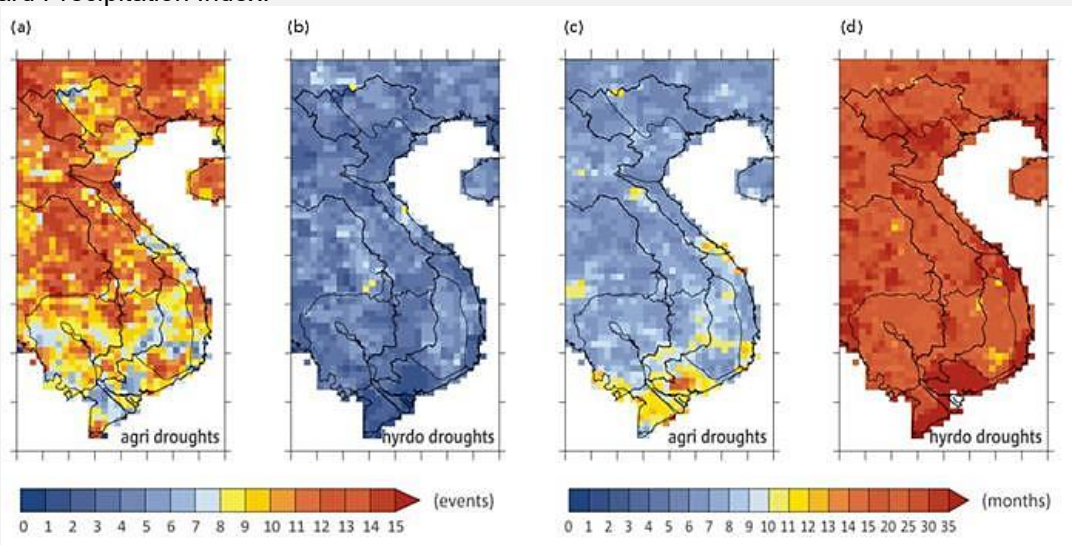
- Drought periods which affect agriculture (including water supply deficiencies) – or a period of lack of water for irrigation and agricultural production - occurred between 5 and 15 times during the 1979-2007 period and had an average duration of 5-15 months. In South Viet Nam the number of droughts is less than in the North, but they lasted longer on average. The frequency of hydrological droughts – or a period of low river and ground water levels - (ranging from 1 to 10 events) is generally less compared with agricultural droughts, but their duration is longer (average duration ranges from 11 to 38 months). Similar to the agricultural droughts, hydrological droughts are less frequent in the South region than in other regions, but their duration is longer. See Figure 11.
- The frequency of droughts remains the same but they become more intense and last longer.
- The number of strong typhoons showed an increasing trend, while typhoons of medium strength are decreasing.
- Sea level is rising, with an average sea level rise increase by 3.5 (±0.7) mm a year in the period 1993-2014. The greatest increase in average water level is in Central Viet Nam.

Figure 10: Mean surface air temperature and decadal rainfall variability for the period 1961 to 2011. *For temperature (left): a red circle shows an increasing trend. For rainfall (right): a blue circle shows an increasing trend and a red circle a decreasing trend. For both: a filled circle indicates that the trend is statistically significant at the 90% level.*[18]



[18] Katzfey J. J., McGregor J. L., and Suppiah R. (2014) (Ibid).

Figure 11: Number (a, b) and average duration (c, d, in months) of extreme and severe agricultural droughts (a, c) and hydrological droughts (b, d) based on rainfall from 1979 to 2007, and using the Standard Precipitation Index. [19]



19. The **future climate scenarios** for Viet Nam - with significant regional variations - project a further increase of annual temperature and rainfall, increased number of hot days, shifting rainfall and dry seasons (delayed start in November and earlier end in March, with an approximately ten days shift), a higher than average global sea level rise (55mm in Viet Nam compared to 53mm globally) and more irregular and extreme weather events such as strong to very strong typhoons, heavy rainfall, heat waves and intense droughts.[20]

[19] Katzfey J. J., McGregor J. L., and Suppiah R. (2014) (Ibid).
[20] MoNRE (2016) (Ibid).

Figure 12: Changes in annual rainfall (%), by mid-century, based on Representative Concentration Pathways (RCP) 4.5 (lower emissions scenario, 'stabilization') (left) and RCP 8.5 scenarios (higher emissions scenario, 'business as usual') (right) [21]

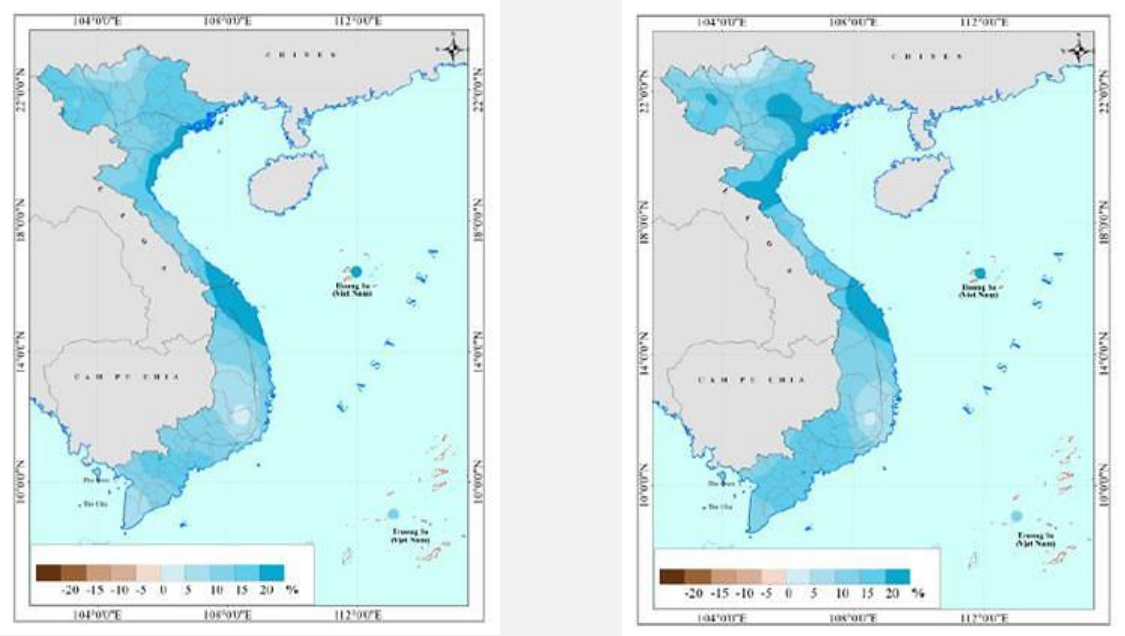
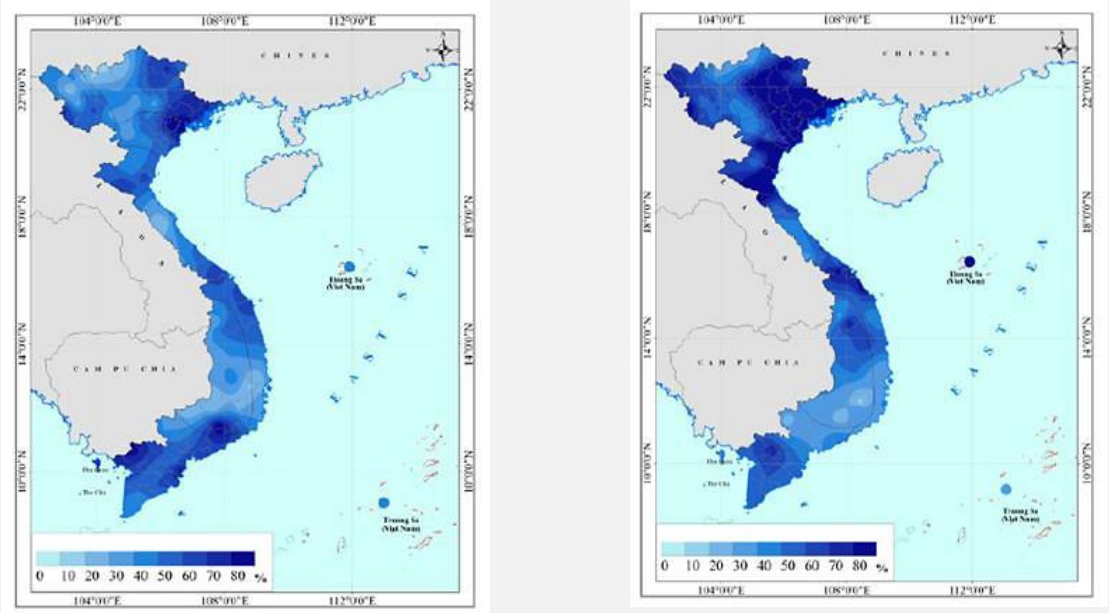


Figure 13: Changes in average maximum 1-day rainfall, by end-of-century, based on RCP4.5 (left) and RCP8.5 scenarios (right)



1.3.2 Observed climate changes and future scenarios in project areas

[21] Five regional climate models were used by MoNRE's IMHEN to dynamically downscale and produce high-resolution simulations for Viet Nam based on 9 global climate models. Two sets of projections were completed using two IPCC climate change scenarios to represent a most optimistic and most pessimistic scenario: RCP 4.5 (representing an optimistic scenario) and RCP 8.5 (pessimistic scenario). MoNRE (2016) (Ibid).

Temperature increase:

20. Air temperatures observed in most stations located in South Central Coast show a positive change. This finding can be found in several studies (e.g. MONRE/IMHEN, 2016[22]; Mai Van Khiem[23], 2015; Thanh-Ngo-Duc, 2014[24]; Dang-Quang-Nguyen et al, 2013[25]). Similarly, observed temperature in Central Highlands has demonstrated an increasing trend (e.g MONRE, 2016[22]; Dang-Quang-Nguyen et al, 2013[25]).

21. Thanh-Ngo-Duc (2014), applied the 27 core extreme climate indices recommended by the joint World Meteorological Organization (WMO) Commission for Climatology (CCI)/World Climate Research Programme (WCRP) Climate Variability and Predictability (CLIVAR) project's Expert Team on Climate Change Detection, Monitoring and Indices (ETCCDMI) to coastal stations. They demonstrated that there have been positive and significant trends in annual 2m temperatures at 7 of the 8 stations in the SCC and the remaining station demonstrated a non-significant positive trend (see Figure 14 below).

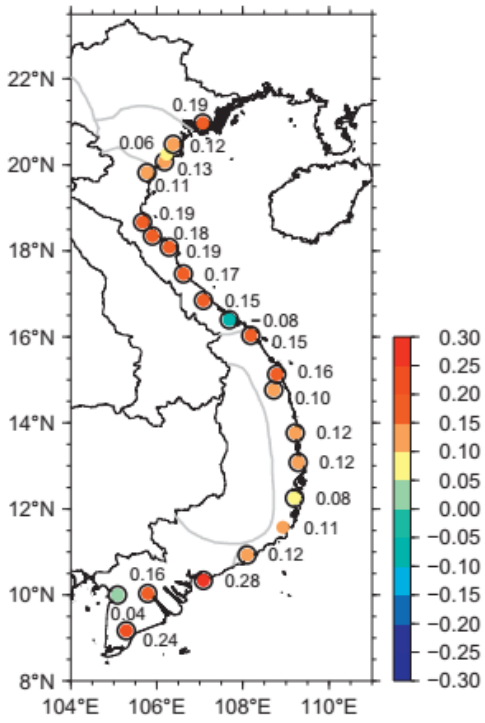


Figure 14: Trends of annual 2 m temperature. Positive (negative) trends are represented by warm (cold) color-filled circles. Black contoured circles indicate where the trends are statistically significant at the 10% significance level (observed data: 1960-2011), (source: Thanh-Ngo-Duc, 2014).

22. Dang Quang Nguyen (2014) calculated trends for the period 1971-2010 using stations across Vietnam. Trends are summarized for each region and for summer (MJJA) and winter (DJFM) in Figure 15. The SCC (region S1) demonstrates increasing trends of 0.26 ± 0.14 °C decade-1 significant at the 95% confidence level for summer, 0.44 ± 0.16 °C decade^{-1} significant at the 99% confidence level for winter, and

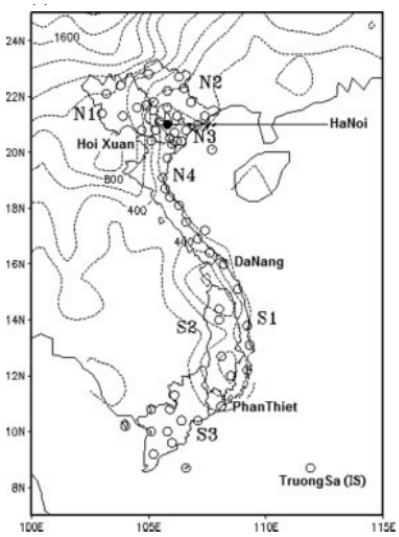
[22] MONRE/IMHEN, 2016. Climate change and sea level rise scenarios for Viet Nam

[23] Mai Van Khiem, 2015. Atlas: Climate and Climate change in Vietnam. Vietnamese National Funded Project State coded KHCN-BĐKH/11-15

[24] Thanh Ngo-Duc, 2014. Climate Change in the Coastal Regions of Vietnam. DOI: http://dx.doi.org/10.1016/B978-0-12-800007-6.00008-3.

[25] Dang-Quang Nguyen, James Renwick and James McGregor, 2014. Variations of surface temperature and rainfall in Vietnam from 1971 to 2010. Int. J. Climatol. 34: 249–264 (2014).

annually 0.35 ± 0.10 °C decade^{-1} significant at the 99% confidence level. Similar results are seen for the CH (region S2) where there have been increasing trends of 0.24 ± 0.15 °C decade^{-1} significant at the 90% confidence level for summer, 0.29 ± 0.17 °C decade^{-1} significant at the 95% confidence level for winter, and annually 0.25 ± 0.12 °C decade^{-1} significant at the 95% confidence level.



	MJJA	DJFM	12 months
N1	$0.24 \pm 0.12^{***}$	$0.30 \pm 0.10^{***}$	$0.25 \pm 0.06^{***}$
N2	$0.20 \pm 0.11^{**}$	$0.26 \pm 0.14^{***}$	$0.25 \pm 0.07^{***}$
N3	$0.21 \pm 0.11^{**}$	$0.28 \pm 0.13^{**}$	$0.27 \pm 0.08^{***}$
N4	$0.19 \pm 0.12^{**}$	$0.23 \pm 0.14^{**}$	$0.22 \pm 0.11^{***}$
S1	$0.26 \pm 0.14^{**}$	$0.44 \pm 0.16^{***}$	$0.35 \pm 0.10^{***}$
S2	$0.24 \pm 0.15^{*}$	$0.29 \pm 0.17^{**}$	$0.25 \pm 0.12^{**}$
S3	$0.28 \pm 0.16^{**}$	$0.40 \pm 0.21^{***}$	$0.36 \pm 0.13^{***}$
IS	INS	$0.17 \pm 0.17^{+}$	$0.15 \pm 0.13^{+}$
VN	0.23 ± 0.16	0.30 ± 0.17	0.26 ± 0.10

Figure 15: Estimated trends in average temperature anomaly in Vietnam in last 40 years (1971 – 2010) (unit: °C per 10 years), (source: Dang Quang Nguyen 2014)

23. The official climate change scenarios for Vietnam were developed by MONRE and are presented in MONRE/IMHEN (2016)[22]. In summary, a dynamical downscaling method was applied using multiple RCMs and GCMs to develop climate change projections at high resolution for Viet Nam (see Table 1 below). These projections are constructed using 5 regional climate models (AGCM/MRI, PRECIS, CCAM, RegCM and clWRF). Altogether, 16 members are employed in the calculation. Different GCMs are used to force 5 RCMs including: the AGCM/MRI RCM (4 members each forced with: the NCAR GCM, the HadGEM2 GCM, the GFDL GCM, ensemble SSTs); PRECIS RCM (3 members forced with GCMs: CNRM-CM5, GFDL-CM3, HadGEM2-ES); CCAM RCM (6 members forced with GCMs: ACCESS1-0, CCSM4, CNRM-CM5, GFDL-CM3, MPI-ESM-LR, NorESM1-M); RegCM RCM (2 members forced with the GCMs: ACCESS1-0, NorESM1-M); clWRF RCM (1 member forced with the NorESM1-M GCM). Temperature change scenarios are constructed by using ensemble of all members (15 members) while rainfall change scenarios are built by using ensemble of 3 PRECIS members. The selection of which future climate projections to use was based on the fact that most of the above-mentioned RCMs produced hindcasts/observed temperatures well over Viet Nam, however, only PRECIS demonstrated hindcast/observed skill in simulating rainfall. Please refer to Climate change scenarios for Vietnam (MONRE/IMHEN, 2016) for more information.

Table 1: Simulations and projects used in the study (IMHEN, 2016)

No.	Regional climate models (RCMs)	Global climate models (GCMs)	Resolution of RCMs
1	CCAM	ACCESS1-0	10km
2		CCSM4	
3		CNRM-CM5	
4		GFDL-CM3	
5		MPI-ESM-LR	
6		NorESM1-M	
7	RegCM	ACCESS1-0	20km
8		NorESM1-M	
9	PRECIS	HadGEM2-ES	25km
10		GFDL-CM3	
11		CNRM-CM5	
12	CLWRF	NorESM1-M	30km
13	MRI-20km_A	NCAR-SST	20km
14	MRI-20km_B	HadGEM2- SST	
15	MRI-20km_C	GFDL - SST	
16	MRI-20km_D	Tổ hợp SST	

Rainfall trends:

24. Most of studies of these regions show an increasing trend of long-term observed annual (Figure 16) and seasonal rainfall in the South Central Coast, as well as increases in the intensity of rainfall; maximum amounts falling on 1 and 5 days (Figure 17) as well as total and intensity falling on Tropical cyclone days (Figure 18). See MONRE, 2016[22]; Thanh-Ngo-Duc, 2014[24]; Dang-Quang-Nguyen et al, 2013[25]; Hoang et al, 2012[26].

[26] Hoang Anh Nguyen-Thi, Jun Matsumoto, Thanh Ngo-Duc and Nobuhiko Endo, 2012. Long-term trends in tropical cyclone rainfall in Vietnam. Long-term trends in tropical cyclone rainfall in Vietnam.

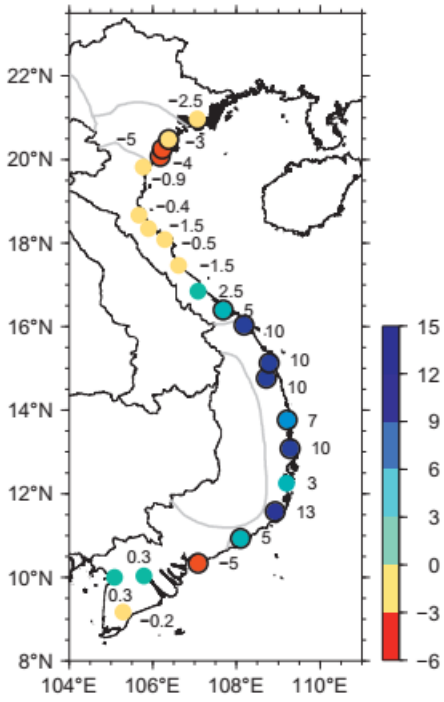


Figure 16: Trends of annual rainfall. Positive (negative) trends are represented by cold (warm) color-filled circles. Black-contoured circles indicate where the trends are statistically significant at the 10% significance level (observed data: 1960-2011), (source: Thanh-Ngo-Duc, 2014).

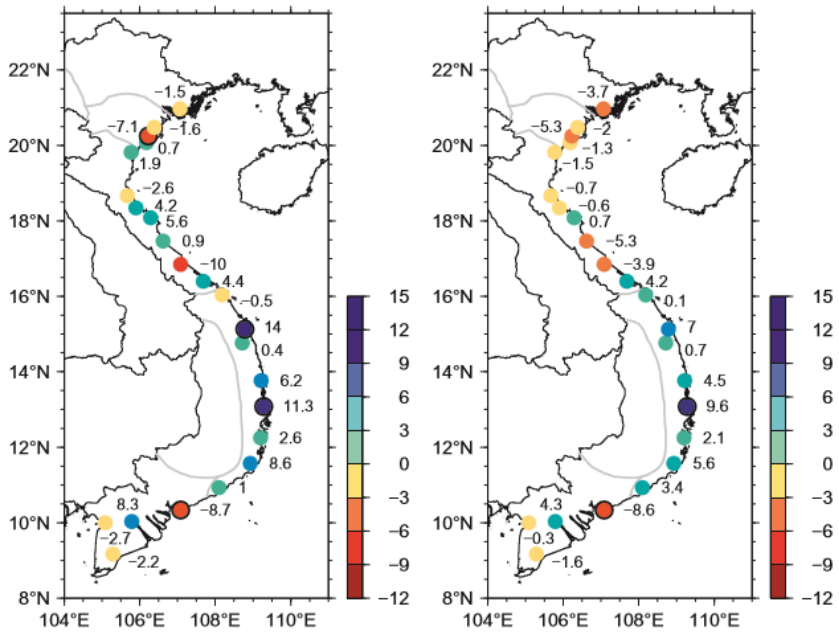


Figure 17: Trends of RX1day and RX5day. Black contoured circles indicate where the trends are statistically significant at the 10% significance level. Units in percent per decade.

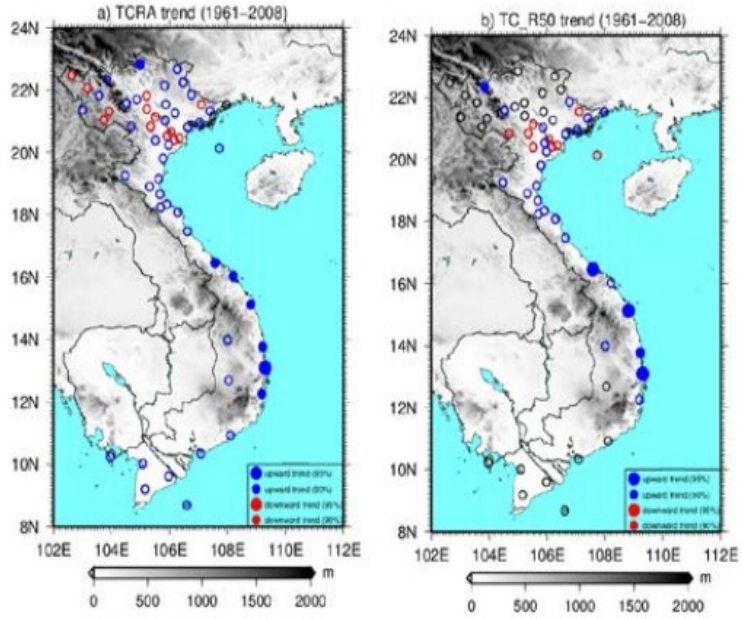


Figure 18: Trends of (a) TCRA and (b) TC_R50 for 58 stations in Vietnam, 1961-2008. Blue (red) symbol indicates increasing (decreasing) trend where small (big) filled circles are statistically significant at 90% (95%) confidence level, open circles are not significant in any of these levels. Black open circles represent stations with no trend. (source: Hoang et al, 2012)

25. In the Central Highlands average rainfall has been mostly decreasing, as indicated by negative trends in Standardized Precipitation Index (SPI) seen at most stations (except for 2 stations each in the far north and south which are at higher altitudes)[27], shown in Figure 19.

$SPI = \frac{R - \bar{R}}{\sigma}$, where R: rainfall, σ: standard deviation of rainfall

26. Conversely the number of days with intensities greater than the 95th percentile threshold have been increasing over the same region (Figure 20).

[27] Vu Minh Tue, Srivatsan V. Raghavan, Pham Duc Minh, Liong Shie-Yui. Investigating drought over the Central Highland, Vietnam, using regional climate models. Journal of Hydrology 526 (2015) 265–273

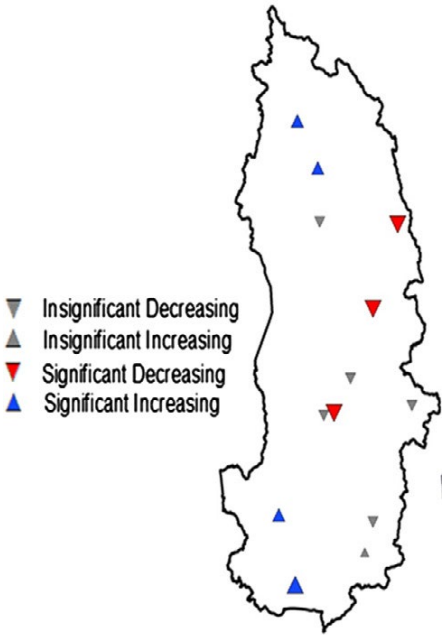


Figure 19: Mann-Kendall trends in SPI (1990-2005) for stations in the central highlands.

27. These findings support the conclusion ***that average rainfall has been decreasing in the Central Highlands and increasing at the South-Central Coast. The intensity of rainfall and frequency of high intensity events has been increasing in both regions***.

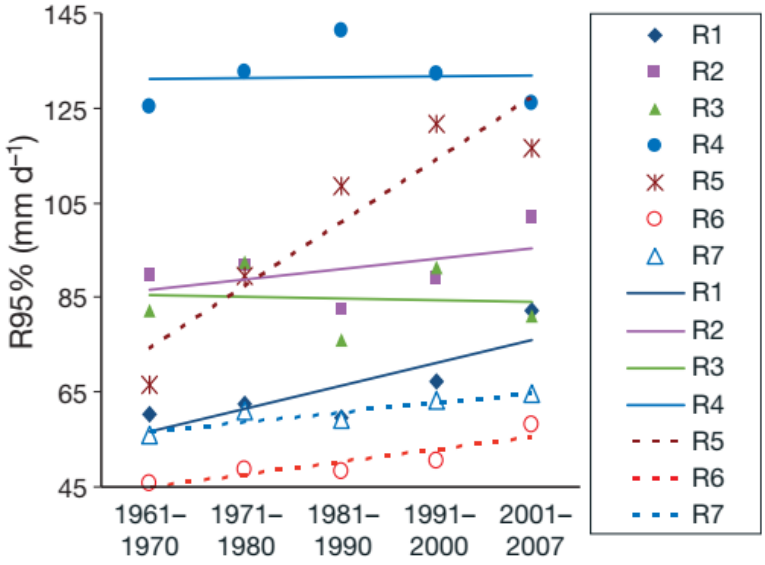


Figure 20: 95th percentile threshold of daily precipitation (mm/d) in wet months (R95) for all sub-regions (source: Ho et al, 2011). R5: South Central Coast; R6: Central Highlands

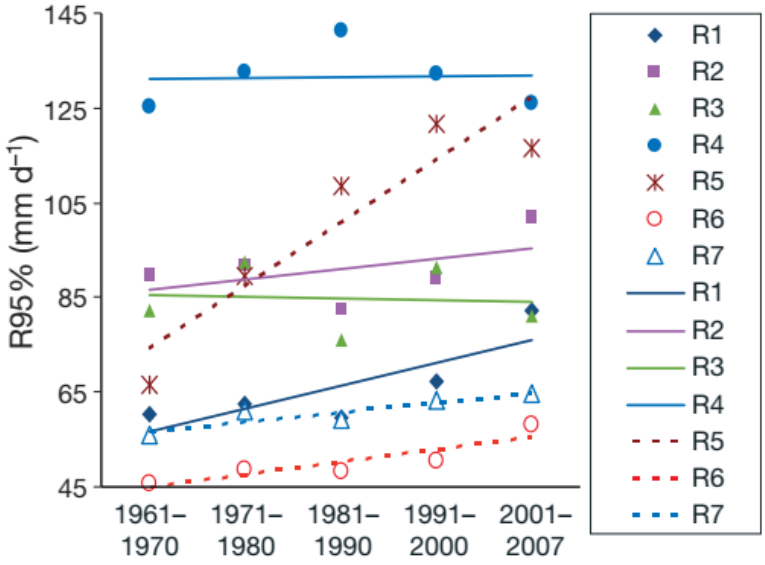


Figure 21: 95th percentile threshold of daily precipitation (mm/d) in wet months (R95) for all sub-regions (source: Ho et al, 2011). R5: South Central Coast; R6: Central Highlands

Drought:

Evidence for increasing drought for the CH and SCC is presented separately below.

Central Highlands

28. The drought period in the Central Highlands starts from the month ending the rainy season (November), the probability increases gradually in the following months and is highest in January or February, decreasing slightly in March, significantly reducing in April and falls sharply to near zero in May (Figure 22). Drought occurs the most frequently in KonTum province while Lam Dong is the least drought prone province.

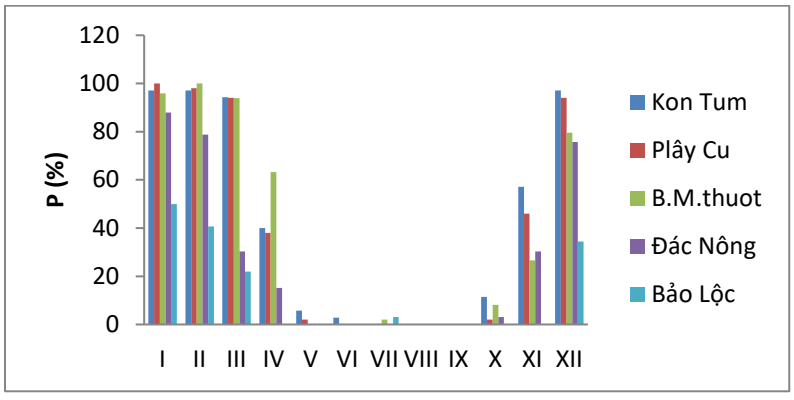


Figure 22: Probability of drought at different locations in Central Highlands (source: Nguyen Van Thang, 2014)[28]

29. The results of an analysis of observed data (1961-2010) shows that drought in the Central Highlands has shown an increasing trend (see Figure 23)[28]. This analysis is based on the K (dry) index which is defined by:

$$K = \frac{PET}{R}$$

Where K: Dry index, PET: Potential Evapotranspiration, R: Rainfall.

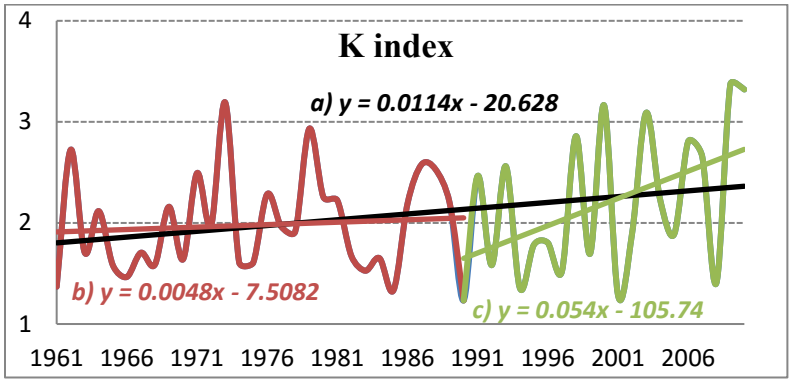


Figure 23: Drought trend in Central Highlands in periods: (a) 1961-2010; (b) 1961-1990; (c) 1991-2010[28]

This increase in frequency and severity of extreme drought is further confirmed in a study by Dao and Chau (2015)[29] and in Annex IIa (Figure 23).

South Central Coast

30. Mai and Tran (2018)[30] conducted a study on climate change detection using both rainfall observations and bias-corrected rainfall projections from the national climate change scenarios. The drought and extreme drought conditions (SPI) were considered for several timescales, including 1-, 3-, 6- and 12-months (SPI_1, SPI_3, SPI_6 and SPI_12, where SPI_1: Meteorological drought, SPI_3 and SPI_6: Agriculture drought, SPI_12: Hydrological drought. Results of the 1975 - 2017 trend of SPI_1 are presented in Figure 24 below. An increased trend of drought conditions can be seen through significant negative trends in SPI in the period 1975 – 2017 at most stations in South Central Coast (Figure 24). Whilst rainfall is expected to increase during the wet season in the future, drought is expected to become more prevalent during the dry season (see Figure 25).

[28] Nguyen Van Thang, 2014. Study on developing a drought warning system for Vietnam. Vietnamese National Funded Project State coded KC.08.17/11-15.
[29] Dao Nguyen Khoi and Chau Nguyen Xuan Quang, 2015. Assessment of climate change on drought for Daklak province. Journal of Science and Technology Development, Vol 17 (3) pp 5- 11.
[30] Mai Kim Lien and Tran Duy Hien, 2018. A study on drought in the south-central region: detection from the observation and the bias-correction rainfall projections of national climate change scenarios. Vietnam Journal of Hydrometeorology; Volume (Issue No.). ISSN 0866-8744

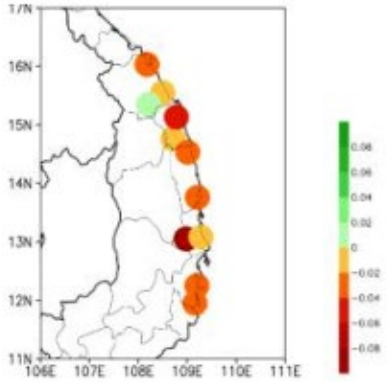


Figure 24: Trends in SPI (1 month)[30].

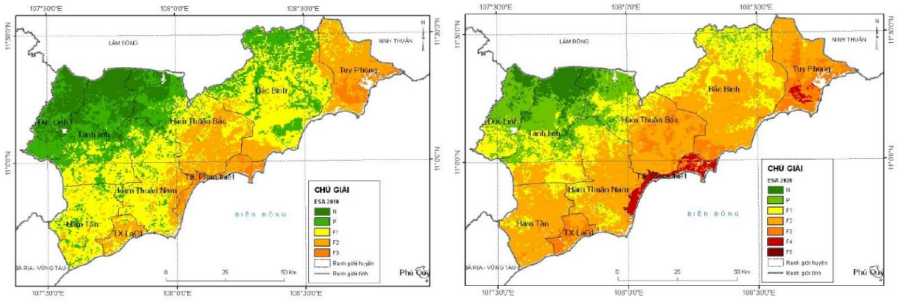


Figure 25: Drought- and desertification-prone areas in Binh Thuan province, in 2010 and in 2030 [31]

Longer and wetter monsoon:

31. In Vietnam, Nguyen Dang Mau conducted PhD research on assessment and projections of the mean and variability of Vietnam's summer monsoon characteristics. Vietnam's Summer Monsoon (VSM) characteristics are characterized by both intra-seasonal variability (ISV) and inter-annual variability (IAV). The 850hPa zonal winds, and rainfall simulated by the PRECIS model for the baseline (1986-2005) and future periods (2046-2065 and 2080-2099) under RCP4.5 and RCP8.5 scenarios were used to show that between 1981 and 2010, the length of the VSM remains at 30 pentads (150 days). The seasonal length has IAV ranging between -6 and 8 pentads (STD 3.4 pentads). In La Nina seasons the seasonal length is usually longer, with shorter summer seasons during El Nino (Nguyen Dang Mau, 2018)[32].

32. Potential Evapotranspiration (PET) is estimated using maximum and minimum temperatures, humidity, wind speed, and solar radiation, and variations in PET are due to the net impact in variations of

[31] Anne Gobin, Le Trinh Hai, Pham Ha Linh, Luc Hens, Pierre Ozer, Le Thi Thu Hien, Nguyen Thanh Binh and Pham Quang Vinh (July 2012). Impact of global climate change and desertification on the environment and society in the southern centre of Vietnam (case study in Binh Thuan province).

[32] Nguyen Dang Mau, 2018. Assessment and projection for the variability of Vietnam summer monsoon characteristics. Phd Dissertation.

these parameters. Increases in maximum and minimum temperatures (as shown in Figure 26 below) results in increases of PET.

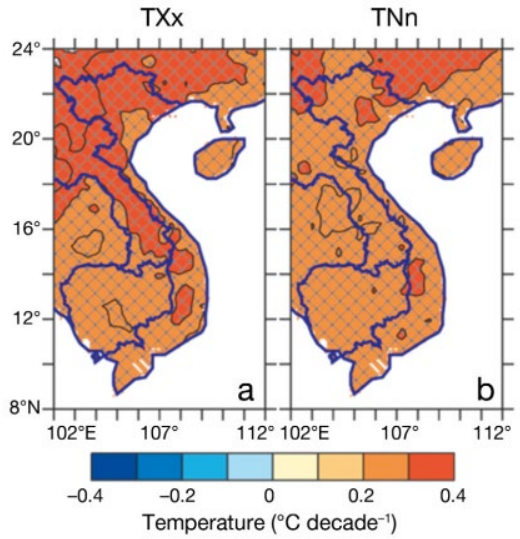


Figure 26: Projected annual trends in (a) daily maximum temperatures (TXx), (b) Daily minimum temperatures (TNn) in period 2000-2050. Thanh-Ngo-Duc et al (2014)[24]

Results from various studies show that increases in PET will result in an increase in crop water requirements and decreases in stream flow (reducing water available for irrigation). Over the CH region of the Mekong Basin, PET is simulated to increase by 27% (between 2010-2030 under both an A2 and B2 scenario), lowering yields of rainfed rice by 2.4% and 17.8% respectively[33].

33. The WMO/SHMI website www.climaterationale.org calculates changes in potential aridity (PA) which is defined as the ratio of ET0 to rainfall. Figure 27 shows the multimodel mean, 25th/75th percentile and min/max simulated changes of potential aridity (PA) and soil moisture for a point over the central highlands (13.07N, 108.09E) under emissions scenario RCP8.5 for the period 2041-2070. The figure shows that PA is expected to increase during May and June with a combination of changes in rainfall and PA resulting in reduced soil moisture during April-June. Figure 28 demonstrates similar expected changes for a point over the south central coast (12.9N, 109.27).

[33] Mainuddin M., Kirby M., Hoanh C.T. (2013) Impact of climate change on rainfed rice and options for adaptation in the lower Mekong Basin. Nat Hazards (2013) 66:905–938 DOI 10.1007/s11069-012-0526-5

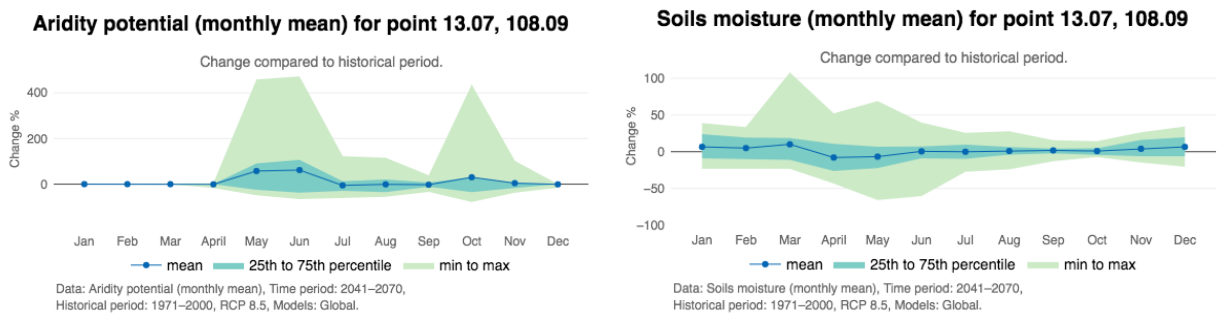


Figure 27: Expected multimodel mean, 25th/75th percentile and min/max monthly changes (2041-2070) in potential aridity (left) and soil moisture (right) from CMIP5 GCMs (RCP8.5) for Central Highlands[34].

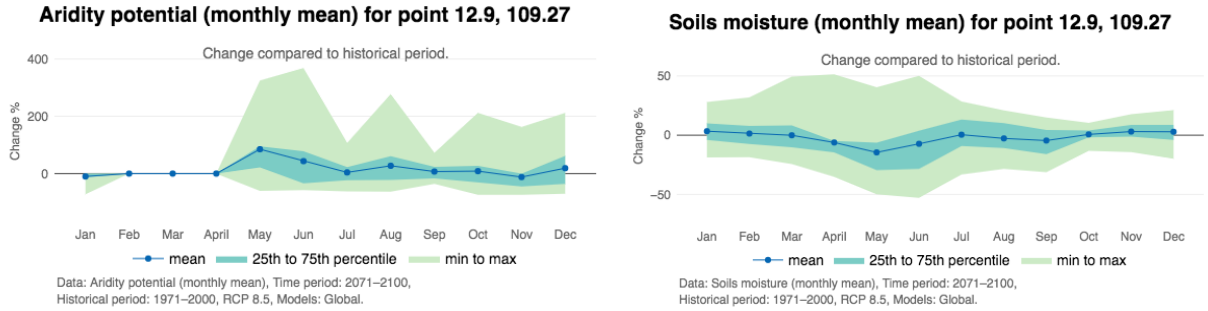


Figure 28: Expected multimodel mean, 25th/75th percentile and min/max monthly changes (2041-2070) in potential aridity (left) and soil moisture (right) from CMIP5 GCMs (RCP8.5) for South Central Coast[35].

34. The impact of increases in temperatures, PET and changes in rainfall and soil moisture have further been related to yields via crop, basin and hydrological models, as well as mixed effects models to simulate the impact of adaptation measures[36]. Using a set of scenarios including representative wet and dry models, as well as the official MONRE scenarios, rice yields were simulated to decrease in the SCC region under all scenarios by 2030 and 2050. Whilst the CH region is recognized as the most negatively impacted, it also has the highest potential to alleviate these damages through investment in irrigation.

35. Dao Nguyen Khoi (2013) also stated that the changes in evapotranspiration and decrease in rainfall may also lead to decreases in soil water content. The mean annual soil water content is projected to decrease by 6.2% in the 2020s, 7.5% in the 2050s and 8.1% in the 2080s for the A1B scenario, the respective decreases in soil water content are 5.5%, 7.5% and 8.1% for B1 scenario. In a study done for the **Ba river basin** (South Central Coast) by IMHEN (2010)[37], PET was projected to be increased between 8% and 10% in the mid-21st century and up to about 25% by 2100 (Figure 29). The increase in evapotranspiration leads to increasing moisture loss over the basin. A rise in potential evapotranspiration, together with a decrease of rainfall in dry season will lead to an increasing irrigation water demand of about 20% in the period 2080-2099 compared to baseline 1980-1999 (Figure 30).

[34] http://www.climaterationale.org
[35] http://www.climaterationale.org
[36] Yu B., Zhu T., Breisinger C., Hai N.M. (2010) Impacts of Climate Change on Agriculture and Policy Options for Adaptation. The Case of Vietnam. IFPRI discussion paper 01015.
[37] IMHEN, 2010. Impacts of climate change on water resources and adaptation measures.

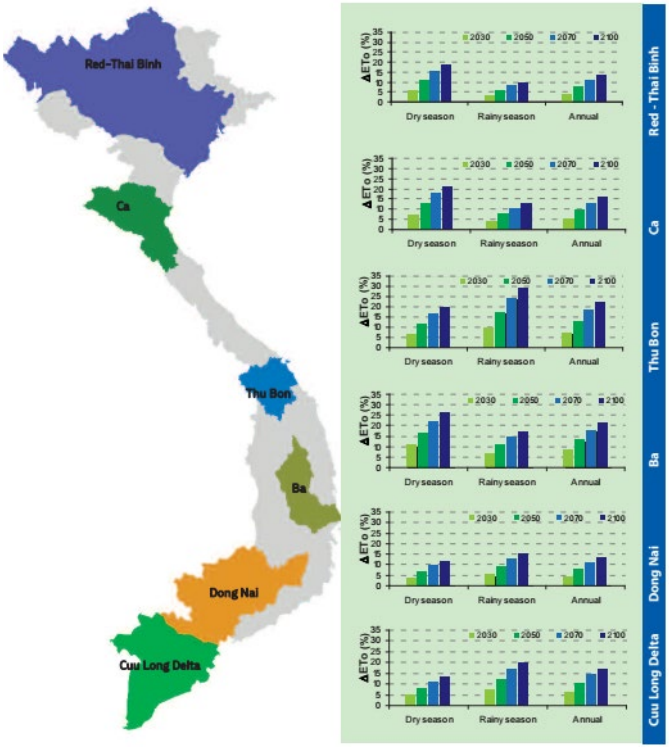


Figure 29: Changes in potential evapotranspiration compared to the period 1980-1999 (baseline)

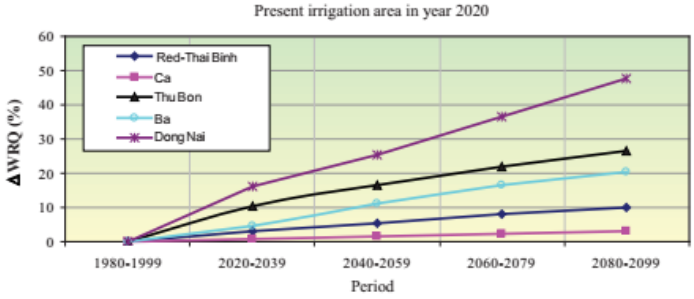


Figure 30 Change in water requirement for irrigation under scenario B2 at different time slices (Ba river basin (cyan-blue line) located in South Central Coast)

Reductions in river/streamflow and water available for irrigation

36. Assessments of the impact of climate change on stream flows in Srepok river located in the Central Highlands is found in numerous studies. Dao Nguyen Khoi (2013)[38] applied the delta change method based on the outputs of MIROC 3.2 Hires GCM driven by A1B and B1 emission scenarios to force the SWAT (Soil and Water Assessment Tool) model. The results indicated a 1.3–3.9°C increase in annual temperature and a 0.5 to 4.4% decrease in annual precipitation, which corresponded to decreases in streamflow. Simulated

[38] Dao Nguyen Khoi, 2013. Impacts of climate change on hydrology in the Srepok watershed, Vietnam. Climate and Land Surface Changes in Hydrology Proceedings of H01, IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, July 2013 (IAHS Publ. 359, 2013) 111-117.

decreases in annual discharges are 7.2%, 6.0% and 7.1% for the A1B scenario and 6.2%, 7.6% and 2.8% for the B1 scenario in the 2020s, 2050s and 2080s, respectively. Decreasing streamflow is explained as being due to both decreasing precipitation and increasing evapotranspiration caused by increases in temperature. The largest decreases in precipitation and runoff are observed in the dry season. In the dry season, the predicted streamflow decreases considerably, varying from 12.8% to 16.2%, 10.9% to 11.3% and 12.8% to 14.2% for the 2020s, 2050s and 2080s, respectively (Figure 31).

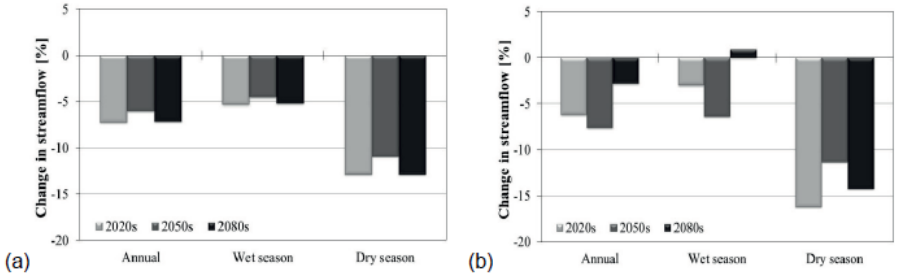
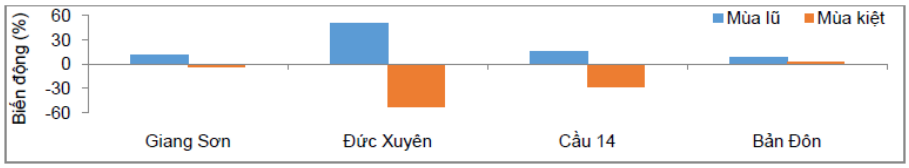
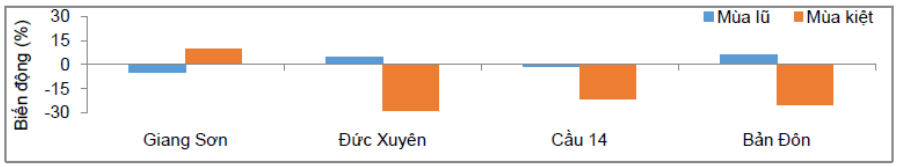


Figure 31: Changes in annual and seasonal stream flow for the (a) A1B and (b) B1 emission scenarios.[38]

37. Results from Nguyen Thi Huyen et al. (2017)[39] showed that monthly stream flows decrease due to temperature and PET increases. Nguyen Thi Ngoc Quyen et al. (2018)[40] further assessed the impact of climate change on water and soil resources in Srepok watershed by using SWAT model based on three downscaled climate change scenarios. Results show that dry flows decrease and flood flows increase in RCP 2.6 and RCP 8.5 scenarios (see Figure 32). The RCP 4.5 scenario shows a prolonged runoff decline in May and Jun, making the dry season tend to be longer in the watershed[40].



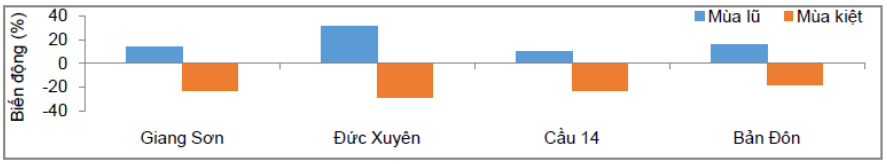
RCP 2.6



RCP 4.5

[39] Nguyen Thi Huyen, Le Hoang Tu, Vo Ngoc Quynh Tram, Duong Ngoc Minh, Nguyen Duy Liem and Nguyen Kim Loi, 2017. Assessing the impacts of climate change on water resources in the Srepok watershed, Central Highland of Vietnam. Journal of Water and Climate Change, 8(3), 524–534.doi:10.2166/wcc.2017.135.

[40] Nguyen Thị Ngọc Quyen, Nguyen Duy Liem, Bui Ta Long, Nguyen Kim Loi, 2018. The effect of climate change on runoff and sediment in Srepok watershed - central highland of Vietnam. Journal of Science and Technology of Forestry and Agriculture, Vol 1. pp 91-101.



RCP 8.5

Figure 32: Change of seasonal discharge compared to baseline scenario (Flood season ; Dry season:)[40].

38. These findings are in line with Nguyen Thi Thuy Trang (2017)[41] in which the changes of discharge in the dry season are −7.7%, −3.4%, and −1.5% under the RCP4.5 scenario, and 1.7%, −3.9%, and −6.6% under the RCP8.5 scenario for the 2030s, 2060s, and 2090s, respectively (Figure 33).

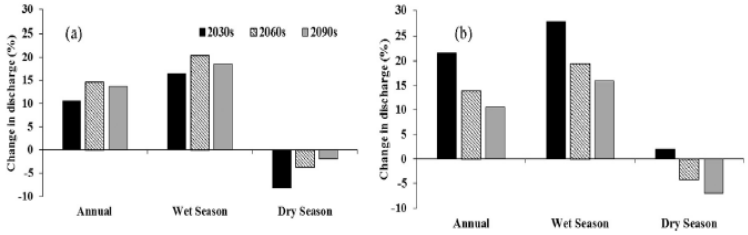


Figure 33: Changes in discharge at the 3S (Sesan, Srepok, Sekong) Basin outlet under (a) RCP 4.5 and (b) RCP 8.5 scenarios[39].

1.3.3 Central Highlands

39. **Current observed changes** in climate and weather-related events in the Central Highlands, based on available data for the period 1960-2010, show the following trends and patterns: [42]

TEMPERATURE INCREASE

- A significant trend of about 0.04 to 0.35°C temperature increase per decade (***Figure 34***). While maximum daily temperature has not shown any changes, minimum daily temperature has shown significant increases. Minimum temperature increased from approximately 0.18°C per decade in Da Lat (South-Central Highlands) to 0.65°C per decade in Kon Tum (North Central Highlands).
- More hot days and fewer cool nights. While the maximum daily temperature has no increasing trend, the number of extreme hot days has increased by about nine days per decade, and the number of extreme cool days decreased by about eight days per decade.

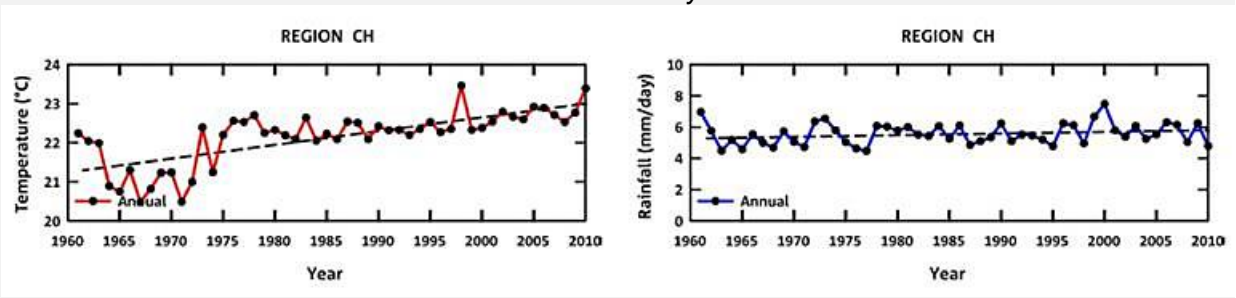
CHANGING PRECIPITATION PATTERNS

- Overall slight increase in annual rainfall (***Figure 34***) but with variations per location, with some showing significant increase while others little change or even no decrease.

[41] Nguyen Thi Thuy Trang, Sangam Shrestha, Manish Shrestha, Avishek Datta, Akiyuki Kawasaki, 2017. Evaluating the impacts of climate and land-use change on the hydrology
and nutrient yield in a transboundary river basin: A case study in the 3S River Basin (Sekong, Sesan, and Srepok). Science of the Total Environment 576 (2017) 586–598.
[42] IMHEN, CSIRO (2014). High-resolution Climate Projections for Vietnam. Regional Summary Central Highlands.

- Increased extreme rainfall amounts. Annual maxima of 1-day and 5-day rainfall amounts have increased by around 12 and 9 percent respectively. The number of very wet days has also increased significantly by up to 2 days per decade.

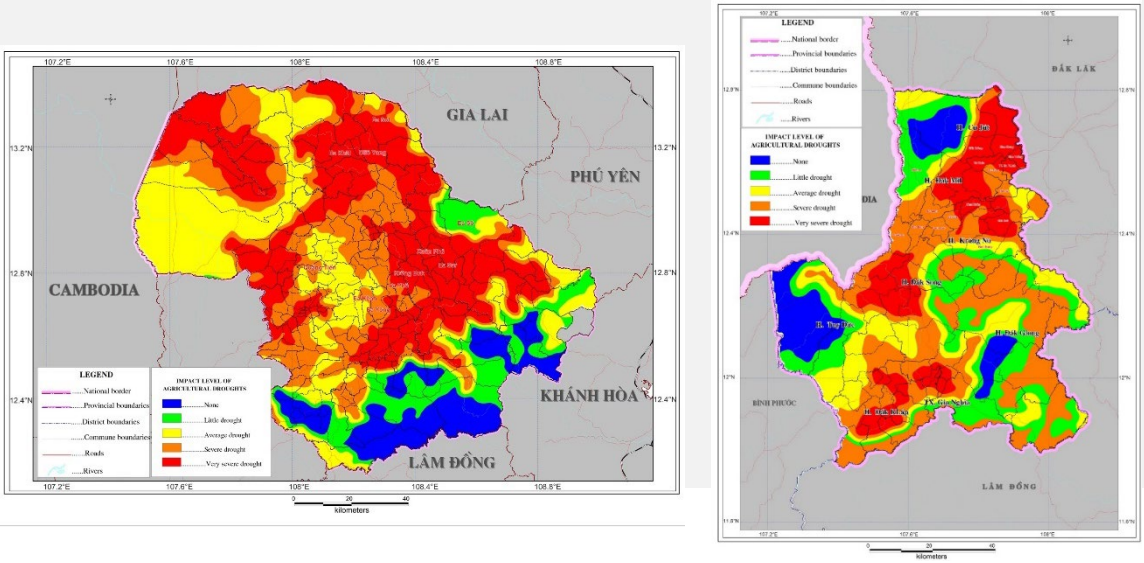
***Figure 34**: Time series (1961-2010) of regionally-averaged annual surface air temperature (left, °C, red) and annual rainfall (right, mm day, blue), with trend line (dashed black line), for the Central Highlands. Annual values are shown by black dots.*[43]



DROUGHT AND FLOOD RISK

- For the entire Central Highlands region, the most frequent disaster events have been heavy rainfall-induced floods, storms, landslides and drought.
- Over the period 1989-2010, Dak Lak has been affected by 19 heavy rainfall and flood events, 4 storms, 7 hailstorms and 1 landslide; while Dak Nong has been affected by 4 floods, 2 hailstorms and 1 storm.[44]
- Droughts are becoming more severe and are impacting a larger area than before (*Figure 37*). For example, the area most severely impacted by the recent drought in 2015-2016 was 2.1 to 2.5 times larger than in 2010. In addition, areas that have never experienced drought are now also increasingly affected. The main climate factors causing droughts in this region are reduced dry season rainfall and a longer than usual dry season.[45]

***Figure 35**: Agricultural drought risk in Dak Lak (left) and Dak Nong (right) (2001-2016). Measurements and calculations based on remote sensing and Temperature-Vegetation Dryness Index (TVDI).* [46]



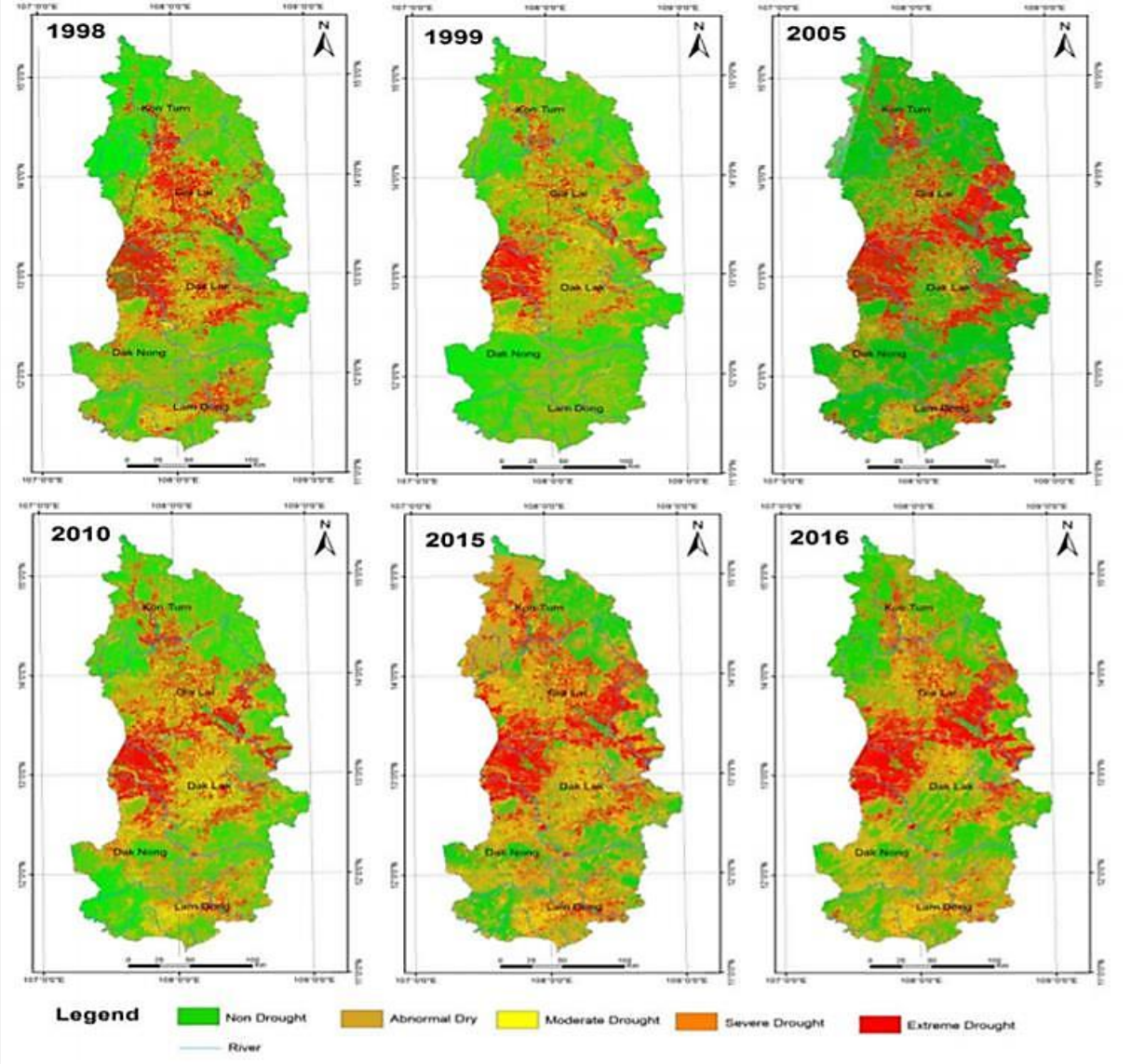
[43] Katzfey J. J., McGregor J. L., and Suppiah R. (2014) (Ibid).
[44] http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=vnm
[45] Including source of graph and maps; Nguyen T. T. H., Mai T. N., Bui D. C., Nguyen T. P. T. (November 2016). Mapping Droughts over the Central Highlands of Vietnam in El Niño Years Using Landsat Imageries.
[46] Source: IMHEN, MoNRE.

- The most drought-prone areas in the Central Highlands are the western districts of Gia Lai (Chu Prong), the northern and central part of Dak Lak (Ea Sup and Buon Don) and the north-western part of Dak Nong (Cu Jut and Dak Mil) provinces.
- The 2015-2016 drought damaged or destroyed 90,744 ha of crops, mainly perennial, in Dak Lak; and 18,525 ha of crops, mainly perennial, in Dak Nong.[47]
- This recent drought, with 40 percent less rainfall than normal in Dak Nong and 49 percent less than normal in Dak Lak for June-September, can be considered as a 1 in 100 years event. However, for the coming 25 years, there is a 22 percent chance that a similar event will occur.[48]

[47] CCNDPC damage and loss data.
[48] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017). SC 108211 VIE: Water Efficiency Improvement in Drought Affected Provinces: Climate Change Risk and Vulnerability Assessment. UK Met Office, ADB, p.9.

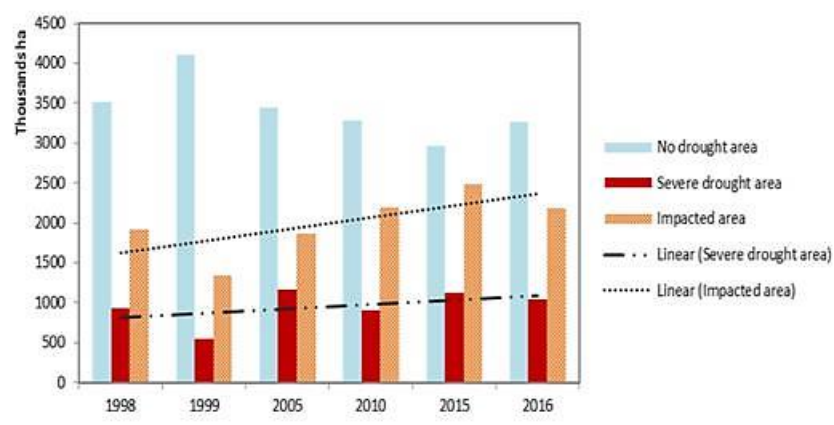
Figure 36: Map of the most severe droughts in the Central Highlands over 1998-2016, utilizing Landsat based Normalized Difference Drought Index (or NDDI). [49]

Maps indicate change in drought impacted area in late dry seasons (in March) of 1998, 1999, 2005, 2010, 2015, 2016. "Abnormally dry" state was detected when NDDI value is larger than 0.1; "moderate drought" was detected by area within NDDI range from 0.2 to 0.3; "severe drought" occurred in area with NDDI larger than 0.3, whereas "extreme drought" was where NDDI is larger than 0.4.



[49] Nguyen T. T. H., Mai T. N., Bui D. C., Nguyen T. P. T. (November 2016) (Ibid).

Figure 37: Changes in drought extent in the Central Highlands over 1998-2016 [50]



40. **Future climate scenarios** for the Central Highlands indicate:[51]

TEMPERATURE INCREASE

- An increase in overall temperatures of about 1.2 to 2.6°C by mid-century and 2.2 to 4.5°C by end-of-century for the higher (RCP8.5) greenhouse gas scenario. Less warming is evident in the lower (RCP4.5) greenhouse gas scenario. Average temperature increase will be slightly higher in the wet season than in the dry season.
- The number of hot days (days with maximum temperatures above 35°C) is projected to increase by 15 to 20 days a year in the lower lying parts of this region. In some years, the maximum temperature will exceed 40°C.
- The number of heat waves is projected to increase by a range of 3 to 6 days by end-of-century, especially for the southern part of this region. In addition, the average length of heat waves is also projected to increase slightly throughout the region.

CHANGING PRECIPITATION PATTERNS

- A 15 to 20 percent increase in rainfall in the wet season - which will start earlier and end later -, and 10 percent decrease and more irregular rainfall in the dry season. Larger variations between minimum and maximum amounts will occur. Likely more intense extreme rainfall events for southern parts of the Central Highlands but little change in the northern parts.
- In addition to a delayed onset, the length and intensity of the southwest monsoon are both expected to decrease slightly by mid-century and continue to decrease further by end-of-century, bringing less overall rainfall to the region and resulting in a drier dry season.

DROUGHT AND FLOOD RISK

- The magnitude and frequency of floods during the wet season increases due to increased intense rainfall linked to longer and wetter monsoon conditions.
- Droughts will become more severe due to rising temperatures and rainfall deficits in the dry season, particularly in the northern part of the region. Short duration (1-2 months) droughts will increase, while long duration droughts (5-7 months) decrease.
- Based on climate projections and historical observations, the number of typhoons is likely decreasing, but the number of strong to very strong ones shows an increasing trend (based on historical records), increasing the risk of floods and landslides.

[50] Severe drought is identified by the value 0.3 on the Normalized Difference Drought Index or NDDI. For more details see: Nguyen T. T. H., Mai T. N., Bui D. C., Nguyen T. P. T. (November 2016) (Ibid).
[51] IMHEN, CSIRO (2014) (Ibid), MoNRE (2016) (Ibid) and USAID Mekong ARCC Program (2013). Vietnam Climate Change Vulnerability Profile.

Figure 38a: Climate models on rainfall and PET for Dak Lak province [52]

RCP4.5 'warm and wet' (blue line), RCP8.5 'hotter and wet' (green line), and RCP8.5 'hotter' (red line) scenarios. The bar and line plot show the monthly average of daily precipitation (line) and median estimated PET (bar) mid-century (2041 to 2070) relative to the baseline period (1976 to 2005, grey line) for each scenario.

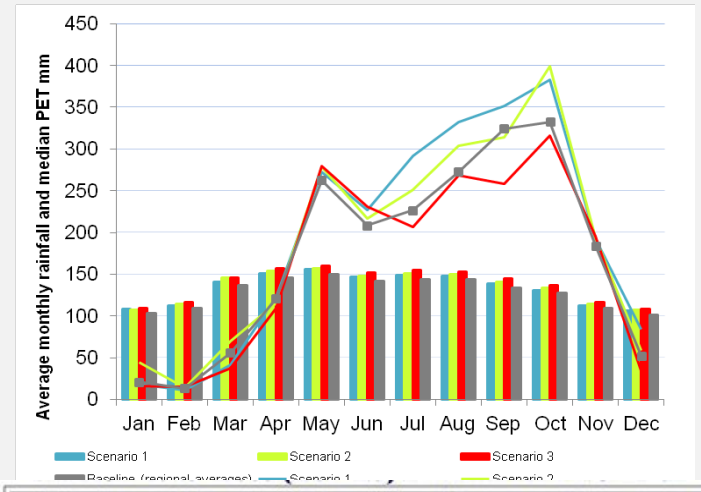


Figure 35b: Average simulated changes in average rainfall during the dry season (November to March) for Dak Lak province for the period 2046-2065 (RCP 4.5).[53]

Maps are based on the PRECIS regional climate modeling system.

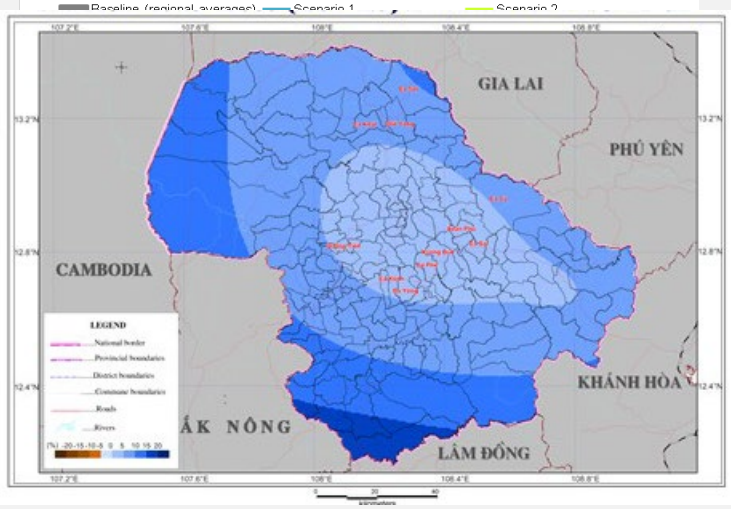
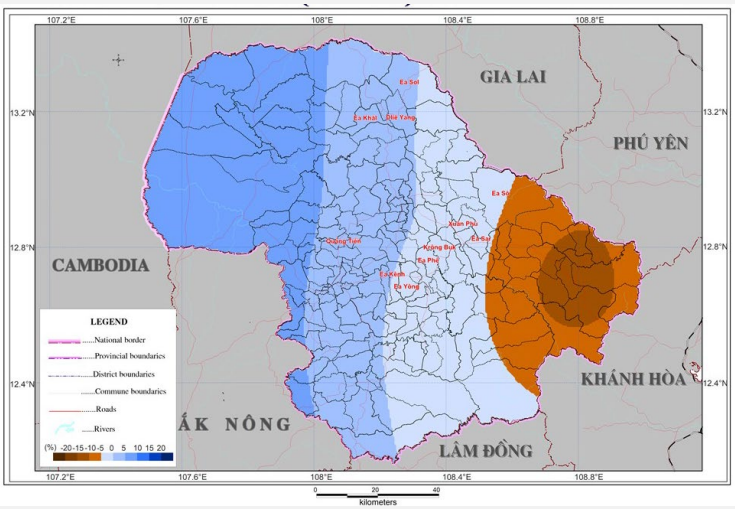


Figure 35c: Averaged simulated changes in average rainfall during the wet season for Dak Lak province for the period 2046-2065 (RCP 4.5)



[52] Source for Figure 35a and 36a: Wade S., Colledge S. Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).
[53] Source for Figure 35b-e and 36b-e: IMHEN, MoNRE

Figure 35d: Averaged simulated changes in average temperature during the dry season for Dak Lak province for the period 2046-2065 (RCP 4.5)

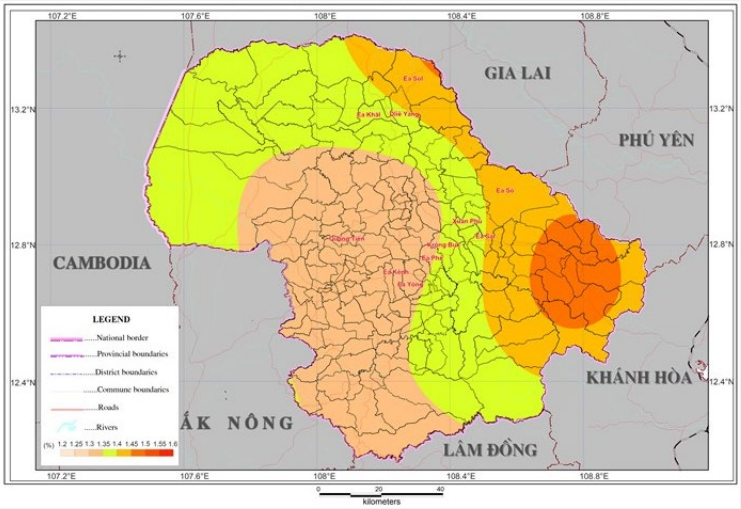


Figure 35e: Averaged simulated changes in average temperature during the wet season for Dak Lak province for the period 2046-2065 (RCP 4.5)

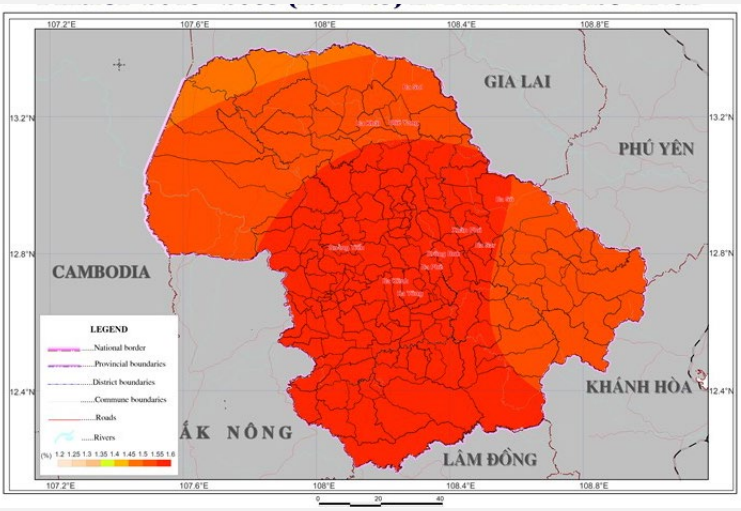


Figure 39a: Climate models on rainfall and PET for Dak Nong province

RCP4.5 'warm and wet' (blue line), RCP8.5 'hotter and wet' (green line), and RCP8.5 'hotter' (red line) scenarios. The bar and line plot show the monthly average of daily precipitation (line) and median estimated PET (bar) mid-century (2041 to 2070) relative to the baseline period (1976 to 2005, grey line and grey bar) for each scenario.

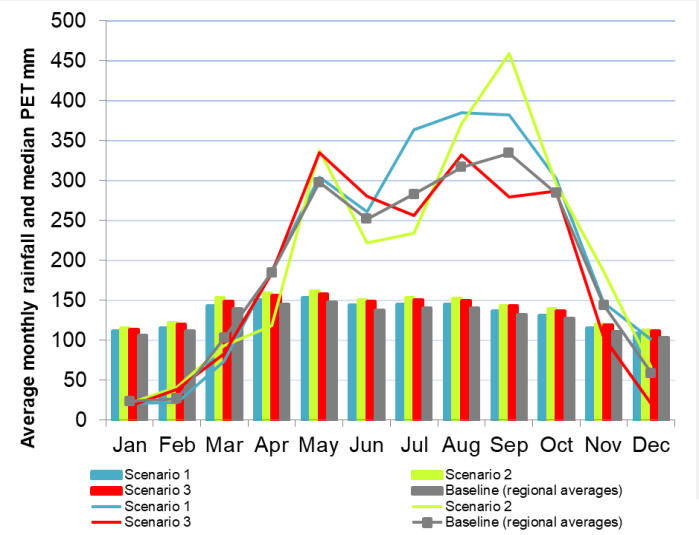


Figure 36b: Averaged simulated changes in average rainfall during the dry season for Dak Nong province for the period 2046-2065 (RCP 4.5)

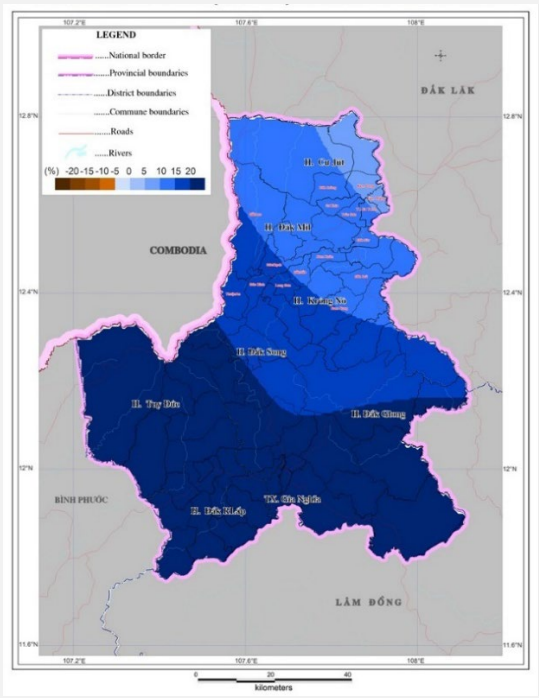


Figure 36c: Averaged simulated changes in average rainfall during the wet season for Dak Nong province for the period 2046-2065 (RCP 4.5)

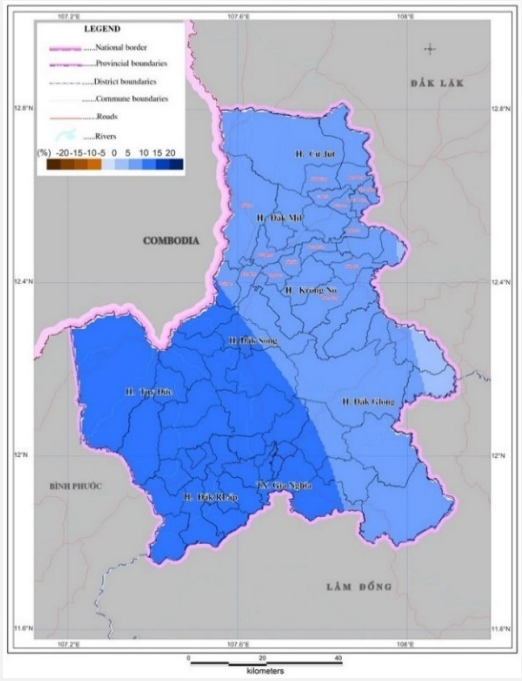


Figure 36d: Averaged simulated changes in average temperature during the dry season for Dak Nong province for the period 2046-2065 (RCP 4.5)

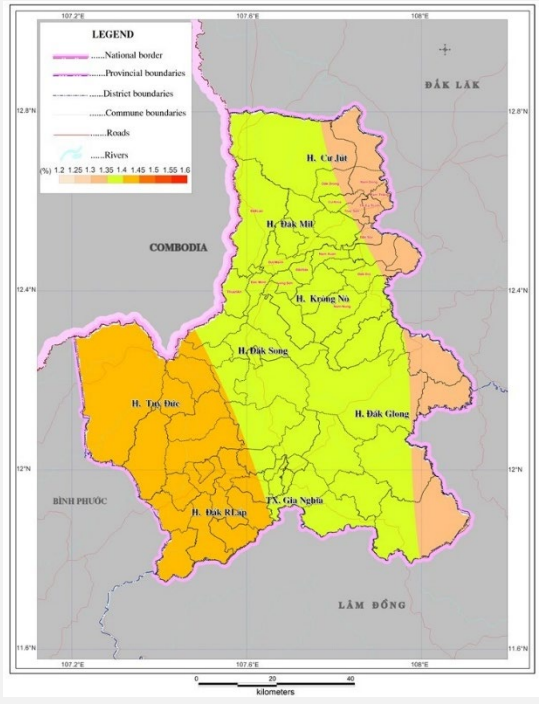
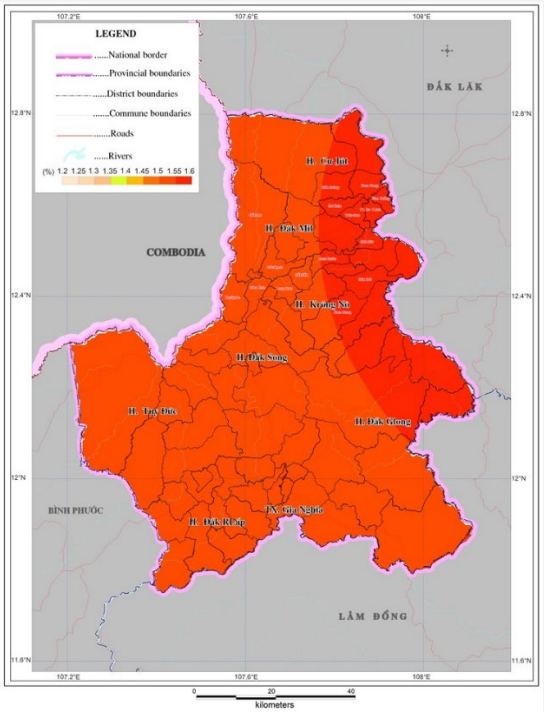


Figure 36e: Averaged simulated changes in average temperature during the wet season for Dak Nong province for the period 2046-2065 (RCP 4.5)



1.3.4 South-Central Coast

41. **Current observed changes** in climate and weather-related events in the South-Central Coast, based on available data for the period 1960-2010, show the following trends and patterns: [54]

TEMPERATURE INCREASE

- Annual temperature has slightly increased, with a trend of about 0.08 to 0.16°C increase per decade (Figure 40). While minimum daily temperature has increased significantly by up to approximately 0.36°C per decade, the change in maximum daily temperature is small and not significant for most parts of this region.
- More hot days and no changes in cool nights. The number of hot days (days with maximum temperatures above 35°C) has increased significantly by up to 4 days per decade, particularly in the southern part of this region. The number of cold nights remains unchanged.

CHANGING PRECIPITATION PATTERNS

- Annual rainfall has increased significantly (Figure 40), with local increases of up to 13 percent particularly in the southern parts of this region. However, there are differences between seasons, with the amount of rainfall reducing during the dry season but increasing during the rainy season.[55]
- Increased extreme rainfall amounts. Annual maxima of 1-day and 5-day rainfall amounts and the number of very wet days have increased throughout the region, the latter with up to 3 days per decade.

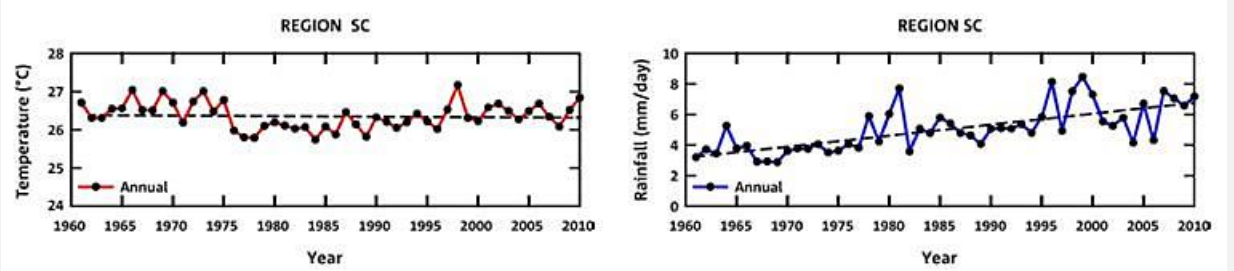


Figure 40: Time series (1961-2010) of regionally-averaged annual surface air temperature (left, °C, red) and annual rainfall (right, mm day, blue), with trend line (dashed black line), for the Central Highlands. Annual values are shown by black dots, South-Central Coast [56]

DROUGHT AND FLOOD RISK

- For the entire South-Central Coast, the most frequent disaster events have been floods, drought, heat waves and strong winds. Storms are more frequent in the northern part of the region than in the southern part.
- Over the period 1989-2010, Binh Thuan has been affected by 21 heavy rainfall and flood events, 4 storms, 6 hailstorms and 2 landslides; Ninh Thuan by 21 heavy rainfall and flood events, 2 storms and 2 hailstorms; and Khanh Hoa by 26 flood events and 5 storms.[57]
- The recent El-Niño-induced drought in 2015-2016 damaged or destroyed 12,102 ha of crops, mainly fruit trees, in Binh Thuan; 1,215 ha of crops, mainly perennial, in Ninh Thuan; and 36,400 ha, mainly perennial and rice, in Khanh Hoa.[58]

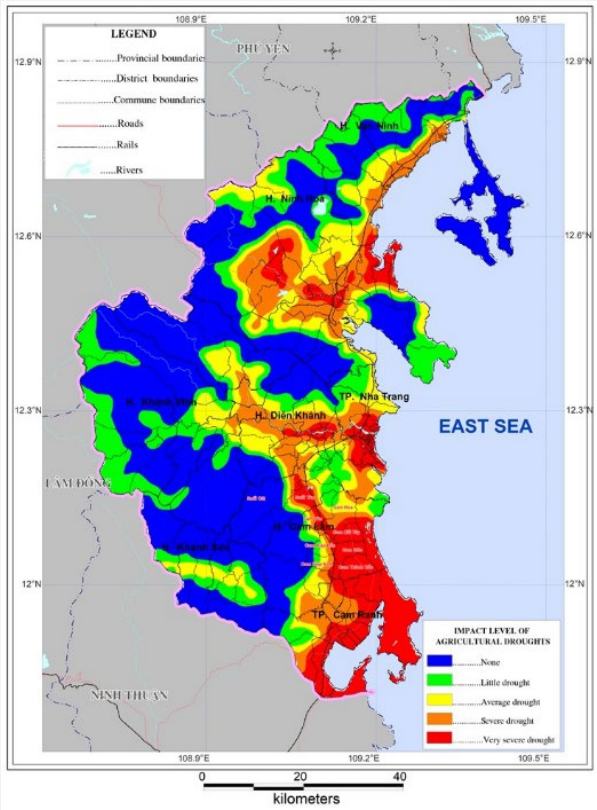
[54] IMHEN, CSIRO. (2014) (Ibid).
[55] Hien T. T. L., Thang N. N., Hens L. (November 2015). Assessment of the Irrigation Capacity during the Dry Season Using Remote Sensing and Geographical Information (Case Study in Binh Thuan Province, Vietnam).
[56] Katzfey J. J., McGregor J. L., and Suppiah R. (2014) (Ibid).
[57] http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=vnm
[58] CCNDPC damage and loss data.

- The recent extreme drought, with 45 percent less rainfall than normal in Binh Thuan and 70 percent less than normal in Ninh Thuan and Khanh Hoa for the period June-September, can be considered as a 1 in 100 years event. However, for the coming 25 years, there is a 22 percent chance that a similar event will re-occur.[59]
- Areas currently most vulnerable to drought and desertification in Binh Thuan are in the semi-arid part of the province: Bac Binh and Tuy Phong districts and the centre of Ham Thuan Bac district.

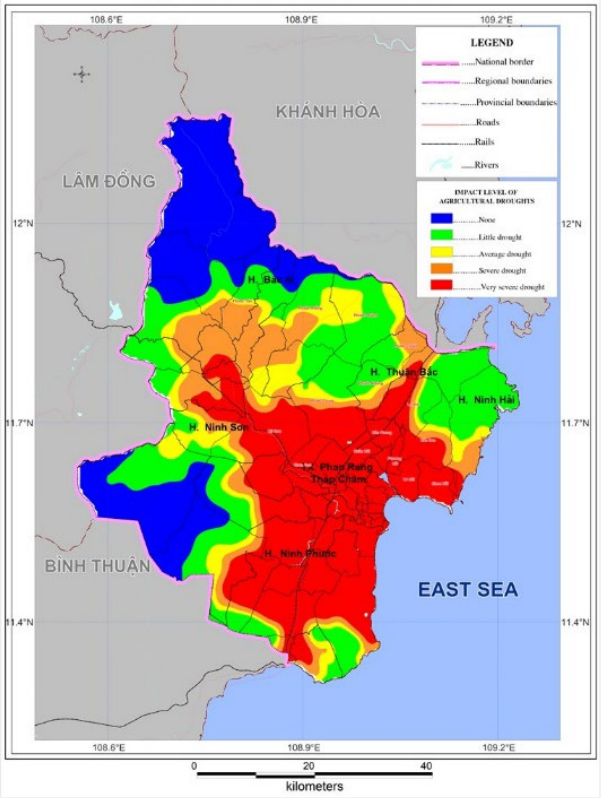
[59] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).

Figure 41: Agricultural drought risk in Khanh Hoa (a), Ninh Thuan (b) and Binh Thuan (c) (2001-2016). Measurements and calculations based on remote sensing and Temperature-Vegetation Dryness Index. [60]

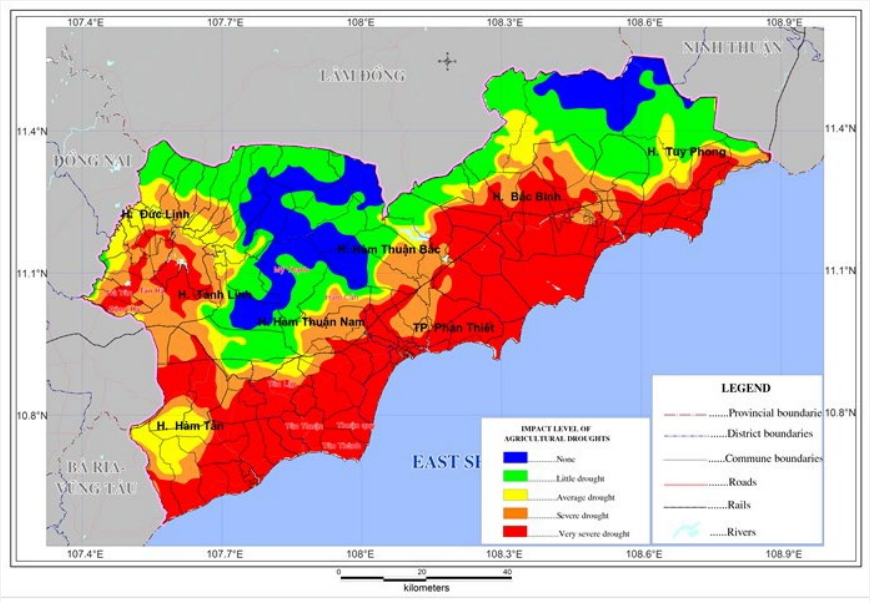
(a)



(b)



(c)



[60] Source: IMHEN, MoNRE.

42. **Future climate scenarios** for the South-Central Coast indicate:[61]

TEMPERATURE INCREASE

- An increase in annual temperatures of about 1.2 to 2.5°C by mid-century and 2.4 to 4.3°C by end-of century under the higher (RCP8.5) greenhouse gas scenario. Less warming is evident in the lower (RCP4.5) greenhouse gas scenario.
- An increase in the number, length and intensity of heat waves and number of hot days (days with maximum temperatures above 35°C) by end-of-century.

CHANGING PRECIPITATION PATTERNS

- Overall shorter and higher intensity of monthly rainfall, with large variations in terms of months and amounts. Rainfall in the wet season will increase by 20 percent, particularly in October-November, but rainfall in the monsoon months, June till September, will likely decrease. The wet season will likely be shorter, starting later (up to 15 days) and ending earlier (up to 30 days).[62]
- Extreme rainfall events are projected to be less intense.
- In addition to a delayed onset, both the length and intensity of the southwest monsoon are expected to decrease significantly. By mid-century, the season length will be reduced by about two weeks and rainfall is reduced by 40 percent. This trend continues until end-of-century.

DROUGHT AND FLOOD RISK

- Droughts in general will occur less often as rainfall will increase during the dry season, but droughts will become more extreme and last longer due to rising temperatures, a changing monsoon and rainfall deficits in the dry season. While small to medium droughts will remain manageable, extreme droughts, similar as in 2015-16, will become a major risk.
- Flood risk will also increase, but mainly in the upland areas and the northern part of the region.
- The number of typhoons is likely decreasing, but the number of strong to very strong typhoons increasing. Typhoons will also occur later in the year.
- Sea level rise will be about 100 to 400mm by mid-century, with further increase by end-of-century and beyond. It will be higher than the global average but with a lower area potentially affected than in the Mekong River Delta. Coastal areas will deal with increased salinity intrusion.

[61] IMHEN, CSIRO (2014) (Ibid) and MoNRE (2016) (Ibid).

[62] Doutreloup S., Erpicum M., Fettweis X., Ozer P. (August 2011). Analysis of the past (1970-1999) and future (2046-2065 and 2081-2100) evolutions of precipitation and temperature, in the province of Binh Thuan, South East Vietnam, based on IPCC models.

Figure 42a: Climate models on rainfall and PET for Binh Thuan province [63]

RCP4.5 'warm and wet' (blue line), RCP8.5 'hotter and wet' (green line), and RCP8.5 'hotter' (red line) scenarios. The bar and line plot shows the monthly average of daily precipitation (line) and median estimated PET (bar) mid-century (2041 to 2070) relative to the baseline period (1976 to 2005, grey line and grey bar) for each scenario.

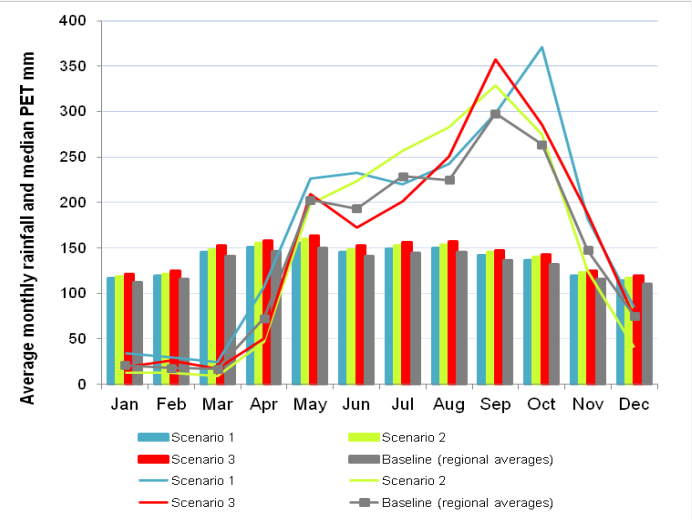
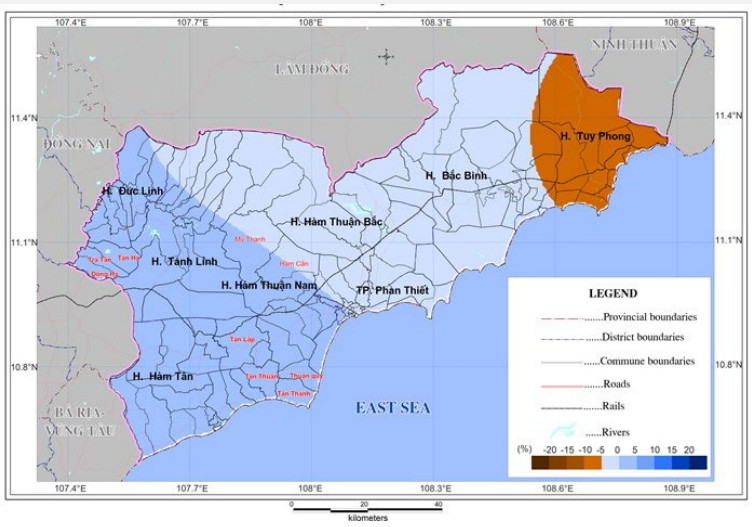


Figure 39b: Averaged simulated changes in average rainfall during the dry season for Binh Thuan province for the period 2046-2065 (RCP 4.5) [64]

Maps are based on the PRECIS regional climate modeling system.



[63] Source for Figure 39a, 40a and 41a: Wade S., Colledge S. Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).
[64] Source for Figure 29b-e, 40b-e and 41b-e: IMHEN, MoNRE.

Figure 39c: Averaged simulated changes in average rainfall during the wet season for Binh Thuan province for the period 2046-2065 (RCP 4.5)

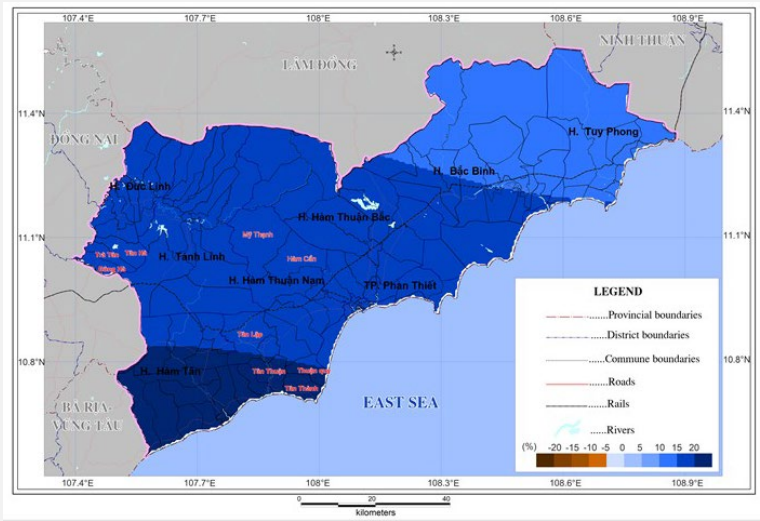


Figure 39d: Averaged simulated changes in average temperature during the dry season for Binh Thuan province for the period 2046-2065 (RCP 4.5)

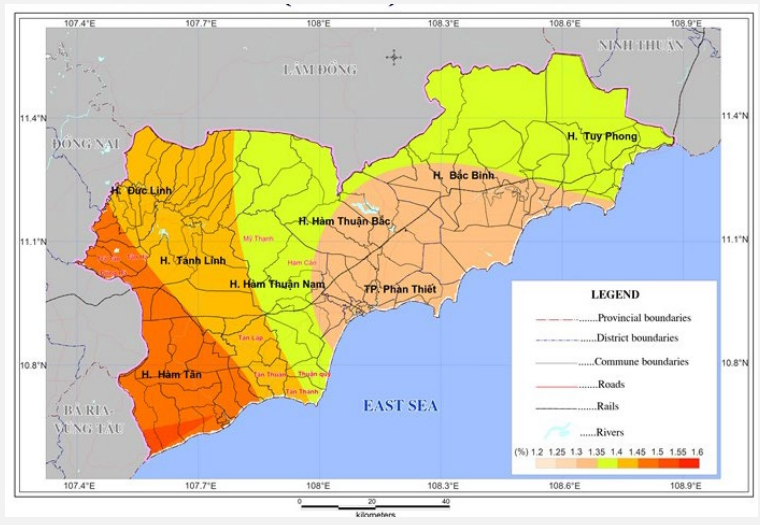


Figure 39e: Averaged simulated changes in average temperature during the wet season for Binh Thuan province for the period 2046-2065 (RCP 4.5)

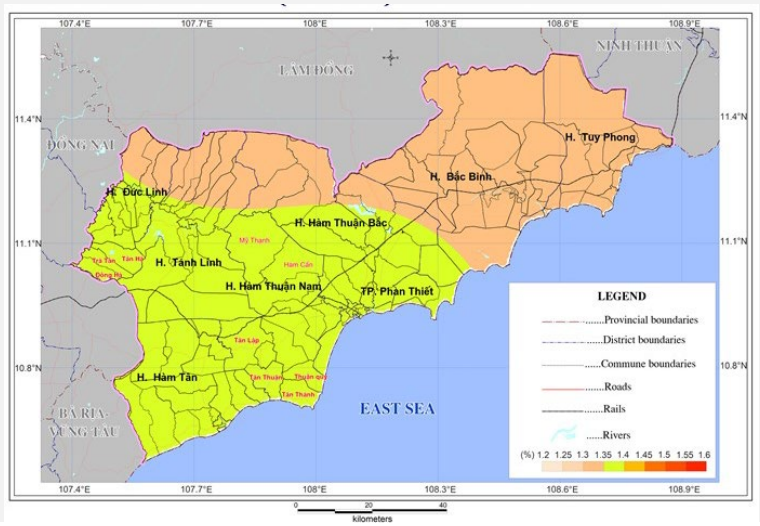


Figure 43a: Climate models on rainfall and PET for Khanh Hoa province[65]

RCP4.5 'warm and wet' (blue line), RCP8.5 'hotter and wet' (green line), and RCP8.5 'hotter' (red line) scenarios. The bar and line plot show the monthly average of daily precipitation (line) and median estimated PET (bar) mid-century (2041 to 2070) relative to the baseline period (1976 to 2005, grey line and grey bar) for each scenario.

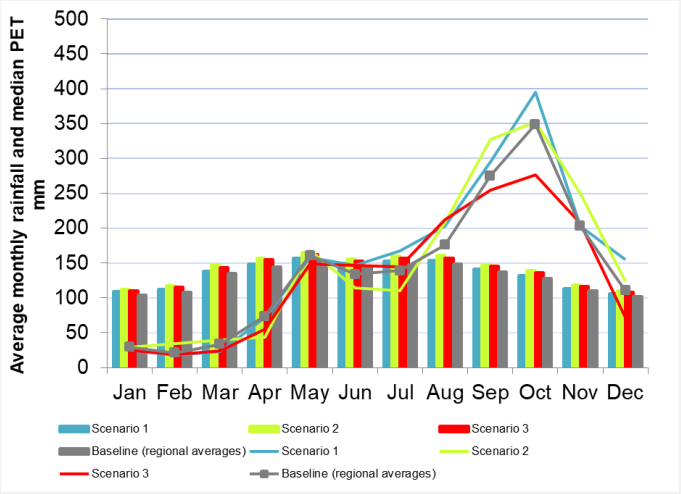


Figure 40b: Averaged simulated changes in average rainfall during the dry season for Khanh Hoa province for the period 2046-2065 (RCP 4.5)

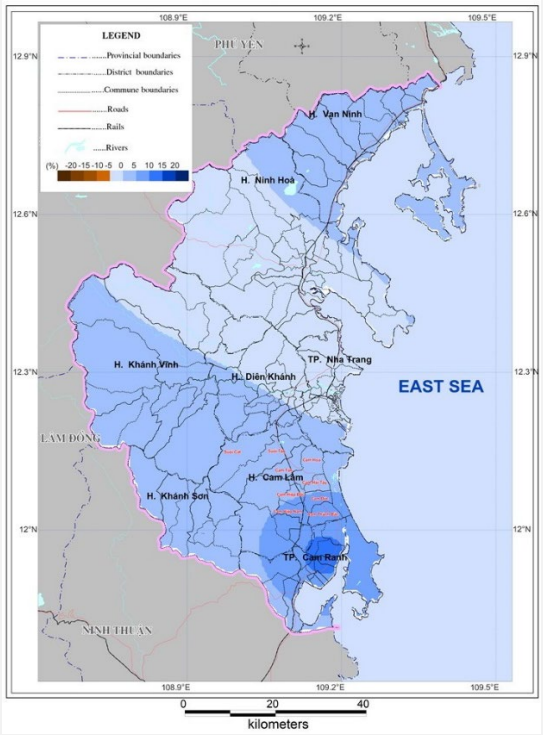
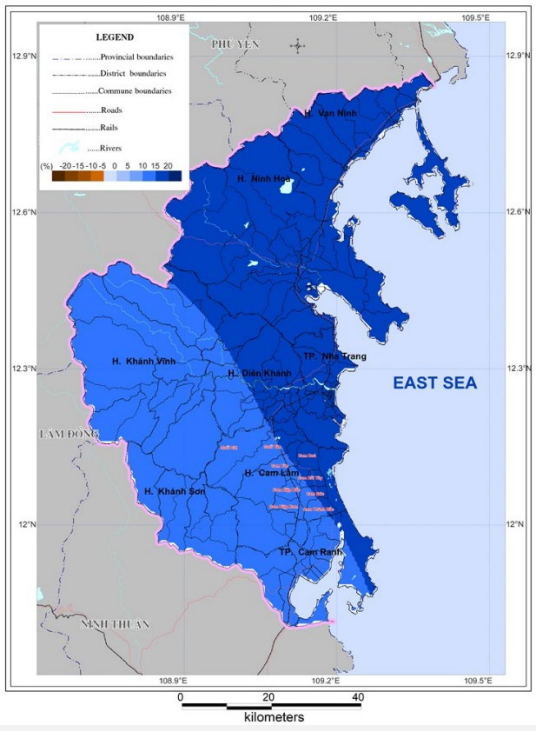


Figure 40c: Averaged simulated changes in average rainfall during the wet season for Khanh Hoa province for the period 2046-2065 (RCP 4.5)



[65] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).

Figure 40d: Averaged simulated changes in average temperature during the dry season for Khanh Hoa province for the period 2046-2065 (RCP 4.5)

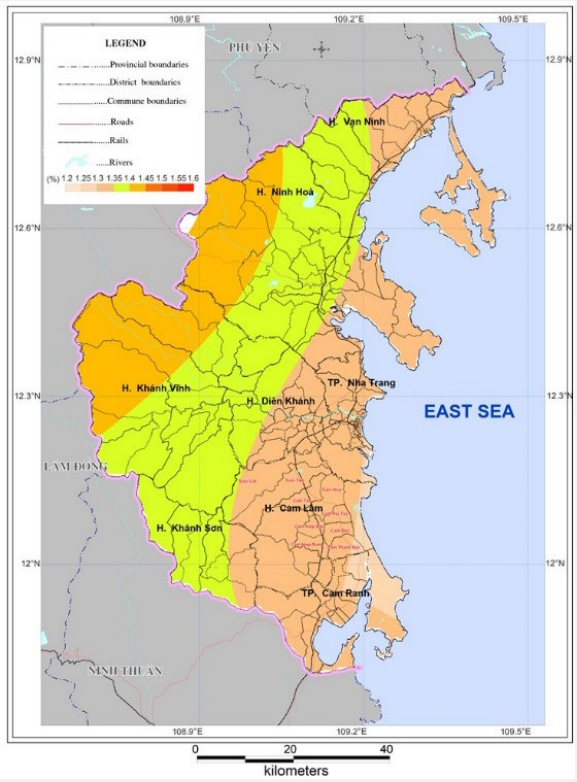


Figure 40e: Averaged simulated changes in average temperature during the wet season for Khanh Hoa province for the period 2046-2065 (RCP 4.5)

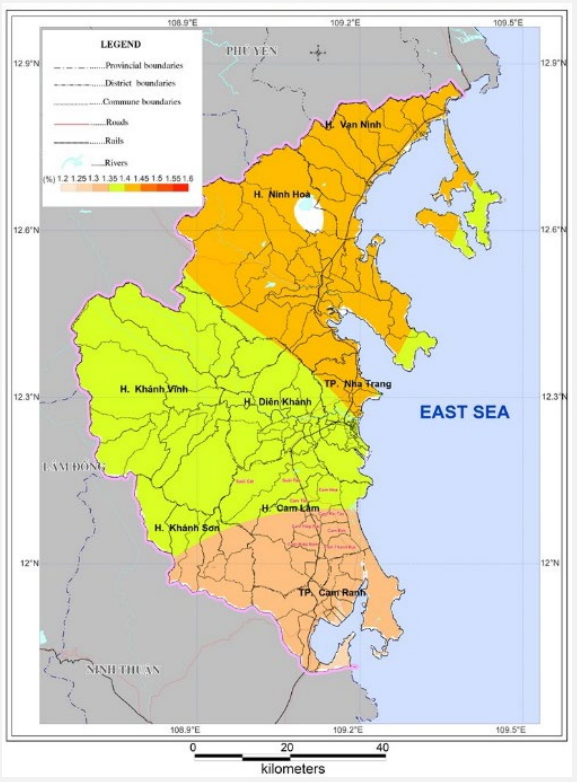


Figure 44a: Climate models on rainfall and PET for Ninh Thuan province

RCP4.5 'warm and wet' (blue line), RCP8.5 'hotter and wet' (green line), and RCP8.5 'hotter' (red line) scenarios. The bar and line plot show the monthly average of daily precipitation (line) and median estimated PET (bar) mid-century (2041 to 2070) relative to the baseline period (1976 to 2005, grey line and grey bar) for each scenario.

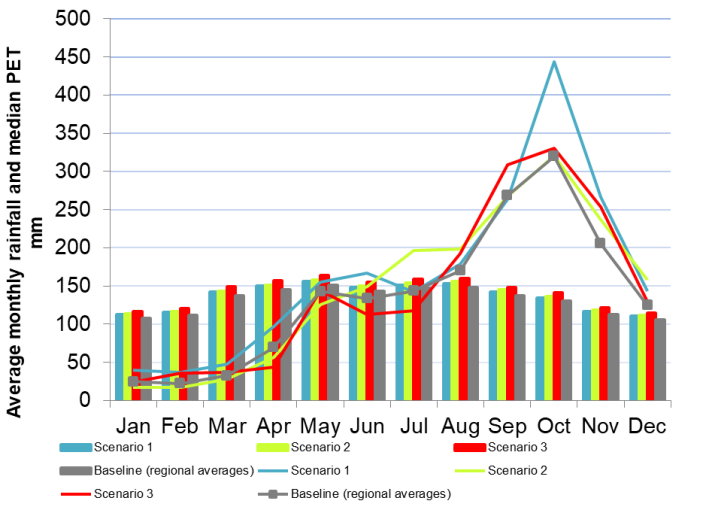


Figure 41b: Averaged simulated changes in average rainfall during the dry season for Ninh Thuan province for the period 2046-2065 (RCP 4.5)

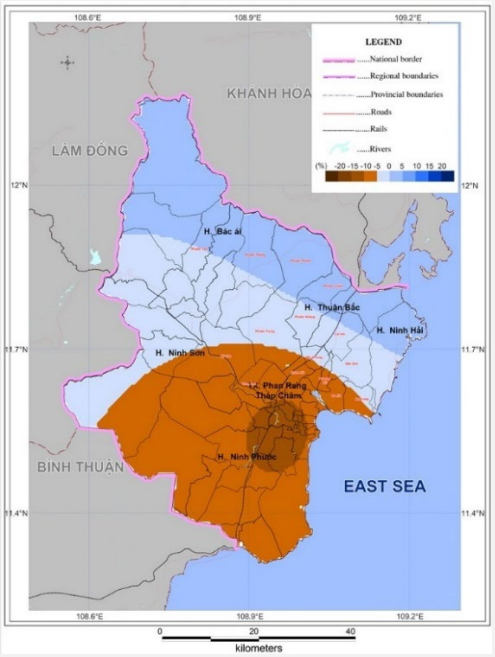


Figure 41c: Averaged simulated changes in average rainfall during the wet season for Ninh Thuan province for the period 2046-2065 (RCP 4.5)

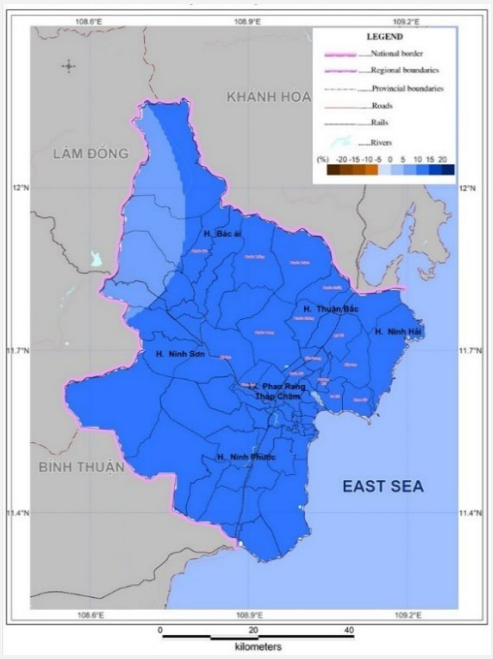
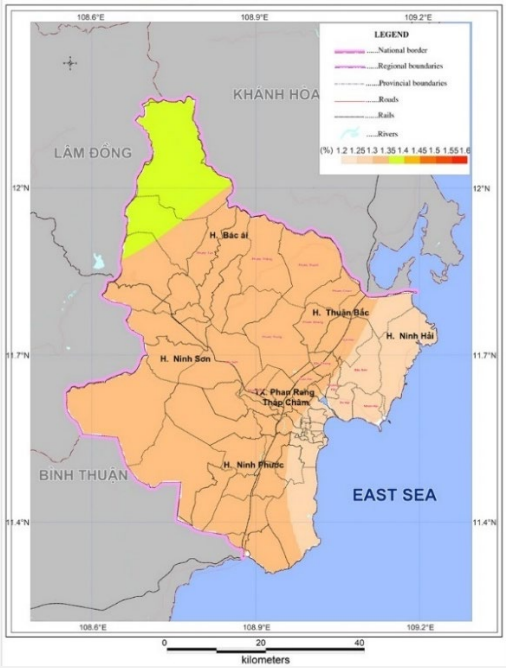


Figure 41d: Averaged simulated changes in average temperature during the dry season for Ninh Thuan province for the period 2046-2065 (RCP 4.5)

Figure 41e: Averaged simulated changes in average temperature during the wet season for Ninh Thuan province for the period 2046-2065 (RCP 4.5)



1.4 Climate change impacts on key sectors and socio-economic groups

43. Overall for Viet Nam, climate exposure and sensitivity will be manifested in the following potential impacts:[66]

- Agriculture, including fisheries: damage to crops, loss of arable lands, decreased agricultural productivity, shifting production zones, growing cycles and distribution of species, habitat destruction and degradation, animal diseases, increased reproduction and spread of harmful pests, loss of livelihoods and incomes, increased migration;
- Water resources: increased evaporation, reduced water availability, reduced flows and groundwater levels, degraded water quality, saline intrusion, destruction of water infrastructure;
- Coastal ecosystems: damage to and destruction of coastal and marine habitats, loss of protection and livelihood value in case of degraded mangroves;
- Infrastructure: damaged infrastructure and key community assets, increased maintenance costs, reduced mobility of goods and services;
- Energy: reduced energy production, disruption in service provision;
- Human health: shifting disease patterns and potential new diseases, decreased labor productivity, psychological stress and trauma.

44. The main climate change impacts for the Central Highlands and South-Central Coast are on water resources availability, agricultural productivity, rural infrastructure, local ecosystems and human health, with the impact on water resources and agricultural production being the most significant for the most vulnerable population groups.

1.4.1 Impacts on water resources

45. An analysis of fifty-six climate change scenarios for Vietnam combined with biophysical modeling to project the impacts of climate change on water supply, water demand and hydropower generation to the year 2050 predicts a significant increase in terms of irrigation demand due to climate change, in addition to decreased agricultural yields for all major crops. The study recommends Government planners to be prepared for more severe extremes, specifically floods and droughts, and the development of options for more water storage capacity and efficiency to prepare for both extremes. Traditional agricultural methods should be reconsidered and shifted into flexible cropping systems resistant to higher temperatures, water deficit stresses and excess water stresses.[67]

46. According to the MoNRE climate change scenarios, increased temperature and changes in precipitation will result in changes in crop water requirements and yields; and changes in river flow with impacts on hydropower and the ability to meet water requirements for municipal, industrial and agricultural uses. Climate scenarios show a drying trend in the north with an increase of precipitation in the central and southern regions. Model results suggest that dry season runoff will generally be reduced and that wet season peak runoff will be increased compared to current conditions with mean annual runoff, with extreme climate scenarios indicating increases up to 20 percent and decreases to 16 percent. Crop modeling results suggest that irrigation demand will mostly increase over Vietnam.

47. A recent analysis by the United Kingdom Meteorological Office identifies for the two regions the following potential impacts on water resources, for three future climate scenarios: warm and wet; hot and wet; and hotter:

[66] GoV (2012). National Climate Change Strategy; GoV (2015). Intended Nationally Determined Contribution; and USAID (2017). Fact sheet. Climate change risk profile. Vietnam.

[67] Gebretsadik Y., Fant C., Strzepek K. (September 2012). Impact of Climate Change on Irrigation, Crops and Hydropower in Vietnam. United Nations University Working Paper No. 2012/79. UNU-WIDER.

Table 2: Overview of potential climate impacts on water resources in the Central Highlands and South-Central Coast, for three simplified climate futures (with yellow: low risk; orange: medium risk; red: high risk; and +/- indicating direction and magnitude of changes) [68]

Potential impact	Warm and wet	Hot and wet	Hotter scenario	Analysis based on research and expert opinions
Water resources				
Increase in evaporation; increase in crop water demand and reservoir losses	+3~4%	+5~6%	+7~8%	Estimate based on increase in temperature for each scenario and evapotranspiration
Change in annual average river flows (risk to water availability)	+22~27% (increase)	+10~11% (increase)	+13~14% (increase)	Estimated based on case study modeling of 3 river basins. In hottest scenario, high evapotranspiration and delayed monsoon rains reduce water flow
Decrease in groundwater table due to decrease in groundwater recharge	(increase)	(increase)	(decrease)	Increases under wet scenarios but some reductions in hotter scenario may reduce groundwater levels
Saline intrusion into groundwater, reducing quality	+ (increase)	++ (increase)	++ (increase)	Higher rates of sea level rise with higher rates of warming; up to 0.1% land loss in Binh Thuan for 0.5m sea level rise

48. Overall, for both regions, when considering average annual water availability, a slight increase in availability of water is expected in the warm-wet and hot-wet scenarios due to an expected increased rainfall. However, inter-seasonal differences will become larger with higher water levels than current in the wet season and less water availability in the dry season, requiring adequate storage options. Under the hotter scenario, water shortages caused by increased demand and higher evaporation will occur.

49. The highest risk for water availability in both regions is extreme droughts. As these droughts will likely be longer and more severe, farmers are projected to depend on groundwater resources in 15 out of 100 years, with extraction of groundwater in this period expected to increase.[69] Coastal areas, particularly in Binh Thuan, will also be affected by saline intrusion as sea levels gradually rise. Increasing sea levels in combination with over-extraction of groundwater and surface water is leading to ingress of seawater and the salinization of coastal waterways and groundwater.

50. Water availability is very location specific, and is, besides climate variability and change, also influenced by the local topography, agricultural practices and the capacity of the irrigation infrastructure. Water availability in upland areas with rain-fed crop systems and limited storage options will remain constrained or worsen, but lowland areas will be better able to deal with incremental climate change, except for extreme droughts and under the hotter scenario. For example, the Trung Tam reservoir in Ea Hleo district in Dak Lak is currently affected by reduced water availability from May to August but can still manage the demand for production. Only once in the past 25 years was the reservoir unable to provide enough water, during the dry season of 1996. With a slight increased annual river flow of 16 percent, the Song Mong reservoir in coastal Ham Thuan Nam district in Binh Thuan can provide the required water supply for the current and planned cultivated crops, within a regular dry season. However, the water balance is under threat during extreme droughts – occurring three times over the past 40 years - and in the hottest scenario when rainfall declines and evaporation increases. [70]

1.4.2 Impacts on agriculture

[68] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).
[69] ADB (June 2017). Climate Risk Assessment and Management for the Project 'Water Efficiency Improvement in Drought Affected Province'.
[70] Other sites in the target areas have not been assessed. Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid), p.33.

51. Climate change is also expected to severely impact agricultural productivity in both regions due to increased extreme droughts, rainfall extremes with higher flood risk, and more unpredictable and shifting wet and dry season variability. A recent analysis by the United Kingdom Meteorological Office identifies for the two regions the following potential impacts on agriculture and rural infrastructure, for three future climate scenarios: warm and wet; hot and wet; and hotter:

Table 3: Overview of potential climate impacts on agriculture and rural infrastructure in the Central Highlands and South-Central Coast, for three simplified climate futures (with yellow: low risk; orange: medium risk; red: high risk; and +/- indicating direction and magnitude of changes) [71]

Potential impact	Warm and wet	Hot and wet	Hotter scenario	Analysis based on research and expert opinion
Agriculture				
Crop yield loss and damage to perennial crops due to extreme drought beyond planned irrigation upgrade	-	+	+	Irrigation water supply will be limited 15% of the time and the chance of an extreme drought like in 2015-16 is high
Reduced crop productivity from loss of arable land due to water logging	+	No change	No change	Under the wettest scenarios, there may be drainage issues
Crop losses due to flood damage	+	+	+	There will be flooding in all scenarios
Reduced crop productivity due to heat waves	No change	No change	-	Some sensitivity to higher temperatures
Shifting of production zones to higher elevations	No change	+/-	+/-	Rising temperatures are not expected to exceed thresholds for target crops
Increased reproduction and spread of harmful pests	Unknown	Unknown	Unknown	E.g. rice feeding, ear-cutting caterpillars
Potential impact	Warm and wet	Hot and wet	Hotter scenario	Analysis based on research and expert opinion
Infrastructure				
Destruction of water infrastructure	++	+	+	Risk of flood damage is high; pipe river crossings, weirs and pumping stations in floodplains in highest risk; coastal provinces assets set back from coastline
Damage to roads, disrupting transport of goods	+	+	+	River crossings highest risk
Disruption of energy supply networks	+	+	+	Electricity supply must be resilient to floods and sufficient during peak demand periods

52. Crop productivity will be most impacted by reduced water availability in the event of longer dry seasons, extreme droughts and under the hotter scenario. Extreme drought periods can result in 40 to 70 percent less water available for crops, especially affecting perennial crops such as coffee, pepper, rubber and fruit trees. Crop yields in upland areas will be negatively impacted by seasonal changes (for example delayed onset of the rainy season) and more unpredictable precipitation patterns. Extreme rainfall events and related flooding will also cause destruction or damage to crops, particularly in the Central Highlands.

[71] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).

53. In Binh Thuan, especially Bac Binh, Ham Thuan Bac, Ham Thuan Nam and Ham Tan districts, less and less land is cultivated during the dry season because of more severe weather conditions during the dry season, unpredictable precipitation and limited or unreliable irrigation capacity. Not using or irrigating the land causes more land degradation due to limited soil moisture and fertilization, which makes it even less attractive for further cultivation.[72] Similar trends are reported for Ninh Thuan and Khanh Hoa.[73]

54. For the main crops currently cultivated in both regions, vulnerability for observed and projected climate conditions is as described in Table 5, below, with perennial crops such as coffee and pepper and annual crops such as rice and maize being the most vulnerable. This table provides an overview and should be reinterpreted per agro-climate zone in both regions as both regions have a large diversity of micro-climates and mono- and integrated cropping systems. The downscaled impact of climate change on crop systems can be very local and depends a lot on the variety used, the level of inter-cropping, and applied farming practices. Table 6 provides the seasonal calendar for the most commonly grown crops.

55. Important factors farmers consider in addition to climate vulnerability are, for example, short, medium and long-term income, labor inputs, one-off and seasonal investment costs, market factors such as access, demand, farmer competition, availability of market actors and price trends and predictability. In certain cases, such as with coffee and pepper, which have a high climate vulnerability but also a high potential income and stable market, many farmers are willing to take the risk, when they can afford the investment. In other cases, for example cassava, with also has a high climate vulnerability but low potential income and unstable market, farmers are more interested in other options. A focus on high value crops with low climate vulnerability or on high value crops with climate resilient options to reduce the climate vulnerability are therefore the preferred strategies to gain interest from farmers and support the resiliency and productivity of their cropping systems.

56. In addition to crops, farmers also raise livestock, such as cows, goats, pigs and poultry. In most households this is limited to a few heads and is used as a contingency or coping mechanism during major disaster and non-disaster shocks, but for some households, especially in the South-Central Coast, the number is higher and livestock is sold for additional income. In addition to susceptibility to diseases, livestock is also vulnerable to observed and projected climate variability and change, mainly temperature and rainfall increases and variability and extreme weather events. The most vulnerable are chickens and pigs. Smallholder cattle are only medium vulnerable, while ducks have a low vulnerability. [74]

[72] Hien T. T. L., Thang N. N., Hens L. (November 2015) (Ibid).
[73] Farmer consultations conducted in Binh Thuan, Ninh Thuan and Khanh Hoa (11-19 September 2017).
[74] ICEM (February 2014), Impact and Adaptation Study. Livestock Report. USAID Mekong ARCC Program.

Table 4: Optimal growing conditions and climate vulnerability of major crops cultivated in the Central Highlands and South-Central Coast (with yellow: low vulnerability; orange: medium; red: high) [75]

Crop	Optimal growing conditions	Climate vulnerability
Perennial crops		
Robusta coffee [76]	Coffee grows in high and mid-elevation zones, with optimal growing temperature ranges between 20°C and 30°C, and annual rainfall requirements between 1,000 and 2,500mm. The trees tolerate a drought of 21-30 days, while with too much rainfall the plant tends to develop wood at the expense of flowers and fruits. One to two months of less than 50mm rain facilitates uniform flowering, while heavy rain during and after harvest is not desirable.	HIGH - The resilience of coffee monoculture production systems to increasing evapotranspiration, drought periods or devastating extreme rainfall events is very low. In addition, suitability of growing conditions is projected to decrease from high to moderate in 2050.
Black pepper [77]	Black pepper grows successfully within the 23-32°C range, and an optimum of 28°C. A total annual rainfall of 2,000 to 3,000mm, with uniform distribution, and a relative humidity of 60-95 percent are ideal. Heavy rains during flowering reduce the rate of pollination and continuous heavy rainfall promotes vegetative development and limits flowering. Pepper grows better in shaded conditions and is vulnerable to excessive heat and dryness.	HIGH - Black pepper is very vulnerable to increased temperature and extreme weather events such as heavy rainfall and droughts. An extreme drought can affect the pepper production with 50 percent yield reduction for three years and 25 percent the following year.
Dragon fruit	This is the main crop in Binh Thuan. Average ages of the trees are 7.5 years, with some as old as 16 years. It grows well up to temperatures of 38°C and within an annual rainfall of less than 2,500mm a year. It requires fertile soil with irrigation, and good drainage during the rainy season since the root system of the plant is susceptible to water logging. Dragon fruit is not very susceptible to pests and diseases, except for a few minor but manageable pests.	MEDIUM - Dragon fruit is fairly robust and drought resilient so not particularly vulnerable. However, an extreme drought can affect yield production with 50 percent for three years and 25 percent the following year.
Mango	Mango is primarily grown in Khanh Hoa. It is a high value crop with the trees lasting for an average of 11.7 years, with some 50 years. Mangoes prefer climates with much sunshine and little rain, and an optimum temperature of 24 to 27°C. The trees need a prominent dry season lasting more than three months, for flowering and fruiting. Mango tolerates a wide range of soils and moisture conditions.	LOW - Mangoes have low vulnerability, except for extreme rainfall events during the flowering and fruiting time (February to May, with peak in March-April). They are drought-tolerant and to a certain extent also flood-tolerant.
Avocado	Avocado cultivation is expanding in the Central Highlands though still small. The trees are heat resilient and thrive well in the Highlands' climate. Optimal growing temperature is between 24°-28°C. During the first year the tree requires special protection against wind. Avocado is susceptible to diseases, especially with low-drained soils, and requires high level of care and management.	LOW – Avocadoes have low climate vulnerability but are very sensitive to pests and diseases and suffer from inadequate on-farm management, particularly during harvesting.

[75] Source of crop information: ICEM (February 2014), Impact and Adaptation Study. Agriculture Report. USAID Mekong ARCC Program; and FAO (2004), Fruits of Vietnam, http://www.fao.org/docrep/008/ad523e/ad523e05.htm

[76] ICEM (February 2014), (Ibid), and Hagger J. and Schepp K. (February 2012). Coffee and Climate Change. Impacts and options for adaptation in Brazil, Guatemala, Tanzania; and Vietnam. GIZ and University of Greenwich Natural Resources Institute, Working Paper Series No.4 on Climate Change, Agriculture and Natural Resources.

[77] Kandiannan K., Krishnamurthy K. S., Anke Gowda S.J., Anandaraj M., (January 2014). Climate change and black pepper production.

Crop	Optimal growing conditions	Climate vulnerability
Durian	Durian requires a hot, humid climate for good growth but can also grow in slightly cooler areas such as the Highlands. Optimal growing temperature is between 22°C and 39°C. A well-distributed annual rainfall of 1,500mm or more is needed, but short dry periods stimulate flowering. It thrives in deep, well-drained and light soil, but also grows normally in heavy soil with good drainage. Due to the weight of large fruits, protection from strong winds is needed. The tree is not affected by pests, except for a few insects.	LOW - Durian can be considered as having low vulnerability, except for rapid onset events such as floods, strong winds and storms.
Banana	Bananas are grown in both regions, but mainly in uplands as a rain-fed crop or as an interim crop while perennials become fully grown. They prefer warm, humid tropical climates. Optimal temperature is about 27°C in the range of 15-38°C. Bananas grow best in full sun, but excessive exposure causes sunburn on fruits. Optimal monthly rainfall is 200-220mm. They require little watering, only for pesticide application. Bananas are susceptible to some diseases, which can be managed with adequate farming techniques.	LOW - Vulnerability of bananas is low, depending on the variety.
Cashew	Cashew trees are grown in both regions. Growth is most rapid at an optimum temperature of 27°C. It needs a dry season of at least four months, and 1,000 to 2,000mm per year over a 6-8 month period is suitable for cultivation. The tree is regarded as very suitable for re-afforestation of poor, exhausted and eroded lands, although the best crops are produced on deep and fertile soils.	LOW - Cashews are considered to possess low vulnerability, especially to the projected increase of temperature, number of hot days and heat waves. As with other crops, heavy rain during flowering or close to harvest can be harmful.
Grape[78]	Grapes are grown in the coastal areas of Ninh Thuan, in irrigated lowlands. They grow well in dry conditions with an average rainfall of 750-900mm, high sunshine hours per month, relative humidity and an optimal temperature of 24°C to 28°C. In sandy soils, more frequent watering is required. Diseases occur in high moisture conditions, but it is manageable with adequate monitoring and drainage.	MEDIUM - Grapes are medium vulnerable, and primarily affected by heavy rainfall (and related flood) events during the flowering and harvest period. They are fairly resilient to dry conditions, but droughts also reduce the yield.
Rubber	For rubber, mostly grown in the Central Highlands and Northern regions of the South-Central Coast, optimal growth conditions are within 27°C and 28°C, with average annual rainfall optimal for a wide range between 1,250 and 4,000mm. Rubber's minimum temperature for optimal growth is 20°C, making the main constraint low temperatures below this optimum.	LOW - A projected increased minimum temperature will increase the suitability of rubber. However, while overall suitability will remain good or high in 2050, it is projected to be lower than present due to drought.
Annual crops		
Maize	Maize is grown across both regions as a short term but low value crop. Optimal rainfall is between 500 and 1,200mm per year, while optimal temperature between 18°C to 32°C. Maize can grow with as little as 300mm but with a 40 to 60 percent lower yield compared to optimum conditions. Yield reductions are further exacerbated under drought conditions.	HIGH - Maize is highly vulnerable with growing suitability reducing. It is very susceptible to small changes in temperature and rainfall, with significant reductions in yield as a result; each day

[78] Papademetriou M. K., Dent F. J. (July 2001). Grape Production in the Asia-Pacific Region; and Tran T. K., Hoang X. T., Le T. T. H. (January 2010). Value Chains Selection & Analysis in Ninh Thuan Province. IFAD Working Paper.

Crop	Optimal growing conditions	Climate vulnerability
		above 30°C reduces the yield, with 35°C being the maximum tolerance.
Cassava	Cassava is well suited to sandy soils and areas with high rainfall variability. It is grown across both regions, but as a low value crop. Optimal growing temperature is between 20°C and 29°C and optimal rainfall is between 1,000 to 1,500mm per year.	LOW - Vulnerability is low, with cassava being a robust crop. It is slightly affected by increased rainfall, but benefiting from an increased temperature, particularly in uplands.
Rice [79]	Both irrigated and rain-fed rice systems are applied in the two regions, with one up to three crop cycles per year, and a more intense cultivation in lowlands than uplands. Upland rice requires around 100 to 650mm per month, and lowland rice 200mm per month and a minimum temperature of 15°C. Rice yields are very susceptible to changes in annual rainfall, minimum and maximum temperature, particularly during the flowering and second half of the vegetative period.	HIGH - Vulnerability is high but depending on the variety. Rice is very vulnerable to extreme droughts, heat waves, and to high temperatures during the dry season. Rain-fed rice is particularly vulnerable to changing precipitation and drought, with potential yield reductions of up to 40 percent.
Other crops	Other crops grown in the South-Central Coast – often in rotation and on small farms - are Vietnamese small apples, spring onions and garlic and a wide range of vegetables, including asparagus, chili and eggplant.	MEDIUM - Garlic is considered to have medium vulnerability to drought. Onion and vegetables are vulnerable to extreme rainfall events, particularly when unseasonal.[80]

Table 5: Crop calendar for most commonly grown crops[81]

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Note
Perennial crops													
Coffee	blossom									harvesting			Perennial tree
Pepper		harvesting		blossom									Perennial tree
Dragon fruit			harvesting, but mixed schedule										Perennial tree
Mango		harvesting											Perennial tree
Avocado					planting	harvest							Perennial tree
Durian						planting and harvesting							Perennial tree
Banana	planting throughout the year										harvest		Perennial tree
Apple	3-4 crops per year, harvesting any time, but mainly August-September												Perennial tree
Grape	3-4 crops per year, harvesting any time, but mainly August-September												Perennial
Apple	3-4 crops per year, harvesting any time, but mainly August-September												Perennial tree
Citrus (pomelo/orange)						planting		planting					3 planting seasons per year

[79] Redfern S. K., Azzu N., Binamira J. S. (2016). Rice in Southeast Asia: Facing Risks and Vulnerabilities to Respond to Climate Change.
[80] Farmer consultations conducted in Binh Thuan, Ninh Thuan and Khanh Hoa (11-19 September 2017).
[81] Farmer consultations August-September 2017 and February-March 2018.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Note
Annual crops													
Maize				Planting and harvesting					planting and harvesting				2 crops per year
Cassava				planting					planting				2 crops per year
Rice	planting			harvesting		planting			harvesting				2 planting seasons per year
Onion	4-5 crops per year, harvesting any time, but mainly January-February												2-3 months per crop
Garlic	harvesting									planting			1 crop per year

1.4.3 Socio-economic groups most vulnerable to climate change impacts

57. Key findings from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) on the link between climate change, livelihoods and poverty state that:[82]

- Climate-related hazards, including subtle shifts and trends to extreme events, affect poor people's lives directly through impacts on livelihoods, such as losses in crop yields, destroyed homes, food insecurity, and loss of sense of place, and indirectly through increased food prices;
- Urban and rural transient poor who face multiple deprivations slide into chronic poverty as a result of extreme events, or a series of events, when unable to rebuild their eroded assets. Poverty traps also arise from food price increase, restricted mobility, and discrimination;
- Many events that affect poor people are weather-related and remain unrecognized by standard climate observations in many low-income countries, owing to short time series and geographically sparse, aggregated, or partial data, inhibiting detection and attribution. Such events include short periods of extreme temperature, minor changes in the distribution of rainfall, and strong wind events;
- Observed evidence suggests that climate change and climate variability worsen existing poverty, exacerbate inequalities, and trigger both new vulnerabilities and some opportunities for individuals and communities;
- Socially and geographically disadvantaged people exposed to persistent inequalities at the intersection of various dimensions of discrimination based on gender, age, race, class, caste, indigeneity, and (dis)ability are particularly negatively affected by climate change and climate-related hazards. Context-specific conditions of marginalization shape multidimensional vulnerability and differential impacts;
- Existing gender inequalities are increased or heightened by climate-related hazards. Gendered impacts result from customary and new roles in society, often entailing higher workloads, occupational hazards indoors and outdoors, psychological and emotional distress, and mortality in climate-related disasters;
- There is little evidence that shows positive impacts of climate change on poor people, except isolated cases of social asset accumulation, agricultural diversification, disaster preparedness, and collective action. The more affluent often take advantage of shocks and crises, given their flexible assets and power status.

58. As stated by the GoV-UNDP 'Viet Nam Special Report on Managing the Risks of Extreme Weather Events and Disasters to Advance Climate Change Adaptation', inequalities influence local coping and adaptive capacity, and pose disaster risk management and climate change adaptation challenges from the local to the national level. Socio-economic inequalities and, for example, health related differences and differences in access to livelihoods or land as well as other factors determine vulnerabilities of households and communities in Viet Nam.[83]

59. A World Bank study looking into the social dimensions of climate change adaptation identifies the main social vulnerabilities for both regions. For the Central Highlands, these include a high number of ethnic minorities, high rates of poverty, many migrants (including the Kinh majority and ethnic minorities migrated in from other regions in the country), and a high number of farmers depending on rain-fed and subsistence agriculture. For the South-Central Coast, social vulnerability is largely determined by high rates of poverty, particularly among pockets of ethnic minority groups, and a dependency on rain-fed agriculture in many areas.[84]

60. The GoV's key laws, strategies and action plans on climate change and disaster risk reduction (see below under section 2) also recognize and prioritize the socio-economic groups most vulnerable to climate

[82] Olsson L., Opondo M., Tschakert P., ea. (2014). Livelihoods and poverty. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[83] IMHEN, UNDP (February 2015) (Ibid).

[84] McElwee P. (December 2010). The Social Dimensions of Adaptation to Climate Change in Vietnam. World Bank Discussion Paper Number 17.

change impacts: pregnant women and women nursing under 12-month children, children, the poor, elderly, people with disabilities, and ethnic minorities, especially in upland areas. GoV statistics confirm the higher than average vulnerabilities of these groups in the target provinces (see table 6).

Table 6: Key socio-economic indicators for the target provinces [85]

Indicator	South-Central Coast			Central Highlands		Viet Nam
	Khanh Hoa	Ninh Thuan	Binh Thuan	Dak Lak	Dak Nong	
Infant mortality (%)	14	16.4	12.5	24	25.7	14.7
Under five mortality (%)	21	24.6	18.8	36.4	39.1	22.1
Under five prevalence underweight (%)	11.8	18.9	15.1	21.5	22.1	14.5
Literacy rate (15 years and above) (%)	94.8	87.5	93.3	92.9	93.7	94.9
Monthly av. income per capita ('000 VND)	2,670	2,331	2,395	1,988	1,824	2,637
Monthly average income per capita ('000 VND) – for the poorest 20%	873	677	937	550	392	660
Monthly average income per capita ('000 VND) – for the richest 20%	6,384	5,768	5,039	4,658	3,792	6,413
Ethnic minority population (%)	5.7	23.1	7.4	19.6	29	15
Rate of poor households (%) - among the entire population [86]	9.87	14.93	5.81	19.37	19.26	9.88
Rate of poor households (%) - among ethnic minorities	68.6	38.8	19.54	37.17	40.75	23.1

61. All five target provinces have indigenous ethnic minority populations such as the Cham, Raglei and Chau Ro in the South-Central Coast and the E De, Gia Lai and Mo Nong (or M'Nong) in the Central Highlands. The indigenous ethnic groups all live under a matriarchal social system. The Central Highlands also have a large share of minority groups such as Tay, Nung, Thai, Muong, H'Mong, K'Ho, Chu Ru ea, who mainly migrated from the North decades ago as part of Government-supported internal labor migration. These latter groups as well as the Kinh are patriarchal.

62. While all five target provinces have different ethnic minority groups, their share of the total population is highest in Dak Nong (29%), Ninh Thuan (23.1%) and Dak Lak (19.6%). There is a clear correlation between poverty and ethnic minority background, with the poverty rate among ethnic groups in these provinces particularly high in Khanh Hoa (68.6%), Dak Nong (40.8%), Ninh Thuan (38.8%), Dak Lak (37.2%) and Binh Thuan (19.5%) compared to the national poverty rate for the entire population. Ethnic minority poverty is particularly high in remote upland areas and in communes with higher rates of ethnic minority population.

63. In the Central Highlands, ethnic minorities and smallholders depending on rain-fed agriculture and with lower levels of food security and nutrition were particularly affected during the recent drought in 2015-2016. After losing their crops and/or animals to climate-related events, they are left with nothing to eat or little to no income to purchase food for their family. This is exacerbated in isolated areas where alternative economic activities are not easily available.[87] Similar patterns occur among ethnic minority groups in the South-Central Coast who cultivate upland rain-fed crops.[88]

64. In rural areas, more women (63% of working women) are engaged in agricultural production than men (57% of working men), however women are mainly employed in informal jobs or subsistence agriculture putting them at greater risk from climate and disaster impacts affecting agriculture. As a large

[85] Data source: GSO. Statistical Yearbook 2015. http://www.gso.gov.vn.
[86] Ministry of Labor, Invalids and Social Affairs, Provincial Departments of Labor, Invalids and Social Affairs, 2016.
[87] CGIAR Research Centers in Southeast Asia (April 2016). The drought crisis in the Central Highlands of Vietnam. Assessment Report.
[88] Farmer consultations conducted in Binh Thuan, Ninh Thuan and Khanh Hoa (11-19 September 2017).

proportion of women farmers (45%) are self-employed, they do not receive social security benefits and lack access to insurance, which leaves them vulnerable and insecure. Women are particularly disproportionally affected in climate-related disasters when resources are scarce, because they spend additional time collecting water, food and fuel which is primarily a women's responsibility. Disaster relief and recovery compensation schemes also do not target day laborers who do not own farm land or paddy rice areas but work as day laborers on other people's farms, which affects women specifically as they are mostly engaged in informal jobs.[89]

65. Unequal access to and control over land and productive assets, training, information, technology, extension services and finance limit women's opportunities and capacity for resilience. Few rural women can access vocational training, extension services, finance, technology, markets and trader networks (29%) compared to men (40%), and training available to women is often short-term and concentrates on 'traditional' women's skills such as less technical production and processing techniques. Heads of households, who are generally male members, are invited to community meetings where disaster and climate information is shared, but information shared in meetings is usually not passed on to women and other family members.[90]

66. In terms of gendered impacts of extreme droughts, various inter-agency assessments conducted during the recent drought confirm that women and girls were more severely affected than men and boys (see gender sub-assessment):[91]

- Women and girls are responsible for domestic work, including ensuring the family has water for drinking and domestic use. This means ensuring the water is clean and living conditions remain sanitary. The drought put multiple constraints on this for a lengthy period;
- However, concerning irrigation management and decision-making on water use for production, men are more responsible and involved than women, resulting in women having less knowledge and experience in water use efficiency practices;
- Lower mobility of women and women's space limited to the village, led in many cases to men receiving relief items, training and awareness raising materials at far-away distribution points;
- Due to the high domestic workload and time spent for household and caring work, women have fewer opportunities to obtain information face-to-face – via other farmers, village leader, local authorities, community groups etc. - for example on early warnings, climate information, Government and non-Government disaster preparedness, response and recovery support, information about new agricultural techniques or water-saving technologies etc.;
- Limited influence of women on household and community decision-making regarding farming or livelihoods as well as financial decision-making;
- Women as the main caregiver in the family also had to deal with the increased risk of diseases and malnutrition induced by the drought, with higher risk among children;
- More men than women migrated temporarily during the drought to look for additional income, with women and children remaining behind to take care of the household, as well as the farming land.

1.5 Targeting: priority locations and people

67. For the main climate change risks for both regions, i.e. changing temperature and precipitation patterns resulting in wetter wet seasons and drier dry seasons and an increased risk of extreme droughts and – particularly in the Central Highlands - rainfall-induced floods, upland and lowland areas with rain-fed cultivation are more vulnerable than irrigated areas. However, irrigated areas will also be impacted, but mainly by extreme weather events such as droughts and floods. All areas will be severely affected under the hottest climate scenario.

[89] United Nations Viet Nam and Climate Change Working Group (August 2017). Policy Brief: Gender Equality in Climate Change Adaptation and Disaster Resilience in Viet Nam.

[90] United Nations Viet Nam and Climate Change Working Group (August 2017) (Ibid).

[91] GoV-NGO-United Nations joint damage and needs assessments for the drought emergency (April 2016); and UNDP (July 2016), Viet Nam drought and saline water intrusion: transitioning from emergency to recovery. UNDP policy analysis. Verified by field consultations.

68. Mono-cropped farming systems are particularly vulnerable to changing temperature and precipitation patterns, especially rice, coffee, pepper and maize. Upland rain-fed crops are vulnerable to seasonal changes, including an imbalanced rainfall distribution and unseasonal rainfall. Fruit trees, cashew, cassava and a number of vegetables have low to medium vulnerability. However, all crops will be to a certain degree affected by increased weather unpredictability and extreme weather events such as droughts and rainfall-induced floods, particularly during flowering, fruiting and harvesting times.

69. The most vulnerable population group is small-scale farmers growing one or two rain-fed crops in upland farms. Small-scale farmers cultivating one or two crops in lowlands, but with limited access to irrigation and dependent on water from streams or wells are a second group particularly vulnerable. For both of these groups, there is a strong positive correlation between vulnerability and poverty, ethnic minority and gender inequality, so prioritization of these sub-groups is required.

2. POLICY AND INSTITUTIONAL FRAMEWORK

2.1 National framework and priorities on socio-economic development[92]

70. In Viet Nam, in addition to the constitution, policies and programs on socio-economic development are steered by the ten-year Socio-Economic Development Strategy (SEDS) and the five-year Socio-Economic Development Plans (SEDPs). The major objective of the current SEDS 2011-2020 is to establish the foundation for Viet Nam to become a modern, industrialized country by 2020. It defines three 'breakthrough areas': (i) improving market institutions towards a socialist oriented market economy, (ii) promoting skills development, particularly for modern industry and innovation, and (iii) further infrastructure development.[93] The SEDS acknowledges that rapid development entails sustainable development, so at the same time ensuring economic development, environmental sustainability and social equity. Through the SEDS' third specific objective, the aim is to mitigate negative environmental impacts of economic development, strive for sustainable management of natural resources, reduce disaster impacts and actively respond to climate change.

71. Linked to the SEDS, the National Action Plan on the Implementation of the 2030 Agenda for Sustainable Development was approved in May 2017 to advance the Sustainable Development Goals (SDGs) in Viet Nam. The action plan's main objective is "Sustaining economic growth in parallel with ensuring social progress and justice and environmental and ecological protection, effective management and utilization of natural resources, proactive response to climate change; ensuring that all citizens promote their full potential, equally participate in development and benefit from the results of development; and building a Vietnamese society that is peaceful, prosperous, inclusive, democratic, just, civilized and sustainable." The plan includes 17 SDGs with 115 specific objectives customized to the Viet Nam context. Of particular relevance for climate change and its impact on water security and agricultural production are: (i) Goal 2 on eliminating hunger, ensuring food security, improving nutrition and promoting sustainable agricultural development; (ii) Goal 11 on promoting sustainable, resilient urban and rural development, and (iii) Goal 13 on responding in a timely and effective manner to climate change and natural disasters.

2.1.1 Policies and programs on agriculture

72. The key strategy on agriculture is the Agriculture Restructuring Plan (ARP), developed by MARD in 2013 for the period 2013-2020, and updated in 2016. The ARP aims for the agricultural sector to shift from central planning to become market-led and consumer-driven, with the government's role changing from being the primary investor and service provider to being the facilitator of investments and services provided by others. The ARP calls for equal partnerships among government agencies, the private sector, farmer or community organizations, and the scientific community—the so-called '4 houses' – in progressing the transformation. Ensuring food security, mainly in terms of guaranteeing adequate rice production, remains a key objective.

73. MARD's most recent Agricultural Master Plan's priorities are in line with the ARP and focus on:

- Sustaining the growth of the agriculture sector; raising the efficiency and competitiveness by increasing productivity, quality, and added values; satisfying the demands of consumers in Viet Nam and boosting exports.
- Moving from resource-intensive to technology-intensive agricultural growth, from fragmented to consolidated land holdings, and diversify from agriculture to rural non-farm employment.
- Improving income and living standards of rural residents, ensuring food and nutrition security in both the short and long-term basis, and contributing to the reduction of poverty.
- Enhancing natural resource management, reducing negative impacts on the environment and climate change, utilizing environmental benefits, raising capacity for risk management, enhancing disaster preparedness, increasing forest coverage to 45 percent by 2020, and contributing to the National Green Growth Strategy.

[92] For a repository of legislation, strategies and plans, see: http://chinhphu.vn/portal/page/portal/English/strategies
[93] http://www.economica.vn/Portals/0/Documents/1d3f7ee0400e42152bdcaa439bf62686.pdf

74. Agricultural policy objectives are pursued through the use of output and input subsidies, and payments for the provision of services to agriculture generally. The main domestic policy instruments, in order of most used, include price support measures (mainly subsidies to control the rice market), irrigation service fee exemption, seed and livestock breeding subsidies, credit schemes, payment based on area (for rice farmers), (pilot) insurance, income support (exemption or reduction of agricultural land taxes) and extension services (top down, supply driven). General services provided to the agricultural sector as a whole include irrigation (largest GoV expenditure in agriculture), and research and development (under the Viet Nam Academy of Agricultural Sciences). Key trade policy instruments are tariffs, import licensing, food safety regulations, export taxes and export licensing.[94]

75. Linked to the ARP, MARD also implements the Scheme of Restructuring of the Irrigation Sector (2014) with the aim to upgrade infrastructure, strengthen management, modernize and improve safety of irrigation systems while protecting against natural disasters. In 2015, MARD also promulgated the Action Plan for the Development of Advanced and Water Saving Irrigation for Upland Crops to Assist Water Resources Sector Restructuring. In addition, the Irrigation Law is currently being updated. Among other provisions, this law requires the adoption of economic efficiency criteria in the allocation of water amongst competing uses including irrigation. In this regard, the draft proposes the introduction of irrigation service pricing mechanisms. The draft law also prescribes stricter requirements on investment in irrigation works. Specifically, irrigation work investors would have to comply with the laws on investment, construction, water resource as well as approved master plans of localities, take measures to reduce water loss and reduce land areas for building irrigation works.

76. Other agricultural sector laws, policies and strategies linked to the ARP include the Livestock Development Strategy (2008), Strategy on Science and Technology in Agriculture and Rural Development (2012), Law on Cooperatives (2012), revised Land Law (2013), Master Plan for Aquaculture Development (2013), Agricultural Cooperatives Innovation and Development Plan (2014)[95], Action Plan on Crop Restructuring (2014, with update in 2016), and the Rice Market Development Strategy (2017). In 2008, the Action Plan Framework for Adaptation and Mitigation of Climate Change of the Agriculture and Rural Development Sector for 2008-2020 was issued (see below under section 3.3.7).

2.1.2 Key cross-cutting socio-economic development target programs

77. Building on the SEDS and with the aim to improve integration of policies, the GoV has recently developed two major target programs or 'umbrella' programs, combining previous sectoral policies and programs into two integrated programs on new rural development and poverty reduction. Each ministry is responsible for the implementation of the specific sub-programs under these.96 While the national government has a function in program design and monitoring and evaluation (M&E), all investment decisions and expenditure allocations are made directly at the provincial level, with some devolution to the districts and communes.

78. The National Targeted Program on New Rural Development (NTP NRD) 2016-2020, coordinated under the Ministry of Agriculture and Rural Development (MARD), aims to modernize rural areas of Viet Nam and improve living conditions through promoting a model-system of a 'new rural commune'. A commune attains this status when it delivers on 19 economic and social criteria in terms of socio-economic

[94] OECD (2015). Food and Agricultural Policies in Viet Nam.

[95] Since 2016 a 'new cooperative model' in line with the 2012 Law on Cooperatives is being gradually implemented and replicated through the Government project '*Pilot finalization and replication of new cooperative model in Mekong River Delta in the period from 2016 to 2020*'. The project includes an overall consolidation and restructuring of all cooperatives, significant capacity building for responsible subnational staff, training to farmers on how to improve the business and management of the cooperatives, and support to improve access to markets and cooperative's facilities.

[96] Over the period 2011-2015, there were more than sixteen National Targeted Programs, often with significant overlap, limited integration and weak coordination. To improve this, the NTPs were consolidated into two major NTPs for 2016-2020. However, overlap and inefficiencies still continue with the two NTPs "*still supporting the same planning process, overlapping in geographical areas, supporting of same types of activities, using the same institutional implementation arrangements, and overlapping of their target groups*". See: World Bank (June 2017). Program Appraisal Document on a proposed IDA Credit to Vietnam for the National Target Programs for New Rural Development and Sustainable Poverty Reduction, p.8.

infrastructure, modernized agricultural production systems with links to industrial and services development, income generation and poverty reduction, clean water supply and sanitation, social protection, governance, cultural development, health improvements etc. The objective is for 50 percent of all communes in the country to reach the 'new rural commune' status by 2020. Each set of criteria comes with specific policies and programs to achieve the overall program, the majority a continuation of previous sectoral targeted programs.

79. The National Targeted Program on Sustainable Poverty Reduction (NTP SPR) 2016-2020, coordinated by the Ministry of Labor, Invalids and Social Affairs (MOLISA), supports infrastructure, livelihoods, basic services and capacity building for the country's poorest districts and communes through five sub-programs. The aim is to reduce the number of poor households by 1.5 percent per year, with more ambitious targets of 3 to 4 percent for disadvantaged and ethnic minority areas. In addition, per capita incomes of poor households will be increased by 150 percent overall and by 200 percent in more disadvantaged areas. The five sub-programs under the NTP SPR are as follows:

- Project 1, also called Program 30a, focused on 64 poor and 23 near-poor districts and coastal areas, with specific sub-components in district infrastructure, coastal infrastructure, production development and labor export.
- Project 2, also called Program 135 and being the largest program, is led by the Committee for Ethnic Minority Affairs (CEMA) and focused on 2,240 poorest ethnic minority communes and 33,273 villages, with specific sub-components on infrastructure, support for production and livelihood diversification, and capacity building.
- Project 3, on 'Production Development focused on Model Replication', is led by MARD.
- Project 4, also called 'Information and Communication for Sustainable Poverty Reduction', is led by the Ministry of Information and Communication.
- Project 5, on Capacity Building and M&E, is led by MOLISA.

2.1.3 Policies and programs on economic development

80. The key strategy on overall economic development is the Master Plan on Economic Restructuring 2013-2020. The overall target of the Master Plan is to guide the transformation of the country's economy towards a modern socialist-oriented market economy with qualitative and sustainable growth, and improved efficiency and competitiveness. Specifically, it aims to improve labor productivity, reorganize state-owned enterprises, develop hi-tech and high value industries – including in the agricultural sector - and accelerate integration into the global economy, through monetary, fiscal and market reforms.

81. The most recent review of the plan recognizes on-going challenges such as an economic growth still largely based on inputs and low quality and labor productivity, a stable but uncertain macroeconomic environment, slow and inefficient restructuring of the state sector, slow transformation of key sectors and limited collaboration among institutions. On transforming the agricultural sector, it acknowledges that rural development is slow, lacks integration and is insufficiently adapted to climate change. [97]

82. The updated plan includes five targets for the period 2016-2020: (i) developing the domestic private sector and attracting foreign direct investment, (ii) restructuring the state sector: state-owned enterprises, public investment, state budget and the public service sector, (iii) restructuring the finance market, particularly credit institutions and the securities market, (iv) modernizing the economy towards improving productivity, quality, efficiency, while promoting international economic integration, and (v) restructuring major markets, including on land use rights, labor and science and technology.

2.1.4 Policies and programs on water resources

83. In 2006, the National Water Resources Strategy (NWRS) was developed by the Ministry of Natural Resources and Environment (MoNRE). The NWRS' main objective is to strengthen the protection, exploitation, use and development of water resources, as well as the prevention and mitigation of adverse impacts caused by water. The main issues that need to be addressed are identified as: (i) awareness of

[97] National Assembly (October 2016). Summary report on economic restructuring plan for period 2016 – 2020. Report No. 460/BC-CP. http://www.mpi.gov.vn/en/Pages/tinbai.aspx?idTin=35701&idcm=273

the importance of water resources in sustainable development; (ii) balance between protection and development of water resources and ensuring adequate supply of water and water security for socio-economic development; (iii) mitigation of adverse impacts caused by water, including floods and droughts; (iv) protection of aquatic ecosystems; and (v) water resources management.

84. Priorities under the NWRS are: river basin planning and management, water storage and transfer, surface- and groundwater protection and sustainable exploitation, pollution control, reservoir upgrading with priority to multipurpose use infrastructure, modernization of weather and hazard monitoring, warning and forecasting system, hazard risk mapping, scientific research and technology development, and consolidation of the legislative and institutional framework.

85. In 2012, the revised Law on Water Resources was promulgated. It has specific provisions on master planning and policy development, water exploitation, protection and conservation, disaster prevention and control, awareness raising, community consultations in water investments and management, water information systems, prohibited actions, budgeting and international cooperation.[98]

86. Viet Nam also has a comprehensive National Strategy and Target Program for Rural Water Supply and Sanitation, developed in 2000 and updated in 2011. The latest target program under this strategy is linked to the NTP NRD and NTP SPR objectives and prioritizes investments in poor, remote, ethnic, border and island areas as well as areas where water is polluted or scarce.

2.1.5 Policies and programs on environmental protection

87. The National Strategy on Environment Protection (NSEP) to 2020, with vision to 2030 was developed by MoNRE in 2012. The primary objectives of the NSEP are to control and minimize the increase of environmental pollution, resources and biodiversity degradation, further improve the quality of the habitat; and to increase the capacity to respond to climate change, striving for sustainable development. The NSEP recognizes the importance of environmental protection as an integral part of the country's socio-economic development towards a green economy, joint and inter-generational responsibilities and opportunities, and the polluter-pays principle.

88. In terms of agriculture, it encourages sustainable land use and cultivation, minimizing the use of chemicals and fertilizers, and preventing deforestation, forest degradation, land erosion and deterioration. On water management, it proposes solutions for the inefficient use of water and to overcome seasonal water scarcity: integrated river basin planning, better management of surface and groundwater resources, particularly in dry season, control of water pollution, adjustments of crop systems to less water-intensive ones, modernization of irrigation systems, and payment for forest ecosystem services schemes. Other sectors included in the NSEP are forestry, protected areas, coastal ecosystems, fisheries and biodiversity.

89. Other relevant laws and policies linked to environmental protection are the Biodiversity Law (2009), the National Strategy and Action Plan on Biodiversity by 2020 (2013) and the Law on Environmental Protection (2014). Section IV of the Law on Environmental Protection specifically addresses climate change with provisions on: mandatory climate risk informed socio-economic development and sectoral planning; greenhouse gas emissions management, including REDD+; management of ozone-depleting substances; renewable energy; eco-friendly production and consumption; waste-to-energy processes; rights and responsibilities of people on climate change information and action; development of technology and science; and international cooperation.

2.1.6 Policies and programs on gender equality

90. The Law on Gender Equality was issued in 2007. One of the key provisions regarding livelihoods is equality between men and women in setting up, carrying out and managing a business and production activities, and equality in accessing information, capital, markets and labor sources. Rural women are

[98] http://extwprlegs1.fao.org/docs/pdf/vie117928.pdf

entitled to training and credit support, encouraging them to expand agriculture, forestry and fishery activities in accordance with the law.

91. The National Strategy on Gender Equality 2011-2020 was approved in 2011, with the main aim to achieve substantive equality between men and women in terms of opportunities, participation and benefits in political, economic, cultural and social domains. Specifically, it aims to increase women's political participation and leadership; improve the State's capacity on addressing gender inequality; narrow gaps in the labor market; increase access to labor markets and economic resources for rural poor and ethnic minority women; ensure equal access to education, training and health care; reduce gender stereotyping in cultural and information products; and eliminate gender-based violence. It calls for women's full and equal access to productive resources such as land for cultivation, credit, insurance, markets and other information. It also identifies the need for services such as agricultural extension, vocational training, health and education to be tailored for women from diverse socio-economic backgrounds.

92. Gender equality has also been mainstreamed in other key pieces of legislation such as the Labor Code, the Civil Law, Penal Code, Law on Marriage and Family, Law on Government Officials and Civil Servants, Land Law, Social Insurance Law, Education Law, Vocational Training Law, Law on Public Healthcare, and Prime Minister decrees and decisions, and ministerial circulars.

2.2 National policy framework and priorities on climate change

93. The Vietnamese Government has shown an early and on-going commitment to tackling climate change, through both engagement with international processes and an extensive domestic policy framework on climate change, disasters and green growth. In addition to these overarching strategies and plans, various sectoral climate change action plans have also been developed, notably on agriculture and forestry, environmental protection, energy, water, transport, education and health.

2.1.1 National Strategy on Natural Disaster Prevention, Response and Mitigation

94. In 2007, the Prime Minister issued the main disaster risk management strategy, developed by MARD as the coordinating ministry for disaster prevention and control. The strategy to 2020 aims to mobilize all resources to effectively implement disaster prevention, response and mitigation in order to minimize the losses of human life and properties, the damage of natural resources and cultural heritages, and the degradation of environment, contributing significantly to ensure the country sustainable development, national defense and security. It contains key priorities such as:

- Develop hazard risk maps as a decision-support tool to inform planning on flood protection and control systems, agriculture, forestry and land use, infrastructure, river basins, coastal zones etc.
- Modernize early warning and forecasting capacities and systems for all regions in Viet Nam.
- Strengthen river and sea dyke and reservoir system, for flood, drought and salinity intrusion control. Integrate solutions to increase run-off and underground water in dry season.
- Transform crop and livestock systems to withstand disaster impacts and make full use of the local natural resources for socio-economic development.
- Community awareness raising and capacity building.

95. In line with the disaster risk management strategy, a Community Based Disaster Risk Management (CBDRM) Program or 'Program 1002' was issued in 2009, with the goal of building disaster risk management capacity of communities and authorities in 6,000 communes in the country. In addition, in 2013, a new Law on Disaster Prevention and Control was promulgated. The law outlines natural disaster prevention and control activities, including a national strategy and plans, and stipulations aimed at the integration of disaster prevention into national and local SEDPs. It also assigns roles and responsibilities among ministries and other key actors in preventing and responding to disasters. It designates MARD as the provider of programmes of awareness raising and CBDRM and puts a special emphasis on vulnerable groups.

2.1.2 National Target Program to Respond to Climate Change

96. The first comprehensive program on climate change in Viet Nam, the National Target Program to Respond to Climate Change or NTP-RCC, was issued in 2008. It stressed the need for mainstreaming

climate change responses into social and economic development, while pursuing broader sustainable development and taking into account gender equality and poverty reduction. The first phase of the NTP RCC (2009–2010) focused on scientific analysis and initial planning and resulted in the first version of the Vietnam Climate Change and Sea Level Rise Scenarios. The second phase (2011–2015) focused on further analysis, detailed planning, capacity building and development of sector and provincial action plans. Once the National Climate Change Strategy was approved in 2012, the NTP RCC concluded and morphed into the National Action Plan to Respond to Climate Change 2011-2020.

2.1.3 National Climate Change Strategy and Action Plan

97. As the current most important strategy, the National Climate Change Strategy (NCCS) for 2011-2020 recognizes Viet Nam as one of the worst affected countries by climate change bringing significant risks to food security and agricultural development, human health, natural resources and ecosystems, and overall sustainable development. The strategy links the response to climate change to greenhouse gas emission reduction and a shift towards a low-carbon economy but prioritizes adaptation in the early stage due to Viet Nam's current socio-economic conditions and development.

98. The NNCS and National Action Plan on Climate Change 2011-2020 outline a large number of priority actions, including among other:

- Upgrading of the hydro-meteorological forecasting and early warning system;
- Restructuring of the agricultural systems towards more climate resilient crops and husbandry, guaranteeing food and income security;
- Modernize farming practices applying more water- and energy-efficient techniques and integrated farming systems;
- Sustainable exploitation and management of water resources, with repair and improvement of dam, reservoir and irrigation systems, fit for multipurpose use (water supply, disaster mitigation, energy provision);
- Investment in afforestation and reforestation, to increase forest coverage.

2.1.4 Communist Party Resolution on climate change and environmental management

99. The 2013 Party Resolution 24-NQ/TW '*Active Response to climate change, improvement of natural resources management and environment protection'* elevates the response to climate change to a key national priority issue, with responsibilities shared by the Government, organizations, private sector and citizens, and with the state under the leadership of the Party playing a key role. It acknowledges the so far passive and uncoordinated national progress on dealing with climate change and managing resources effectively and sustainably, in a context of increased risk and rapidly degrading ecosystems, both severely impacting on people's health and livelihoods as well as the nation's socio-economic development. The Resolution therefore calls for increased efforts on adaptation and disaster risk reduction, a more rapid transition towards a green growth model, improved climate risk informed socio-economic development planning, and integrated and sustainable management of natural resources and ecosystems.

2.1.5 Vietnam Green Growth Strategy and Action Plan

100. The Vietnam Green Growth Strategy (VGGS), approved in 2012 and coordinated by the Ministry of Planning and Investment (MPI), aims to accelerate the process of economic restructuring in order to use natural resources efficiently, reduce greenhouse gas emissions through research and application of modern technologies, develop infrastructure to improve the entire efficiency of the economy, cope with climate change, contribute to poverty reduction, and drive economic growth in a sustainable manner. It is structured around three strategic tasks: (i) reducing greenhouse gas emissions and promoting the use of clean and renewable energy, (ii) promote green production through clean industrialization, development of green industry, agriculture, technologies and equipment, investment in natural capital; and prevention and treatment of pollution, and (iii) stimulate green lifestyles and promoting sustainable consumption.

101. In 2012, the Prime Minister approved a plan for greenhouse gas emission management and carbon market development in Viet Nam. The Green Growth Action Plan was issued in 2014 and provides more detail for the three VGGS' strategic tasks. While there is no specific program or action plan on Nationally Appropriate Mitigation Actions (NAMA) in Viet Nam yet, there are various projects or subprograms

implemented in a number of key sectors, notably agriculture, the cement sector, the building sector, waste management and renewable energy.

2.1.6 National Action Program on Reduced Deforestation and Forest Degradation

102. The National Action Program on Reduction of Greenhouse Gas Emissions through Efforts to Reduce Deforestation and Forest Degradation, Sustainable Management of Forest Resources, and Conservation and Enhancement of Forest Carbon Stocks (REDD+) for 2011-2020 or REDD+ Action Program was approved in 2012 and is coordinated by MARD. Phase I (2011-2015) focused on the establishment of policies and systems for REDD+ roll-out, awareness raising and capacity building, as well as piloting of specific REDD+ mechanisms such as on benefit-sharing, payment for forest ecosystem services etc. Phase II (2016-2020) focuses on the actual implementation at scale of various REDD+ projects and activities.

2.1.7 Action Plan in Response to Climate Change in Agriculture and Rural Development

103. In 2016, MARD issued an updated action plan on addressing climate change in the agricultural sector for the period 2016-2020 and with a vision to 2050. The plan has three major sections on: strengthening the policy and institutional framework and capacities; adaptation and mitigation actions within the agricultural sector; and prevention and mitigation of disasters within the agricultural sector. Section two and three of the action plan include priority actions such as:

- Promotion of integrated farming models: crop-livestock, crop-fish, agro-forestry, integrated food-energy systems, closed loop agriculture etc. with adaptation and mitigation co-benefits
- Development and use of climate-resilient high yield crop varieties and breeds
- Diversification of crops and farming techniques, combining intensive farming with protection of natural resources and management of climate risks
- Forest protection and afforestation
- Invest in multi-purpose irrigation systems
- Promote water and energy-efficient irrigation techniques such as drip irrigation, sprinkler, improved drainage management, particularly for high value crops
- Construction or upgrading of reservoirs, dyke and dam systems
- Automated multi-hazard early warning systems
- Continuation of the community-based disaster risk management program

2.1.8 Action Plan for Implementation of the Paris Agreement

104. To advance Viet Nam's commitments towards the 2015 Paris Climate Agreement and the country's Intended Nationally Determined Contribution (INDC)[99], the GoV has approved a specific implementation plan in October 2016. The plan includes priority activities for the period until 2020 ('readiness' phase) and 2021-2030 ('implementation' phase) on five components: mitigation; adaptation; human, technological and financial resources for implementation; measurement, reporting and verification systems; and the institutional and policy framework. For the period 2016-2020, priority activities are, among others:

- Mitigation: policy development on renewable energy, piloting of a national carbon market system, operationalizing greenhouse gas inventories, and updating emission reduction targets for the nationally determined contribution
- Adaptation: develop a national adaptation plan (lead by MoNRE), prioritize investments in hazard forecasting, dam and dyke construction for drought and salinity control, mangrove reforestation and watershed protection, and continue implementation of the NCCS and relevant sectoral action plans on disaster risk management, agricultural restructuring, forestry etc.

105. The Paris Agreement Implementation Action Plan acknowledges the following implementation challenges on adaptation: high investments needs on disaster prevention and adaptation while national resources are limited; inefficient institutions with weak capacity at the lowest level where most of the work needs to be done; limitations in the country's forecasting and warning systems in terms of timeliness and reliability; a focus on disaster response rather than prevention; too much investment in structural measures with limited attention to non-structural measures; and an underdeveloped risk insurance market.

[99] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Viet%20Nam%20First/VIETNAM%27S%20INDC.pdf

2.2 Institutional arrangements

2.2.1 At national level

106. In 2012, the GoV established the inter-ministerial National Committee on Climate Change (NCCC) to lead, coordinate, harmonize, and monitor climate change response and green growth, and ensure coordination of ministries in the implementation of the NCCS and VGGS. It is chaired by the Prime Minister, with MoNRE being the Standing Office. The NCCC replaces the previous national steering committee set-up to oversee the implementation of the NTP-RCC. The VGGS is further monitored through an inter-ministerial Management Board, under the NCCC, chaired by the Deputy Prime Minister, with MPI as the Standing Office. Sectoral, inter- and intra-ministerial coordination for specific climate resilience programs is also facilitated through coordinating committees within the main ministries: the MARD Steering Committee for Climate Change Adaptation and Mitigation, the MARD REDD+ Steering Committee, the MoNRE Department of Meteorology, Hydrology and Climate Change (DMHCC), and a MonRE led inter-ministerial Working Group on NAMA.

107. Water resources management is coordinated through a Prime Minister-level National Water Resources Council, and at provincial and district level by the People's Committee. Specific functions of water resources use and management are allocated to ministries as follows: MoNRE is responsible for overall water resources management, planning and research (with a key role for the National Center for Water Resources Planning and Investigation); MARD is responsible for the management of flood and typhoon protection systems, hydraulic structures, irrigation management, wetland management, and rural water supply and sanitation; the Ministry of Industry and Trade is responsible for the construction, operation and management of hydropower facilities; the Ministry of Construction is responsible for the spatial planning and construction of urban water supply, sanitation and drainage facilities; and the Ministry of Transport for the planning, construction and management of waterway transport systems.

108. Planning and implementation of policies and programs on climate resilient agriculture is the exclusive responsibility of MARD and is done through the MARD inter-departmental Steering Committee for Climate Change Adaptation and Mitigation. The MARD Science, Technology and Environment Department is the Standing Office of the Committee and coordinates all departments within MARD. The development of plans and allocation of resources is lead by the MARD Department of Planning and Finance, with major technical input from all other departments such as the departments of crop production, plant protection, livestock and husbandry, animal health, forestry and cooperatives and rural development.[100] Collaboration with international development partners is facilitated by the MARD International Cooperation Department.

109. The production of weather and climate information is the sole responsibility of MoNRE. Within MoNRE, the National Centre for Hydro-Meteorological Forecasting (NCHMF) – under the National Hydro-Meteorological Service - is in charge of managing the observation stations, developing short, medium and long-range weather and weather event forecasts and communicating natural hazard early warnings. The NCHMF has a number of regional centers and core staff at the provincial level. The latter mainly manage observation stations and transfer data horizontally and vertically through the system. Climate change modeling, the development of medium (3 months) and long-term climate forecasts and research on climate change is done by MoNRE's IMHEN. IMHEN also has a dedicated Research Center for Agrometeorology, the only public agency in Vietnam is specialized in research on agricultural meteorology. They conduct agro-climate zoning, crop impact and yield modeling and pests and disease impact modeling. [101]

110. The development of agro-climate advisories, meaning the combination of weather and climate forecasts with agricultural information on what to plant, when and how for use by farmers and agricultural planners, is the responsibility of DARD. Based on information circulated from the national level by the NCHMF and MARD, advisories are to be developed at provincial level and further localized at each subsequent administrative level.

[100] For the organizational structure of MARD, see: https://www.mard.gov.vn/en/PublishingImages/Icard-E.jpg.

[101] For more details, see the sub-assessment report on climate information.

111. MOLISA is the ministry in charge of gender equality, with its Department for Gender Equality being the key department. At Prime Ministerial level, there is also the inter-ministerial Committee for Advancement of Women to promote gender equality and women's empowerment in all sectoral laws, policies and programs. Both structures are mirrored at subnational levels. In addition, the Viet Nam Women's Union (VWU) is the Communist Party's socio-political or 'mass organization' responsible to protect the rights and benefits of women across the nation. One of the main functions of the VWU related to gender equality is to build capacity on gender equality, carry out propaganda or awareness raising activities on Government policies and programs, and report back on their implementation.

2.2.2 At subnational level

112. Coordination structures on climate change at subnational level are mirroring those at the national level. In each province, Provincial Coordination Committees have been established to coordinate the development of provincial level action plans on climate change, and most provinces have also established an office for climate change that is officially linked to the PPC, but usually based in DONRE. A number of provinces, for example Khanh Hoa, have also established sub-committees under their provincial climate change committee.

113. Water resources management at the provincial and district level is coordinated through a Water Resources Council chaired by the PPC, with departmental roles the same as described above. PPCs are responsible for overall irrigation management and directly in charge of the irrigation management companies (IMC) and water user associations. The role of the IMCs is to operate and maintain storage and pumping facilities together with the higher order canal systems (main and secondary channels).

114. At district and commune level, there are no specific inter-departmental committees, but both DARD and DoNRE are leading the coordination and policy development efforts on issues such as climate resilient agriculture, water resources management and climate change adaptation, under the overall guidance of the PPC at each respective level.

2.2.3 With and among development partners

115. In 2009, a financing and coordination mechanism between the GoV and major development partners[102] was set up called the Support Program to Respond to Climate Change (SP RCC). The main coordinator on behalf of the GoV is MoNRE. The SP RCC's aim is to mobilize funding for the implementation of climate change policies and programs (through soft loans), enhance policy development and serve as a platform for aid harmonization, policy dialogue and project formulation in fifteen identified sectors relevant for climate change. The work is based on an agreed policy matrix which identifies policy priorities for support. The SP RCC's institutional structure was initially linked to that of the NTP RCC but is currently operating through its own Program Coordination Unit based in the MoNRE DMHCC.

116. United Nations (UN) agencies deliver support to Viet Nam through the five-year GoV-UN One Strategic Plan 2017-2021.[103] The Plan is aligned with the SEDS 2011-2020, the SEDP 2016-2020, the SDGs and Viet Nam's international human rights commitments. Focus Area 2 specifically addresses climate resilience and environmental sustainability. In addition to the UN-GoV Joint Steering Committee, co-chaired by the Vice-Minister of MPI and the UN Resident Coordinator, specific internal 'Results Groups' are set-up to facilitate joint planning, coordination, monitoring and reporting of the results. The two groups relevant for climate change are a Results Group Disaster Risk Reduction and Resilience, chaired by UNICEF and co-chaired by UNDP, and a Results Group Climate Change and Environment, co-chaired by FAO and UNDP.

117. International and national non-governmental organizations (NGOs) coordinate their programming and advocacy work on climate change through the Climate Change Working Group (CCWG). The CCWG has a systematic collaboration with various ministries, through a Memorandum of Understanding with

[102] The main funders are JICA, AfD, World Bank, CIDA, Australian Aid and the Korea EXIM Bank, but other development partners such as the United Nations, GIZ and international NGOs also join the policy dialogue meetings as observers.
[103] http://www.un.org.vn/en/publications/doc_details/542-one-strategic-plan-2017-2021.html

MoNRE and a separate one with MARD. These agreements specify the topics and joint CCWG-GoV activities per year. Core group members of the CCWG are: CARE International, Oxfam, World Vision, Save the Children, Plan International, Red Cross organizations, WWF, SNV, Malteser International and Vietnamese organizations such as SRD, MCD, GreenID. Vietnamese NGOs also have a separate coordination group called 'Vietnamese NGOs and Climate Change Network'. Other development-oriented NGO working groups are the Sustainable Agriculture and Natural Resources Management Working Group, the Water Supply, Sanitation and Hygiene Working Group, and the Ethnic Minority Working Group.[104]

[104] For more details, including on membership: http://www.ngocentre.org.vn/workinggroups

3. PAST AND ONGOING EFFORTS TO IMPROVE THE LIVES AND LIVELIHOODS OF SMALL-SCALE FARMERS IN THE CENTRAL HIGHLANDS AND SOUTH-CENTRAL COAST

118. The first part of this chapter provides an overview of the most relevant past and ongoing socio-economic development programs and projects for the five target provinces, in line with the country's policy framework (see chapter 2). The second part focuses on the programs and projects that aim to strengthen climate resilience of small-scale farmers by addressing the main climate change risks and impacts for both regions (see chapter 1). These initiatives aim to improve water availability due to increasing climate variability and change, strengthen agricultural productivity and resilience, reduce disaster risk, provide climate information services including early warning, or implement REDD+ actions. The chapter looks at GoV, bilateral, multilateral, NGO and research initiatives, with a table overview provided at the end. This chapter provides crucial information to help identify gaps in coverage and support, as well as learning and evidence on successful approaches to tackle specific problems and barriers (see chapter 4 and 5). It will ensure a well-informed design and replication of good practice.

3.1 Socio-economic development programs and projects

3.1.1 Poverty reduction

119. Since 1998, provincial PPCs, with technical support from MPI, CEMA and development partners, are implementing the ethnic minority poverty reduction program '*Socio-Economic Development of the Most Vulnerable Communes in Ethnic Minority and Mountainous Areas in Vietnam'*, also called Program 135. Initially approved for a period of seven years, the program was extended for a second phase from 2005 to 2010, and a third phase from 2011 to 2015. The initial objective and main objective until today is to implement government policies targeting the most vulnerable communes, promoting production and access to basic infrastructure, improving education, training local officials and raising people's awareness for better living standards and quality of life. Initially focused on infrastructure, it shifted to a focus on livelihood improvement and rural development.

120. Linked to Program 135, from 2006 to 2008, provincial PPCs also implemented the regional '*Program 134'* which provided housing, land for resettlement and/or agricultural production, clean water, water supply for irrigation and legal aid to poor ethnic minorities in the Central Highlands. Since 2002, through '*Program 139'* ethnic minorities across Viet Nam are also provided free health insurance, and through '*Program 168'* exemption of school fees, support with textbooks and school supplies.

121. Since 2014 and until 2019, MPI is implementing the '*Central Highlands Poverty Reduction Project'*, in all five Central Highlands provinces, through a US$ 150million loan from the World Bank. The overall objective is to enhance living standards by improving livelihood opportunities in upland areas. The project has the following components: village and commune infrastructure development; sustainable livelihoods development through linking farmer groups and agricultural enterprises for investment in commercial agriculture or agroforestry; connective infrastructure development, capacity building and communication.

122. Since 2016 and until 2023, MPI, the Ministry of Transport and the provincial PPCs are implementing the '*Support to Border Areas Development Project'* in Kon Tum, Gia Lai, Dak Lak, Dak Nong and Binh Phuoc, through a US$ 106.5million loan from the Asian Development Bank (ADB). The project supports the socio-economic development of the border area between Viet Nam, Cambodia and Lao PDR through institutional capacity building support and the construction of transport and other basic infrastructure, including irrigation, water supply and wastewater treatment, and rural roads.

3.1.2 Microfinance[105]

123. Among the formal financial institutions, the *Vietnam Bank for Agricultural and Rural Development* (VBARD) is the largest credit provider for farmers and agricultural enterprises nationwide. VBARD is a commercial bank, with about 60 percent of its capital owned by the GoV. In addition to profit-oriented

[105] Sources: Binh T. N., Vogel R., Rural and Microfinance in the Lower Mekong: Policies, Institutions and Outcomes. ADB (2011), and websites of the respective institutions or funds.

banking business, VBARD also has a development function. It implements GoV nation-wide policies for rural development, including for example the MARD *Coffee Rejuvenation Program*, providing free coffee seedlings and preferential loans (7% per year with maximum VND 50million) for households replanting coffee (see next section).

124. Since 2003, the Viet Nam Bank for Social Policy (VBSP), a state owned, non-commercial and non-profit credit institution with branches in every province, offers 16 types of loans products to poor and near-poor households and specific socio-economic groups prioritized in GoV programs such as ethnic minorities, migrant workers going abroad, students from disadvantaged families, households living in flood-prone areas, veterans, people with disabilities, etc. The VBSP is also used as a vehicle to provide low-interest loans for GoV programs aimed at for example forest plantation[106], agricultural investment, cooperative development, job creation for small businesses, water and sanitation, and house strengthening. The VWU collaborates with the VBSP particularly in terms of the borrowers screening process, client monitoring and follow-up, trainings on financial management and loan recovery.

125. One of the largest microfinance networks in Viet Nam is the *People's Credit Funds* network, set up in 1993 by the State Bank. These are member-owned financial cooperatives that aim to mobilize savings from and provide credit to its members as mutual assistance. They operate under the principles of voluntary participation, self-management, and self-responsibility. The funds are linked through regional branches and the Central People's Credit Fund (or as of 2013 the Cooperative Bank of Vietnam) and a national federation, the Association of People's Credit Fund. At the end of 2015 there were more than 1,145 People's Credit Funds in Vietnam, reaching nearly two million people, primarily in the rural areas.

126. Since 2016 and until 2021, the NGO Développement International Desjardins is implementing the national level '*Strengthening the People's Credit Fund Network'* project, with a US$ 18.1million grant from the Government of Canada. The project aims to improve the efficiency of the Cooperative Bank of Vietnam and its People's Credit Fund network to supply a range of financial products and services to rural clientele. Project activities include: i) implement business plans, define strategies to professionalize the credit funds and develop tools to help managers, trainers and staff; ii) provide support to the staff in setting up the process to supervise the credit funds, and define the mechanisms to secure operations; iii) conduct a risk analysis of financial operations and loans portfolio; iv) support staff to define the methodology and the tools to assess and develop sustainable financial products and services to meet the needs of clientele; and v) support training and coaching activities including the transfer of expertise to staff.

127. Over 2009-2013, the Central People's Credit Fund or Cooperative Bank of Vietnam have also been supported by the French Development Agency AFD through a US$ 37.5million loan to the Ministry of Finance. The objective of the support was for the credit funds to be able to finance medium-term loans targeted at rural entrepreneurs and businesses in the Northern and Central mountainous regions.

128. In 1992, as part of a GoV poverty reduction program, the VWU established a microfinance mechanism called the '*Tao Yeu May'* or TYM Fund. It operates since but mainly in Northern and North-Central Viet Nam.[107] The Fund provides small-size low-interest loans with flexible repayment periods to women with incomes below the poverty line, in combination with training on basic business and financial management skills, through small groups of lenders. The women groups are also required to contribute to a group savings account and to a mutual assistance fund to support members' emergency expenses. In 2010, the TYM Fund became the first licensed microfinance institution in the country.

129. A number of provincial branches of the VWU have also set up their own microfinance funds, often through support from NGOs or development partners with continuation of the fund after project finalization. For example, the Dak Nong VWU has established a social fund called the *Women's Economic Opportunity Fund*. The fund lends microcredit to households through savings and credit groups at village level, building

[106] For example in the MARD Forest Sector Development Project in Central Vietnam, implemented from 2004 to 2015, through a World Bank loan.

[107] 61 districts in 12 northern and north-central Vietnam provinces as of mid-2017. See: http://tymfund.org.vn

on the existing VWU grassroots network. Group members have access to loans of maximum VND 35million for a maximum loan term of 18 months. Collateral is not required and interest rate is 10 percent per year. Farmers can use the credit for various agricultural purposes such as purchase of seedlings or fertilizers, but also for non-agricultural purposes such as tuition fees or weddings.[108] Between 2010 and 2016, the fund was supported by IFAD through the '*Sustainable Economic Empowerment of Ethnic Minorities*' project (see next section) but is currently still operational.

130. From 2011 to 2015, the State Bank of Vietnam implemented the '*Microfinance Development Program'* through a US$ 90million loan from the ADB Asian Development Fund. The aim of the program was to develop a vibrant microfinance sector and improve access to formal financial services for the poor, especially in rural areas. It also aimed to promote a fair competition among diverse financial institutions, and support the market orientation in microfinance, thereby gradually reducing the government's direct involvement in microfinance operations.

131. In 2006, seven local microfinance providers, previously set up and supported by the NGO ActionAid, joined to form the *National Microfinance Network* or *M7*. It became a licensed microfinance institution in 2012. Their mandate is to support poor households, especially women, with credit and savings support. One of the M7 members, the district-level *Ninh Phuoc Women's Development Fund* still operates in Ninh Thuan.

132. Between 2011 and 2017, IFAD's '*Agriculture, Farmers and Rural Areas Support Project*' in Ninh Thuan included a significant microfinance component through supporting the province-wide Ninh Thuan *Women's Development Fund* and setting up a network of savings and credit groups, managed by the local VWU (see next section).

133. Currently, World Vision Vietnam operates a microfinance component targeted at poor ethnic minority households as part of its *Area Development Programs* in a number of districts in Binh Thuan and Dak Nong (see section 4.2.6).

134. From 2014 to 2018, the United Nations Capital Development Fund (UNCDF) is implementing the regional program '*Shaping Inclusive Finance Transformations'* or SHIFT, in Viet Nam, Cambodia, Lao PDR and Myanmar. The program is funded through the UNCDF and a US$ 9.9million grant from the Australian Department of Foreign Affairs and Trade. SHIFT helps low income people, particularly women, use well-regulated and affordable financial services for productive activities and low-cost digital and credit savings products. In Viet Nam, with US$ 857,000 own funding and a SHIFT co-investment of US$ 325,000, the LienVietPostBank has further developed its e-wallet services through a low cost and user-friendly mobile app called '*Vi Viet'* that provides women a safe and easy way to access financial services. So far, over 400,000 women have used the application, and the bank is now working with the VWU to expand its network in rural areas to engage over 2,500 agents or transaction points and reach over 500,000 women users by 2018.[109]

3.1.3 Agriculture and livelihoods

135. From 2014 to 2017, the Food and Agricultural Organization (FAO) (lead), UNIDO, UNESCO, IOM and UNV, in partnership with MARD implemented the joint program '*Support to the National Target Programme on the New Rural Development*', funded through a US$ 1.1million grant from the One UN fund and US$ 290,000 GoV contribution. The program was implemented at national level and in Son La and Quang Nam. The components were: (i) rural residents and producers' knowledge enhanced for modernizing agro-production, rural livelihoods and social development; (ii) capacity building in policy, strategy and public investment for creating new incentives for the new rural development process; and (iii) coordination and M&E of the NRP NRD. Activities included: development of new agricultural technologies, commune learning

[108] IFAD (October 2015). Rural Finance and Coffee Smallholders in Viet Nam. Case Study in Dak Nong Province.
[109] Improving Financial Inclusion in Vietnam with a Promising New E-Walet (Vi-Veit). See: https://spark.adobe.com/page/icr5z4LdvzjU2/

centres and cultural houses, value chain improvement, capacity building, policy advisory task force, participatory planning, and results-based M&E.

136. Since 2014 and until 2019, MARD is implementing the project '*Productive Rural Infrastructure Sector Project in the Central Highlands*' in all five Central Highlands provinces, through a US$ 80million loan from the ADB Asian Development Fund.[110] The objective is to increase rural and agricultural productivity, increase rural incomes and sustain livelihoods through regenerating and upgrading underdeveloped or outdated productive rural infrastructure, targeting areas with good potential for agricultural production with existing irrigation schemes. It hereby directly supports the implementation of the NTP NRD.

137. Started in 2017, MARD is implementing the project '*Enhancing Agricultural Competitiveness in Viet Nam'* in Khanh Hoa, Can Tho and Thai Binh, with a US$ 1.8million grant from the Japan Fund for Poverty Reduction, administered by ADB. Supporting the implementation of the GoV ARP, the project aims to establish public-private collaboration arrangements in agriculture value chains and strengthen public investment planning and expenditure management for agriculture commercialization. Activities include: value chain assessments, climate-responsive financing for agribusiness development and investment, public-private partnership establishment, policy and institutional analysis, provincial agribusiness value chain strategies and plans, and capacity building.

138. From 2015 to 2020, MARD is implementing the '*Vietnam Sustainable Agriculture Transformation Project'* or VnSAT project, mainly funded through a US$ 238million loan from the World Bank. The aim is to improve farming practices and value chains and promote institutional strengthening for the effective implementation of the ARP. For the Central Highlands, the project focuses on an intensive coffee rejuvenation, replanting and sustainable production program, and capacity building of national and local Government and value chain partners to support agricultural transformation. The beneficiary target is 62,000 coffee producing households. Activities include: training programs, farmer field schools, demonstration models, farmer group establishment, preferential loans for coffee replanting and rejuvenation, loans for farmers to invest in water efficiency technologies such as drip irrigation and roots watering, technical support on coffee certification, a virtual call center linked to mobile applications etc.[111]

139. Since 2017 and until 2022, the Ministry of Science and Technology is implementing the '*Aus4Innovation*' program, in partnership with the Commonwealth Scientific and Industrial Research Organisation, private sector, and Vietnamese and Australian universities. The program is funded through a US$ 8.6million grant from the Australian Department of Foreign Affairs and Trade. Aus4Innovation will undertake targeted interventions to improve Viet Nam's innovation capacity through research commissioned to underpin preparedness for a digital future, industry relevant research and technology transfer in agriculture, and modes of creative thinking in education to feed an entrepreneurial and start-up economy. Included under the activities are agricultural technology transfer pilots in three locations in North, Central and South Viet Nam.

140. Since 2013, the World Bank International Finance Corporation is implementing the '*Private Sector Engagement for Agricultural Development*' project, through a US$ 7.6million grant from the Government of Canada. The project aims to improve sustainable rural growth for 7,500 farmers in the Mekong delta and Central Highlands of Vietnam, and focuses on: (i) increasing lending for agricultural activities by up to five private sector banks to give farmers the means to invest in the most profitable seeds, techniques and storage equipment, and to give them the flexibility to wait for the ideal time to sell their goods at better prices; (ii) providing training to farmers to help them improve their agricultural practices, by diversifying their income streams, and improving their financial management; and (iii) improving the handling and storage of crops by farmers, agribusinesses and warehouses to ensure the quality, quantity, and market value of the crops is maintained.

[110] The districts covered by this project in Dak Lak are: Ea Sup, Krong Nang, Lak, M'Drak and Buon Ma Thuot city.
[111] The districts selected in Dak Lak are: Cu Kuin, Cu Mgar, Buon Ho, Krong Buk, Krong Nang, Krong Pak and Ea H'Leo.

141. Between 2010 and 2016, the International Fund for Agricultural Development (IFAD) has supported Dak Nong through the '*Sustainable Economic Empowerment of Ethnic Minorities*' project. The project was funded through a US$ 12.8million loan from IFAD, a US$ 0.3million grant from IFAD, a US$ 2.3million Government contribution, including US$ 0.9million from the Vietnam Bank for Agriculture & Rural Development, and an estimated US$ 0.7million as beneficiary contribution. The main objective was to contribute to the sustainable improvement of the livelihoods of poor and ethnic minority households, with particular focus on women. The project had two components: (i) ethnic minority livelihood development; and (ii) rural financial services, with activities such as: development and promotion of livelihood models, enterprise-to-farmer and farmer-to-farmer extension services, training programs, set up of farmer interest groups, a loan program based on joint liability, a Women's Union managed credit program, construction or upgrading of roads, bridge, drainage and waste management systems, irrigation canals and dams, water supply systems, and drying yards.

142. Between 2011 and 2017, IFAD has also supported Ninh Thuan, Gia Lai and Tuyen Quang through the '*Agriculture, Farmers and Rural Areas Support Project*'. The project in Ninh Thuan was funded through a US$ 12.8million loan from IFAD, a US$ 3.3million Government contribution and an estimated US$ 1.5million as beneficiary contribution. The objective of the project was to sustainably improve livelihoods among ethnic minority and rural poor households, with the following three major components: (i) institutional strengthening for implementation of pro-poor initiatives; (ii) pro-poor value chain development; and (iii) commune market-oriented socio-economic development planning and implementation. Activities included: value chain mapping and assessment, set up of farmer interest groups, development and promotion of livelihood models, competitive grant schemes for farmer groups and rural enterprises, a Women's Union managed credit program, training for farmers, extension workers, planners and other local authorities, construction or upgrading of roads, bridges, irrigation, water supply systems, electricity lines and markets.[112]

143. In 2015, as part of the regional '*Grow Asia'* Initiative, over 60 partners from global and local companies, provincial governments, national research institutes, international organizations and NGOs established the '*Partnership for Sustainable Agriculture in Vietnam*'.[113] The multi-stakeholder platform aims to support agricultural transformation by scaling solutions and supporting knowledge management – including through its '*Grow Asia Exchange'* online portal - on inclusive finance, digital solutions and farmer aggregation. It focuses on six crops (coffee, tea, rice, corn, pepper and potatoes) and the cross-cutting issue of agrochemicals. Activities so far have included: farmer training on agrochemical use, development of national curricula on sustainable agriculture, pilots on improved on-farm management of agrochemicals, farmer group and cooperative establishment, demonstration farms, introduction of water-efficiency technology, certification of farms and rural enterprise, and support to sectoral coordination.

144. From 2012 to 2016, the Swiss Agency for Development and Cooperation funded the implementation of the '*Market Access for the Rural Poor – Through Value Chain Promotion Programme'*, with a US$ 5.3million grant. The Programme supported five projects on: tea (Helvetas Swiss Intercooperation); rattan and bamboo (Oxfam Hong Kong); textile (Vietnam Handicraft Exporters Association); red algae (Medical Committee Netherlands Vietnam and Capital Seaweed Company) and cardamom, cinnamon and star anise (SNV). The overall goal of the programme was to reduce poverty in more than 10,000 poor and near-poor households, especially those of ethnic minorities, through generating additional income and employment in selected agricultural value chains in which they can participate. The '*Pro-Poor High Quality Red Algae Value Chain Promotion in Vietnam'* project was implemented in Khanh Hoa and Ninh Thuan and supported over 440 smallholder families living along the coast.

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[112] Currently, MPI, PPCs and IFAD are designing an extension of this program for Ninh Thuan. This next phase will replicate good practice from the previous project but specifically focus on climate resilient agriculture. The project is intended to start in 2019.

[113] Including, among others: MARD (Crop and Plant Protection Department, National Agriculture Extension Center, Western Highlands Agriculture and Forestry Science Institute, Northern Mountainous Agriculture & Forestry Science Institute, Institute of Policy and Strategy for Agriculture and Rural development, Directorate of Fisheries, Department of Planning, Vietnam Academy of Agricultural Sciences), Viet Nam Tea Association, GIZ, SNV, WWF, IDH's Sustainable Trade Initiative, Nestle, Jacobs Douwe Egberts, Olam, ACOM, Unilever, PepsiCo, Bayer, Syngenta, DuPont, Dow AgroSciences, Monsanto, Cargill, Metro Cash Carry, Intimex, Vina Fruit, EDE Consulting, Rainforest Alliance, 4C/Global Coffee Platform ea. See: https://www.growasia.org/vietnam.

145. Over the period 2004-2015, Oxfam implemented four projects in Thuan Bac and Bac Ai districts in Ninh Thuan aimed at improving the livelihoods of Raglai ethnic minority communities. From 2004 to 2007, the '*Food Security and Income Generation for poor Raglai ethnic men and women in Bac Ai district, Ninh Thuan province'* project*;* from 2007 to 2010 the *'Community Empowerment for Raglai people through livelihoods and market interventions'* project and a community-based forestry project (see below), and from from 2011 to 2015, the '*Enhancing Market Access and Promoting Economic Leadership for Raglai Women in Ninh Thuan'* project (US$ 337,000 grant). Activities across all projects were similar and included: gendered market mapping and selection of products, production inputs and support for market development, capacity building for producer group members on market skills, improved extension and veterinary services, advocacy for supportive policies and support by Government and the private sector, and cross-cutting actions aimed at improving the role of women in the household and community.

146. From 2004 to 2011, Oxfam Québec implemented the '*Rural Enterprise Expansion'* project, through a US$ 4.7million grant from the Government of Canada. The project aimed to improve the enabling environment for 109 participating micro, small and medium enterprises in Hai Duong, Quang Ninh and Thanh Hoa provinces. Project objectives included fostering growth of rural micro/small enterprise, mainstreaming women in business, and furthering dialogue and policy promoting women and micro/small enterprises. Activities focused on building capacity of the VWU and Vietnam Co-operative Alliance to establish and manage sustainable business development centres.

147. From 2012 to 2015, the SNV Netherlands Development Organisation in partnership with the Vietnam Chamber of Commerce and Industry managed the *'Vietnam Business Challenge Fund'*, with US$ 4.6million grant funding from the United Kingdom Department for International Development. The fund supported the private sector in Viet Nam to develop innovative business models that deliver both commercial benefits for the company and social impact for the low income population through 'inclusive business' models. The project has supported 16 models in three sectors: agriculture, low carbon growth and infrastructure and basic services, with one of the projects implemented in Binh Thuan, focusing on sustainable fishing and restoration of marine resources. A similar program called the '*Inclusive Business Accelerator*' ran from 2014 to 2016, with funding from the Netherlands.

148. Since 2016 and until 2020, the SNV Netherlands Development Organisation in partnership with MARD, the Viet Nam Chamber of Commerce and Industries and the local Women's Union, is implementing the '*Enhancing Opportunities for Women's Enterprises*' project, with funding from the Dutch Government. The project is implemented in Binh Thuan, Ninh Thuan, Binh Dinh and Quang Binh and focuses on strengthening women entrepreneurship, improving access to inputs and business assets, and increasing women leadership at all levels of the value chain.[114]

149. Between 2015 and 2020, the NGO Société de Coopération pour le Développement International is implementing the '*Vietnamese Cooperative Enterprise Development*' project in five provinces (Ninh Thuan, Binh Thuan, Ben Tre, Lam Dong and Soc Trang), with US$ 12.9 million grant funding from the Government of Canada. The project aims to increase the competitiveness of Vietnamese agricultural cooperatives, helping create economic opportunities for over 10,000 smallholder farmers, particularly women. The project will develop a national strategy to scale up and replicate the success of high-performance cooperatives. It will assist cooperatives to create and implement business plans, while developing financing mechanisms to enable them to acquire new technology for the processing and marketing of agricultural products (such as dragon fruit and grapes in Binh Thuan and Ninh Thuan respectively). In addition, it will deliver Farmer Field School training programs on governance and gender equality, environmentally sustainable agricultural production techniques, such as safe application of fertilizer and pesticides, and post-harvest handling in order to meet quality certification standards and access new markets.

[114] A similar project is implemented by SNV, CARE International and Oxfam in North Viet Nam (Lao Cai and Bac Kan), called '*Women's Economic Empowerment through Agriculture Value Chain Enhancement'* or WEAVE, from 2016 to 2019, with funding from the Australian Government.

3.1.4 Water

150. From 2001 to 2006, MARD implemented the '*Phan Ri - Phan Thiet Irrigation'* project in Bac Binh district in Binh Thuan, funded through a US$ 46million loan from Japan. The project improved irrigation and drainage facilities (for over 11,700ha of farming land) and rural infrastructure and strengthened the capacity of the local extension services.

151. From 2008 to 2014, the Italian Development Cooperation has supported Binh Thuan with the '*Binh Thuan Water Sector Project'*, funded through a US$ 18million loan provided by the Italian Government. The project supported the construction of irrigation infrastructure for 1,500ha of farms cultivated by ethnic minority farmers in Bac Binh district and drinking water facilities for 135,000 people in Ham Thuan Bac district.

152. From 2010 to 2013, the Ninh Thuan PPC implemented the project '*Harnessing water resources in Ninh Thuan Province*', with a US$ 27million loan and US$ 327,000 grant from the French development agency AFD. The project repaired or constructed new irrigation and water storage infrastructure for 2,500ha of farm land alongside the Cai river basin. Operation and management was organized through an irrigation fees system.

153. From 2007 to 2015, the provincial PPCs implemented the project '*Central Region Small and Medium Towns Development*' in 8 towns in Binh Thuan (Phan Thiet), Ninh Thuan (Ca Na and Thap Cham), Khanh Hoa (Cam Ranh and Ninh Hoa), Dak Nong (Gia Nghia) and Phu Yen (Song Cau and Tuy Hoa), through a US$ 53million loan from the ADB Asian Development Fund. The project improved: access to safe and sustainable water supply, drainage and wastewater treatment, reduced flooding and ponding, and improved solid waste management systems; behavioral change towards environmental hygiene and sanitation; and sustainable management and delivery capacities of water supply and sanitation service providers.

154. From 2015 to 2020, Dak Lak PPC is implementing the project *'Irrigation development in sustainable coffee areas in Dak Lak'* under PPC Resolution 153/2015/NQ-HĐND, with a planned budget of US$ 296.3million. The project is focused on irrigation infrastructure and water efficiency, aiming to increase the area of irrigated coffee by 16 percent – or 30,646ha - by 2020. The Resolution also includes a vision for 2025 to expand the irrigated area by 40 percent, or equivalent to 74,247ha, from the current situation.[115]

155. From 2011 to 2014, with US$ 4.5million grant funding from the Korea International Cooperation Agency, the provincial PPC of Dak Lak constructed a clean water supply system benefiting 80,000 households in Buon Ho town.

156. From 2015 to 2017, the MoNRE National Center for Water Resources Planning and Investigation and Soc Trang and Ca Mau PPCs have implemented the project '*Improvement of Groundwater Protection in Vietnam*', with funding from the German Development Cooperation. The project promoted integrated water resources management and provided support on policy development (technical guidelines and circulars) and coordination, research, data collection and modeling assistance, community awareness raising and capacity building on groundwater protection.

157. From 2016 to 2021, the MARD Center for Rural Water Supply and Sanitation is implementing the '*Results-based Scaling up of Rural Sanitation and Water Supply Program'*, with a US$ 200million loan from the World Bank and US$ 25.5million GoV co-financing. The overall objective is to improve hygiene behavior and increase and sustain access to rural sanitation and water supply in rural areas, in line with the National Strategy and Target Program for Rural Water Supply and Sanitation and the NTP NRD. The project is implemented in 25 provinces, including in Dak Lak, Dak Nong, Binh Thuan and Ninh Thuan.

[115] 82% of the planned budget is for building new reservoirs. 19% of the budget is sourced from the national government, 34% from Government bonds, 6% or US$ 17.6million from the provincial budget, 23% from Overseas Development Aid, and 18% from enterprises and beneficiaries. https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Nghi-quyet-153-2015-NQ-HDND-phat-trien-thuy-loi-vung-ca-phe-ben-vung-Dak-Lak-giai-doan-2015-2020-285454.aspx

158. From 2018 to 2023, MARD and local DARDs of Khanh Hoa, Son La, Nam Dinh and Dong Thap provinces will implement the '*Aus4Water'* program, funded with a US$ 17.7million grant from the Australian Department of Foreign Affairs and Trade. The program will increase rural households' access to clean water supply through innovative public-private sector partnerships and with meaningful involvement of and opportunities for women along the water supply chain.

159. From 2012 to 2014, a research project called '*Linking increases in water use efficiency for food production at the farm scale to global projections*' was implemented in Ninh Thuan, by the Leibniz Institute for Agricultural Engineering Potsdam-Bornim, in partnership with the International Food Policy Research Institute and Southern Institute for Water Resource Planning. Funding was provided by the German Government. The research combined a local farm scale approach with a global modeling approach to further develop a methodology for estimating agricultural water flows, costs of production factors that affect farmers at the farm scale and to improve projections for agricultural water use.

160. From 2009 to 2016, the NGO International Development Enterprises implemented the project '*Introducing Low-cost Micro Irrigation Technology for Poor Farmers in South-Central Vietnam'* in six districts in Ninh Thuan, with funding from the Swiss Government. With locally adapted sprinkler and drip irrigation, the project covered 650ha and reached 2,100 households, including 200 very poor households. The overall aim of the project was to promote low cost technologies and practices through a pro-poor market based approach and farmer-driven innovation. Project activities included: engagement of farmers and retailers in product research and development, market development with set-up of a technology supply chain network, marketing campaigns in collaboration with local authorities and mass organizations for technology replication.

161. Since 2014, the Vietnamese start-up Mimosatek is promoting so-called '*precision-agriculture'* technology to smallholder farmers and agricultural business across the country, but mainly in the Central Highlands. Currently focused on on-farm irrigation, the 'MGreen' system comprises of small-scale weather stations, soil sensors, automated measurement and data processing devices and a smartphone application, that help the farmer to know when, where and how much to irrigate ensuring reduced costs for agricultural inputs and maximum yield outcomes. The system currently operates best for a mono-cropped farm, but the company intends to develop alternative systems for inter-cropped farms. Mimosatek aims to reach 1 million farmers with their technology by 2022.

162. From 2015 to 2018, Electricity Viet Nam is upgrading hydropower facilities in Ninh Son district of Ninh Thuan through the project '*Da Nhim Hydropower Plan Expansion Project'*, with a US$ 85million loan from the Government of Japan. Once finished, the project will have expanded electricity supply with an additional 100million kilo watt per hour, as well as increase water supply in dry seasons.

163. From 2018 to 2023, MARD with provincial PPCs will implement the '*Dam Rehabilitation and Safety Improvement Program'*, with a US$ 420million loan from the World Bank and a US$ 40million GoV contribution. The focus is on priority repair and upgrading of multipurpose dams and reservoirs in more than 31 provinces in Viet Nam, to ensure safety of downstream infrastructure and long-term viability and operational efficiency. [116]

3.1.5 Forestry

164. Since 2001, the PPCs with technical support from MARD, are implementing the forest protection '*Program 178'*. Through this Program, communities that live on forest land are paid VND 100,000 per ha per year to sustainably manage the forest. In addition, the GoV '*Project 304'* also provides money to minority families that have relocated to forested areas to manage forest land. Households typically get a Red Book title to 30ha of forestland and manage implementation of forest protection plans in exchange for an annual or quarterly payment. [117]

[116] Sites selected in Dak Lak are: 10 reservoirs in Krong Pak, Krong Nang, Krong Buk, M'Drak, Ea Kar districts and Buon Ho town
[117] USAID (December 2008). Vietnam Central Highlands Needs Assessment Final Report.

165. From 2007 to 2010, Oxfam implemented the project '*Community forestry management for poverty reduction*' in Ninh Thuan and Lao Cai, funded through a US$ 555,000 grant from Oxfam Australia and Oxfam Great Britain. The overall objective of the project was to ensure that over 2,000 poor ethnic minority households have equal and secured access to and control over forest and forest-land and production services, contributing to achieving food and income security. Activities included: establishment of village forest protection groups, land use mapping, planning and allocation, participatory community planning, income generating activities, including community tourism, credit scheme for agricultural inputs, environmental protection, improvement of forestry extension services, advocacy and capacity building for local authorities.

166. From 2012 to 2014, FAO in partnership with the MARD Forestry Department implemented the project '*Community Based Forest Harvesting in Vietnam for poverty reduction in Viet Nam'*, with a US$ 256,000 FAO grant. The project's objective was to document, identify and disseminate guidelines for sustainable models and methods of community-based forest harvesting, in support of a national policy framework. Among other activities, the project carried out a systematic review of best practices, including at the household level, from across Vietnam.

167. From 2007 to 2016, MARD with PPCs of Dak Lak, Dak Nong, Kon Tum, Gia Lai, Phu Yen and Lam Dong implemented the project '*Forest for Livelihood Improvement in the Central Highlands'*, funded with a US$ 48million loan from ADB, a US$16million grant from the Trust Fund for Forestry, US$ 18million from the GoV and a US$ 12million beneficiary contribution. The project aimed at sustainable management of forests, improvement of livelihoods, watershed protection and conservation of biodiversity. It benefited approximately 80,000 poor households living in and adjacent to forest land, including ethnic minorities, in 600 villages in 60 communes.[118]

168. From 2015 to 2018, MARD and local DARDs in Dak Lak (Krong Bong district), Cao Bang, Bac Kan, Hoa Binh, Tra Vinh and Bac Lieu, with technical support from ActionAid Vietnam, are implementing the '*People Participation in improvement of forest governance and poverty alleviation in Vietnam'* project, funded through a US$ 1.3million grant from the Ministry of Foreign Affairs of Finland.[119] The project targets 260,000 people, particularly the poor and ethnic minorities whose livelihoods are closely linked to traditional forest management, with improved control over forest through better access to information and institutions.

169. From 2012 until 2021, JICA in partnership with MARD and the provincial PPCs is implementing the project '*Protection forests restoration and sustainable management*' in Binh Thuan, Ninh Thuan and 9 other provinces in Central Viet Nam, through a US$ 100million loan from the Japanese Government, US$ 5.1million contribution from the central Government and US$ 18.6million from the provinces. The project's components are on: upland and mangrove forest regeneration, establishment of forest protection stations and units, community co-management models, livelihood support and institutional capacity building.

3.2 Projects and programs on climate resilience

170. Under the climate finance investment mechanism of the SP RCC, provinces, including Dak Lak, Khanh Hoa, Ninh Thuan and Binh Thuan were requested to submit projects for strengthening climate resilience. In 2012, more than 64 projects have been approved, with 16 projects implemented over 2013-2014.

3.2.1 Water security in the context of climate variability and change

171. From 2005 to 2008, the Australian Centre for International Agricultural Research in collaboration with the Tay Nguyen University, Ho Chi Minh City University of Economics and MoNRE implemented the research project '*Managing groundwater access in Tay Nguyen (Central Highlands) Vietnam'* in Dak Lak,

[118] The project area in Dak Lak were the southernmost districts in the province: Krong Bong, Lak, Ea Kar and M'Drak

[119] The project is linked to the national-level '*Management Information System for Forestry Sector'* (FORMIS) project that aims to develop a fully integrated Management Information System for forestry decision making in Vietnam. FORMIS has been implemented since 2008 and continues till 2018, with US$ 14.6million funding from the Ministry of Foreign Affairs of Finland.

with a US$ 402,912 grant from the Australian Government. The aim was to better understand the groundwater flows and use and recommend appropriate policy incentives for more sustainable management.

172. From 2007 to 2009, Partners Voor Water in collaboration with MoNRE implemented the pilot project '*Re-hydrating the earth by sustainable, small scale sub-surface water retention techniques*' in Ninh Thuan. The project demonstrated a system for runoff harvesting and water retention to improve soil moisture availability and recharge shallow groundwater levels.

173. From 2004 to 2010, UNESCO implemented the pilot project '*Augmenting groundwater resources by artificial recharge in Binh Thuan province, Viet Nam'*, in partnership with the Vietnamese Academy of Science and Technology, the local DARD and DoNRE, and the Sapienza University in Italy. The project was funded by the Italian Government, the International Council for Science and UNESCO. The project conducted hydro-geological and hydrological studies, aquifer mapping and water testing, groundwater modeling, and capacity building on aquifer management.

174. From 2014 to 2019, MARD and MoNRE as key members of the Vietnam Water Partnership are implementing the project '*Integrating Water Security and Climate Resilience Programmes into Vietnam Irrigation Management Plan*', as part of the '*Global Water Partnership – Southeast Asia Program'*.[120] The project focuses on the integration of climate resilience and water security into the national irrigation plan, development of a roadmap and tools for similar integration work at the subnational level, and piloting climate resilient irrigation systems in Thai Binh provinces in Northern Vietnam.

175. From 2013 and until 2019, the provincial PPCs of Ninh Thuan, Binh Thuan and Ha Tinh with technical support from the Belgian Bilateral Cooperation are implementing the project '*Integrated Water Management and Urban Development in Relation to Climate Change*', funded through a US$ 28.5million grant from the Belgian Government. The project's main objective is to strengthen the capacities on integrated water resource management and urban development in the context of climate change. It includes activities such as downscaled climate, hazard and hydrology modeling, provincial climate change action planning, urban master planning, institutional capacity building, and urban water supply, drainage and other green infrastructure investments. Two studies are currently in the pipeline: one on water demand versus availability within a climate change context; and the other on irrigation management practices, from farm to company level. The project does not plan any specific infrastructure or other support to farmers directly.

176. From 2018 to 2022, MARD and provincial PPCs will implement the project '*Water Efficiency Improvement in Drought Affected Provinces'* (WEIDAP) in five provinces: Dak Lak, Dak Nong, Binh Thuan, Ninh Thuan and Khanh Hoa. The project is funded through a US$ 100million loan from ADB's Asian Development Fund, a US$ 300,000 grant from the ADB Climate Change Fund, a US$ 750million grant from the Water Partnership Fund, Government contributions equalizing US$ 16million and farmer contributions equalizing US$ 1.6million. The project aims to improve agriculture water productivity ('crop per drop') and climate resilience by increasing water use efficiency in irrigated agriculture in provinces affected by the 2015-2016 drought. The project has three major outputs and areas of interventions as follows:[121]

1) Modernized irrigation management services adopted: irrigation water resources allocation and delivery, maintenance of irrigation infrastructure, piloting of a water delivery charging mechanisms, and policy and institutional arrangements for management, operations and maintenance.
2) Modernized irrigation systems developed and upgraded: rehabilitation and development of modern irrigation infrastructure
3) On-farm water distribution, application and management practices for high value crops improved: promote adoption of on-farm water efficiency agricultural techniques, and support the development of high tech agricultural production zones.

[120] The global program has multiple donors including the World Bank, WMO and the Governments of Argentina, Chile, Denmark, Hungary, Jordan, the Netherlands, Pakistan and Sweden.

[121] ADB, MARD (April 2017). Water efficiency improvement in drought-affected provinces (WEIDAP), Viet Nam (TA 9147-VIE): project preparation consultancy services. Mid Term Report.

3.2.2 Strengthening agricultural resilience

177. Since 2006, ADB, FAO and IFAD are supporting the countries in the Greater Mekong Sub region through the regional '*Core Agriculture Support Program'*, with phase I running from 2006 to 2010, and phase II from 2011 to 2020. In Viet Nam the project tis mainly implemented at national level, with pilot activities in Northern provinces. Phase I of the program focused on facilitating cross-border agricultural trade and investment, promoting public-private partnerships, enhancing capacity in agricultural science and technology, establishing emergency response mechanisms for agricultural and natural resources crises and strengthening institutional linkages and mechanisms for cooperation. Phase II focuses on promoting food safety and modernizing agricultural trade, promoting climate-friendly agriculture via market-based strategies (including carbon financing, climate-resilient farming systems, weather-based insurance) and promoting agriculture as a source for clean rural renewable energy.

178. From 2014 to 2017, FAO in partnership with MARD has implemented the national level project '*Enhancing NAMA Readiness: building capacity in integrated food and energy systems in Vietnam*', funded through a US$ 770,000 FAO grant. The project aimed to improve institutional capacity for the development of a framework for NAMA in the agricultural sector, through capacity building, policy dialogue and policy development support.

179. From 2015 to 2018, UNDP and FAO are supporting MARD and MoNRE on adaptation planning through the multi-country '*Integrating Agriculture in National Adaptation Plans (NAP-Ag)'* program, funded through the German Government's International Climate Initiative.[122] The program aims to strengthen technical capacity on risk informed investment planning and budgeting, develop integrated roadmaps for economically viable and gender-responsive NAPs, improve the resilient agricultural impact evidence base to inform the NAP, and promote agricultural NAPs through advocacy and knowledge sharing.

180. Since 2015, the Ministry of Science and Technology is managing the *'Vietnam Climate Innovation Center*', with technical and funding support from the World Bank, UKaid and the Australian Department of Foreign Affairs and Trade.[123] The Center is promoting private sector engagement in green growth by helping local small and medium enterprises commercialize and scale the most innovative private sector solutions to climate change. The center provides financing and a suite of targeted services to local innovators, including business advisory services and training to build local capacity, financing to bridge funding gaps, and policy support to promote more effective policies and sector regulations. Since its establishment, innovations as follows have been supported, among other: micro-organic composting, organic fertilizer, precision agriculture, energy saving clean cookstoves, bamboo flooring and furniture, adobe brick molding, water filters, and renewable energy solutions.

181. From 2007 to 2011, the Australian Centre for International Agricultural Research in partnership with the Vietnam Academy of Agricultural Sciences and the local DARD, conducted a research-for-development project in Ninh Thuan and Binh Dinh called '*Improving the utilisation of water and soil resources for tree crop production in coastal areas of Vietnam'*, with a US$ 666,198 grant from the Australian Government. The research looked into efficient irrigation and nutrient management practices for horticultural crops grown in wet and dry seasonal climates with limited water and highly permeable soils.

182. Since 2014 and until 2019, the International Water Management Institute and E.D.E. Consulting, with US$ 2.2million funding from the multinational Nestlé and the Swiss Agency for Development and Cooperation, partnered with the Hanoi University of Science and the local DARDs for the program '*More coffee with less water – towards a reduction of the blue water footprint in coffee production'*. The program targets 50,000 coffee farmers in all the Central Highlands provinces and includes a large training program

[122] The program is also implemented in Thailand, the Philippines, Uganda, Kenya, Zambia, the Gambia, Guatemala, Colombia and Uruguay.

[123] The network builds on the World Bank's *Climate Technology Program*, a US$ 70million initiative that catalyzes the growth of climate technology sectors in developing countries through small and growing businesses. It has launched seven Climate Innovation Centers, including in Viet Nam, supporting more than 300 firms in these countries. See: http://www.vietnamcic.org

on irrigation management and application of good agricultural practices, an online and SMS based weather information system[124] and policy support on water management.

183. Since 2016 and until 2018, Atlantic Commodities Vietnam Ltd. or ACOM, a Vietnamese coffee and cocoa exporter[125], with funding from the multinational Jacobs Douwe Egberts/Mondelez International, and in partnership with DARD, is implementing the '*Cultivation Soil Management and Water Conservation project'* in Dak Lak and Lam Dong. Through demonstration farms and farmer groups, the project aims to promote the adoption of agroforestry farming, improved soil and nutrient management, terrace farming, water conservation, coffee rejuvenation and certified coffee production, targeting over 2,000 farmers and 3,500ha. The above project builds on a previous project implemented by ACOM in 2013-2015 in Lam Dong, with co-funding from the Sustainable Trade Initiative or IDH and Mondelez International through their '*Coffee Made Happy'* program. The project provided trainings to 1,500 farmers on good agricultural practices, record keeping and business planning; seedlings, shade trees and other inputs; soil testing and fertilizer recommendations; and support on obtaining and sustaining coffee certification.[126]

184. From 2016 to 2018, SIMEXCO, a large state-owned coffee bean exporter, in partnership with UTZ, E.D.E. Consulting and the Western Highlands Agriculture and Forestry Science Institute, implements the '*Sustainable Coffee Landscape'* project in Dak Lak. The project aims to raise awareness of 5,362 farmers (with 7,604ha of farm land) about; climate change impacts on coffee production and possible adaptation options, the need to reduce water consumption through more efficient technologies, improve the use of fertilizers without harming the environment, and the advantages of farmer groups. The project will conduct Farmer Field Schools, demonstration plots and extensive data gathering through Farmer Field Books.

185. All the above public-private partnerships are closely linked to the IDH flagship programs the '*Initiative for Sustainable Landscapes'* and the '*Sustainable Coffee Program'.* The landscape initiative aims to bring the public, private and civil society sector together to co-invest in farm landscape improvement and sustainable production, for example through inter-cropping, agroforestry, improved fertilizer and water management etc. The Coffee Program operates more at the national level by providing a platform for dialogue between public, private and civil society partners. In Viet Nam, the platform is called the Vietnam Coffee Coordination Board, chaired by MARD.[127] Recently, the Board approved a coffee sustainability curriculum to be used as training material by extension services, businesses and other partners.

186. From 2017 to 2021, a research partnership led by the French Agricultural Research Centre for International Development, and including ICRAF World Agroforestry Centre, SNV, international and local universities and private sector partners such as the international coffee company Illy, is implementing the '*Breeding Coffee for AgroForestry Systems'* project. The project is running in Viet Nam (including the Central Highlands), Nicaragua, El Salvador and Cameroon and is funded through a US$ 5.4million grant from the European Union *Horizon 2020* research and innovation programme. It aims to diversify the range of varieties available and cropping practices integrated into agroforestry systems for a more sustainable coffee production.

187. Since 2003, MARD with support from the SNV Netherlands Development Organisation is implementing the '*Biogas Program for the Animal Husbandry Sector in Vietnam*', with funding from the Dutch Government. The main objectives are to improve the livelihood and quality of life of rural farmers in Viet Nam through exploiting economic and non-economic benefits of domestic biogas, and to develop a commercially viable domestic biogas sector. By mid-2016, the program has facilitated the construction of 157,583 small-scale bio-digesters in 55 provinces, including Dak Lak and Khanh Hoa, benefiting more than 800,000 people.

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[124] See http://thoitiet.hus.vnu.edu.vn/

[125] ACOM was established in 2002 as a subsidiary of ECOM Agroindustrial, one of the world's top three community trading and processing companies, mainly in coffee, cocoa and cotton.

[126] For more details, see https://www.idhsustainabletrade.com/uploaded/2016/10/151209-6-pager-ACOM.pdf

[127] Members include the Vietnam Coffee and Cacao Association (VICOFA), the organization with the largest number of producers and traders in the coffee sector, with the large majority being Vietnamese producers and traders. The Board also receives support through the Grow Asia Initiative's Partnership for Sustainable Agriculture in Vietnam (see section 4.2.3).

3.2.3 Climate information services, for agriculture, water and early warning action

188. From 2013 to 2014, the MoNRE IMHEN implemented the research project *'Building Drought Maps for Viet Nam'*, with Government funding. As a result of improve remote sensing and surveying on weather, climate and soil moisture and capacity building, the project improved the IMHEN hydrometeorology database and developed drought maps for the eight major ecological zones in Viet Nam. The project builds on an earlier one from 2008-2010 which developed drought maps for the South-Central region and Central Highlands.

189. Since 2015 and until 2018, CARE and the ICRAF World Agroforestry Centre, in partnership with the MoNRE IMHEN and local DARDs, are implementing the research-for-development project '*Agro-Climate Information Services for Women and Ethnic Minority farmers in South-East Asia'* targeting 200,000 farmers in Viet Nam (Dien Bien and Ha Tinh), Cambodia and Lao PDR. The project is funded through a US$ 1.6million grant from the Research Program on Climate Change, Agriculture and Food Security led by the Consultative Group for International Agricultural Research (CGIAR). The project has five major components: co-development of seasonal agro-climate forecasts and advisories through Participatory Scenario Planning, set-up of gender empowering farmer learning networks, an action-oriented capacity building program for agricultural planners and farmers, a knowledge generation platform, and policy dialogue for scaling agro-climate information services. The project is building on earlier work by CARE from 2012 to 2014 piloting agro-climate information services in Thanh Hoa and Bac Kan.

190. Between 2013 and 2016, Oxfam in partnership with IMHEN implemented the project '*Agro-climate forecast and information system for enhanced resilience of poor farmers*' in Quang Tri. The overall objective was for poor women and men, particularly ethnic minorities to claim and receive the required information and services to adapt their crop calendar and farming system to consequences of climate change. Activities included: assessment of the existing agro-climate forecasting system, introduction of crop calendar and forecast development software, development and dissemination of agro-climate forecast bulletins, formation of farmer interest groups, farmer learning events, and capacity building of hydro-met and agricultural staff.

191. Since 2011 and until 2022, the Vietnam Academy of Science and Technology is implementing the project '*Disaster and Climate Change Countermeasures Using Earth Observation Satellite'*, through a US$ 68million loan from the Government of Japan. The objective of the project is to upgrade and establish Viet Nam's disaster and climate change planning, mitigation, and response, by providing earth observation satellites, equipment and facilities for satellite development and utilization, and capacity development for operation and maintenance of the facilities and equipment.

192. Since 2013, the Norwegian Meteorological Institute in collaboration with the Asian Disaster Preparedness Center is delivering a capacity building program to the national hydro-meteorological services in Viet Nam as part of the project '*Strengthening Weather and Climate Services of Myanmar, Bangladesh and Vietnam to Deal With Hydro-Meteorological Hazards'*, funded by the Norwegian Ministry of Foreign Affairs. Trainings are delivered twice a year and focus on digital tools for daily and seasonal weather monitoring and forecasting, climate services for early warning and disaster risk reduction, ocean modeling etc.

193. Since 2016, and until 2019, the NGO ICCO, in partnership with MARD and a number of private sector organizations, is implementing the '*Information services for coffee farmers in Vietnam'* or GREENcoffee project, in Dak Lak, Gia Lai, Kon Tum and Lam Dong provinces. It is funded through the '*Geodata for Agriculture and Water'* or G4AW Program from the Netherlands Government. Targeting more than 100,000 coffee farmers, the project is providing an SMS and mobile app-based information system that delivers information on daily weather and weather forecasts, extreme weather conditions, daily prices and price forecasts for coffee, basic advice on farming techniques, pests and diseases etc. The system integrates a question-and-answer hotline manned by technical experts. It was launched in August 2017.

194. Since 2015, the Vietnamese enterprise AgriMedia is offering SMS-based weather and market information services to farmers, agricultural enterprises, reservoir operators and agricultural planners

through its iMetos system. The system includes the installation of small-scale weather stations operated at the local level, but linked through a server managed in Hanoi. Currently 60 weather stations have been installed across the country, including in Dak Lak, and 500,000 farmers have signed up to the SMS service, paying a monthly subscription fee. By 2018, the company aims to install up to 200 to 300 weather stations to cover the entire country. In addition to iMetos, in August 2017, AgriMedia in partnership with VinaPhone also launched a call-center, manned by more than ten technical experts to provide advice to farmers.

195. Starting in 2017, the Institute for Water and Environment and the Vietnam Academy of Water Resources, both under MARD, are implementing the research project '*Application of Satellite Data to Strengthen the Capacity of Reservoir Operation and Management for Increasing Resilience to Drought and Ensuring Water and Food Security for Ninh Thuan'*, with grant funding from the USAID-NASA SERVIR-Mekong program.[128] Activities included are: field surveys to collect data, development of a data system to support reservoir operation, field surveys to assess the accuracy of the system, and stakeholder engagement.

196. Starting in 2017, FAO in partnership with MARD have initiated the pilot application of a drought risk index through the project '*Strengthening the agro-climatic information system to improve the agricultural drought monitoring and early warning system in Vietnam, pilot study in Ninh Thuan province*', funded through a US$ 200,000 FAO grant. The risk index is based on FAO's Agriculture Stress Index System, which is a component of their Global Information and Early Warning System and will focus on rice, maize, fruit and other crops. Rather than using rainfall data, the index is based on vegetation health collected via satellite imagery and historical data spanning thirty years. Seasonal and ten days outlooks are then produced to disseminate to farmers and agricultural planners. In a next step, the aim is to expand the pilot to seven other most drought affected provinces including in the Central Highlands, and integrate the index into Viet Nam's multi-hazard warning system.

197. Starting in 2017 and until 2018, FAO, UN Women and Save the Children are implementing the project '*Forecast-based Financing for Drought Preparedness and Early Action of Women Farmers in Vietnam'* in Gia Lai and Ca Mau, with a US$ 950,000 funding from the European Civil Protection and Humanitarian Aid Operations program. The aim of the project is to pilot a forecast-based financing (FbF) system[129] for drought early warning and early action on food security and livelihoods, and water, sanitation and hygiene. Activities include: development of scientific thresholds for drought occurrence with levels of severity and probabilities, linking of thresholds to preparedness actions via drought early action plans, community dissemination and learning through women's groups, cost benefit analysis for scaling, and advocacy at national level through an FbF working group. The project follows a drought emergency livelihood recovery program implemented by FAO and Action Aid in 2016 that delivered vouchers and unconditional cash transfers to more than 6,000 farmers in Gia Lai, Dak Lak and Dak Nong.

198. Starting in 2017, the International Center for Tropical Agriculture in partnership with the World Meteorological Organization, University of Southern Queensland and the insurance company Willis Ltd. is implementing the project '*Applying seasonal climate forecasting and innovative insurance solutions to climate risk management in the agriculture sector in South-East Asia*'. The total funding is US$ 16.1million,

[128] A five-year (2014-2019) data-for-development program, SERVIR-Mekong works in partnership with leading regional organizations to help countries in the Lower Mekong Region - Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam - use information provided by Earth observing satellites and geospatial technologies to manage climate risks. The program has the following objectives: (i) build and institutionalize the technical capacity of government decision makers and key civil society groups to integrate geospatial information into their decision-making, planning, and communication; (ii) improve the sharing of user-tailored geospatial data, products and services; (iii) develop new high quality user-tailored data, tools, applications, and models to address on-the ground priorities; and (iv) SERVIR-Mekong hub strengthened as a regional provider of geospatial data, analyses, and capacity building services. The Asian Disaster Preparedness Center is the prime implementer, with three other consortium partners, Spatial Informatics Group, Stockholm Environment Institute and Deltares, assisting in the implementation.

[129] The FbF approach has been developed and promoted by the Red Cross Red Crescent Movement and the World Food Program since 2015. The approach has been successfully demonstrated in Uganda, Zimbabwe, Peru, Guatemala, Bangladesh, Dominican Republic, Haiti, Mozambique, Nepal and the Philippines and is now being replicated across the world. For more information, see http://www.climatecentre.org/programmes-engagement/forecast-based-financing

including US$ 9.5million funding from the German Government's International Climate Initiative and US$ 2.6million from Willis Ltd. The objective of the project is to develop resilient climate risk management systems, best practices and insurance products, to shield smallholder farmers and businesses engaged in coffee, sugar, rice, cassava, rubber, and grazing across the agricultural value chain, from physical and financial disaster associated with climate variability and change. Activities include: expansion of the current data collection network, climate, agricultural and hydrological modeling, seasonal-to-yearly climate forecasts, demonstration of index-based insurance products, policy development on risk insurance and capacity building.

199. From 2017 until 2020, MPI with technical support from the German National Meteorological Service is implementing the project '*Enhancing Climate Services for Infrastructure Investment'*, with grant funding from the German Government's International Climate Initiative. The project is advising the national partners on building human resources, technical and institutional capacity and networks to improve value-added climate data, from processing climate data to developing user-focused climate products and advisory services for infrastructure planning.

3.2.4 Disaster risk reduction

200. From 2003 to 2006, the Viet Nam Red Cross, the Netherlands Red Cross and Spanish Red Cross implemented the first CBDRM project '*Preparedness for Disasters Related to Climate Change'* in Ninh Thuan, Binh Thuan, Nghe An, Ha Tinh and Quang Binh, with US$ 460,000 grant funding from the Netherlands. The project implemented structural and non-structural measures for disaster preparedness such as awareness raising, community risk analysis and planning, small-scale mitigation measures, support to disaster response teams and capacity building. A similar project '*Community Based Disaster Preparedness in Viet Nam'* was implemented by the same organizations reaching 61,000 people in Ninh Thuan (Ninh Phuoc and Ninh Hai districts), Binh Thuan (Tuy Phuong district), Quang Tri and Hue from 2007 to 2008, with US$ 415,000 funding, including a US$ 350,000 grant from the European Union Disaster Preparedness fund.

201. From 2011 to 2014, World Vision implemented the project '*Enhance Community Capacity in Community-Based Disaster Risk Management Planning and Implementation'* in Bac Binh and Ham Thuan Bac districts in Binh Thuan, with funding from the German Government. The project was integrated into its area development program (see under section 3.2.5).

202. From 2014 to 2016, under Decision 48, the Ministry of Construction implemented a '*Target Programme to provide support policies and solutions for poor households to build storm and flood resilient houses in Central Region'*, in 14 provinces in Central Viet Nam, including Khanh Hoa, Ninh Thuan and Binh Thuan. As part of this program, 688 houses used by poor households in the three latter provinces were made flood and storm proof. A second phase of the program will expand it to an additional 1,629 in the three provinces, and 85,100 for a total of 20 provinces.

203. From 2008 to 2011, UNDP in partnership with MARD implemented the '*Strengthening Institutional Capacity for Disaster Risk Management in Viet Nam, including Climate Change Related Disasters*' project at the national level and in Binh Thuan, Cao Bang and Can Tho, with US$ 4.3million grant funding from UNDP and the Australian Government. The project focused on the implementation of the National Strategy on disaster risk management, including the development of a new law, improvement of the early warning system, institutional capacity strengthening, disaster damage information systems and the set-up of the MARD CBDRM Program. A second phase of the project was implemented through a partnership of UNDP, MARD, Oxfam, the Viet Nam Red Cross and the Viet Nam Women's Union from 2012 to 2016 and focused on the dissemination of the new law and the extensive roll-out of the CBDRM Program in 20 provinces, including Binh Thuan.

204. From 2017 and until 2022, MARD, the Ministry of Construction and PPCs of 28 coastal provinces, including Binh Thuan, Ninh Thuan and Khanh Hoa, in partnership with UNDP are implementing the project '*Improving the resilience of vulnerable coastal communities to climate change related impacts in Viet Nam*', with a US$ 29.5million grant from the Green Climate Fund. The objective of the project is to improve the

resilience of vulnerable coastal communities to climate change related impacts in Viet Nam through: safe housing to protect vulnerable communities from increased flooding and storms; robust mangrove coverage to provide a natural buffer between coastal communities and the sea; and enhanced climate risk information to guide climate resilient and risk informed planning.

205. From 2017 till 2021, provincial PPCs in Ninh Thuan, Binh Dinh, Phu Yen, Ha Tinh and Quang Ngai will implement flood recovery interventions through the '*Emergency Flood Disaster Reconstruction Project for Vietnam*', funded via a US$ 136million loan from the World Bank. Funds will be used to rehabilitate disaster affected infrastructure such as irrigation, dams and reservoirs, roads, bridges etc. An additional component focuses on institutional capacity strengthening on disaster recovery.

3.2.5 REDD+

206. Since 2009, FAO, UNDP and the UN Environment Program in partnership with MARD are implementing the *UN-REDD Program* in Viet Nam. Phase I, from 2009 to 2012, focused on institutional capacity strengthening for REDD+ readiness. Phase II, from 2013 to 2018 and with US$ 30million funding from Norway, continues the development of the REDD+ implementation framework in Viet Nam, with a particular focus on setting up subnational systems in six provinces: Binh Thuan, Ca Mau, Lam Dong, Ha Tinh, Lao Cai and Bac Kan.

207. A proposal is currently being prepared by FAO as lead of the MARD-UN REDD partnership, to also implement a large-scale REDD+ project in all the Central Highlands provinces. The focus will be on forest protection and reforestation, livelihood security of ethnic minorities through sustainable forest management and forestry value chains and providing evidence to improve the implementation of the national REDD+ Action Program.

208. The table below provides a geographical distribution of the programs and projects described above. Programs and projects with a focus on the national level or not implemented in one of the five target provinces have not been included:

Table 7: Geographical distribution of past and on-going development programs and projects *(color coding: white: no integration of climate change; blue: integration of climate change; green: main focus on climate change)*	Central Highlands		South-Central Coast		
	Dak Lak	Dak Nong	Binh Thuan	Ninh Thuan	Khanh Hoa
Government (with state, loan or grant funding)					
Ethnic Minority Poverty Reduction Program 135 (MPI, CEMA, since 1998)	X	X	X	X	X
Ethnic Minority Program 134 (PPC, 2005-2006)	X	X			
Ethnic Minority Program 139 (health) and 168 (education) (PPC, since 2002)	X	X	X	X	X
Central Highlands Poverty Reduction Project (MPI, 2014-2019)	X	X			
Improving Central Highlands Vocational College for Ethnic Youths in Dak Lak Province (PPC, 2013-2015)	X				
Health Care in the Central Highlands (Ministry of Health, 2004-2011)	X	X			
Support to Border Areas Development Project (MPI, 2016-2023)	X	X			
Productive Rural Infrastructure Sector Project in the Central Highlands (MARD, 2014-2019)	X	X			
Enhancing Agricultural Competitiveness in Viet Nam (MARD, since 2017)					X
Sustainable Economic Empowerment of Ethnic Minorities (PPC, 2010-2016)		X			
Agriculture, Farmers and Rural Areas Support Project (PPC, 2011-2017)				X	
Vietnam Sustainable Agriculture Transformation Project (MARD, 2015-2020)	X	X	X		

Table 7: Geographical distribution of past and on-going development programs and projects *(color coding: white: no integration of climate change; blue: integration of climate change; green: main focus on climate change)*	Central Highlands		South-Central Coast		
	Dak Lak	Dak Nong	Binh Thuan	Ninh Thuan	Khanh Hoa
Binh Thuan Water Sector Project (PPC, 2008-2014)			X		
Harnessing Water Resources in Ninh Thuan Province (PPC, 2010-2013)				X	
Central Region Small and Medium Towns Development (PPC, 2007-2015)		X	X	X	X
Irrigation development in sustainable coffee areas in Dak Lak (PPC, 2015-2020)	X				
Construction of clean water supply system in Buon Ho Town (PPC, 2011-2014)	X				
Results-based Scaling up of Rural Sanitation and Water Supply (MARD, 2016-2021)	X	X	X	X	
Aus4Water program (MARD, 2018-2023)					X
Da Nhim Hydropower Plan Expansion Project (Electricity Viet Nam, 2015-2018)				X	
Dam Rehabilitation and Safety Improvement Program (MARD, 2018-2023)	X				
Forest Protection Program 178 and Project 304 (MARD, PPC, since 2001)	X	X	X	X	X
Forest for Livelihood Improvement in the Central Highlands (MARD, 2007-2016)	X	X			
Protection forests restoration and sustainable management (MARD, 2012-2021)			X	X	
Support Program to Respond to Climate Change (MPI, since 2010)	X		X	X	X
Integrated Water Management and Urban Development in Relation to Climate Change (PPC, 2013-2019)			X	X	
Water Efficiency Improvement in Drought Affected Provinces (MARD, PPC, 2018-2022)	X	X	X	X	X
Target Programme to provide support policies and solutions for poor households to build storm and flood resilient houses in Central Region (Ministry of Construction, 2014-2016)			X	X	X
Emergency Flood Disaster Reconstruction Project for Vietnam (PPC, 2017-2021)				X	
UN (with grant funding)					
Integrated nutrition and food security strategies for children and vulnerable groups in Viet Nam (FAO, WHO, UNICEF, 2015-2017)				X	
Augmenting groundwater resources by artificial recharge in Binh Thuan province, Viet Nam (UNESCO, 2004-2010)			X		
Strengthening the agro-climatic information system to improve the agricultural drought monitoring and early warning system in Vietnam, pilot study in Ninh Thuan (FAO, 2017)				X	
Applying seasonal climate forecasting and innovative insurance solutions to climate risk management in the agriculture sector in South-East Asia (CIAT, since 2017)	X	X			
Strengthening Institutional Capacity for Disaster Risk Management in Viet Nam, including Climate Change Related Disasters (UNDP, 2008-2011)			X		
Improving the resilience of vulnerable coastal communities to climate change related impacts in Viet Nam (UNDP, 2017-2022)			X	X	X
UN-REDD Program (FAO, UNDP, since 2009)			X		

Table 7: Geographical distribution of past and on-going development programs and projects *(color coding: white: no integration of climate change; blue: integration of climate change; green: main focus on climate change)*	Central Highlands		South-Central Coast		
	Dak Lak	Dak Nong	Binh Thuan	Ninh Thuan	Khanh Hoa
Non-governmental organizations (with grant funding)					
Pro-Poor High Quality Red Algae Value Chain Promotion in Vietnam (MCNV, Capital Seaweed, 2012-2016)				X	X
Food Security and Income Generation for poor Raglai ethnic men and women in Bac Ai district, Ninh Thuan province (Oxfam, 2004-2007)				X	
Community Empowerment for Raglai people through livelihoods and market interventions (Oxfam, 2007-2010)				X	
Community forestry management for poverty reduction (Oxfam, 2007-2010)				X	
Enhancing Market Access and Promoting Economic Leadership for Raglai Women in Ninh Thuan (Oxfam, 2011-2015)				X	
People Participation in improvement of forest governance and poverty alleviation in Vietnam (ActionAid, 2015-2018)	X				
Pro-poor Policy Monitoring and Analysis (Oxfam, 2013-2016)		X		X	
Vietnam Business Challenge Fund (SNV, 2012-2015)			X		
Enhancing Opportunities for Women's Enterprises (SNV, 2016-2020)			X	X	
Vietnamese Cooperative Enterprise Development (2015-2020)			X	X	
Biogas Program for the Animal Husbandry Sector in Vietnam (SNV, since 2003)	X				X
Improving community livelihood resilience and adaptive management of locally managed marine reserves of Vietnam (MCD, 2013-2015)					X
Introducing Low-cost Micro Irrigation Technology for Poor Farmers in South-Central Vietnam (iDE, 2009-2016)				X	
GREENcoffee Information services for coffee farmers in Vietnam (ICCO, 2016-2019)	X				
Preparedness for Disasters Related to Climate Change (VNRC, NLRC, SRC, 2003-2006) and Community Based Disaster Preparedness in Viet Nam (VNRC, NLRC, SRC, 2007-2008)			X	X	
Area Development Program (World Vision, 2005-2018)			X		
Enhance Community Capacity in Community-Based Disaster Risk Management Planning and Implementation (World Vision, 2011-2014)			X		
Research institutes					
Linking increases in water use efficiency for food production at the farm scale to global projections (LIAE, IFPRI, 2012-2014)				X	
Managing groundwater access in the Central Highlands of Vietnam (ACIAR, 2005-2008)	X				
Re-hydrating the earthy by sustainable, small scale sub-surface water retention techniques (Partners for Water, 2007-2009)				X	
Improving the utilisation of water and soil resources for tree crop production in coastal areas of Vietnam (ACIAR, 2007-2011)				X	
Application of Satellite Data to Strengthen the Capacity of Reservoir Operation and Management for Increasing Resilience to Drought and Ensuring Water and Food Security for Ninh Thuan (MARD-IWE, MARD-VAWS, since 2017)				X	
More coffee with less water – towards a reduction of the blue water footprint in coffee production (IWMI, E.D.E, 2014-2019)	X	X			

Table 7: Geographical distribution of past and on-going development programs and projects *(color coding: white: no integration of climate change; blue: integration of climate change; green: main focus on climate change)*	Central Highlands		South-Central Coast		
	Dak Lak	Dak Nong	Binh Thuan	Ninh Thuan	Khanh Hoa
Breeding Coffee for Agro-Forestry Systems (FARCID, ICRAF, SNV, 2017-2021)	X	X			
Private sector					
Partnership for Sustainable Agriculture in Vietnam (Grow Asia, since 2015)	X	X			
Promotion of precision-agriculture, including precision-irrigation (Mimosatek, since 2014)	X				
Cultivation Soil Management and Water Conservation project (ACOM, 2016-2018)	X				
Sustainable Coffee Landscape Project (SIMEXCO, UTZ, E.D.E, 2016-2018)	X				
SMS-based weather and market information services (AgriMedia, since 2015)	X				

4. GAPS AND BARRIERS to IMPROVING WATER SECURITY AND AGRICULTURAL RESILIENCE FOR SMALL-SCALE FARMERS IN RESPONSE TO INCREASING CLIMATE RISKS [130]

209. This chapter describes the key gaps and barriers for enhancing the resilience and livelihoods of small-scale farmers in light of the climate risks and impacts as described in chapter 1, within the policy and institutional context of Viet Nam, as described in chapter 2, and building on the mapping and analysis of past and on-going projects and programs as done in chapter 3.

4.1 Current irrigation and water storage systems are not able to effectively address increasing rainfall variability and extreme droughts

210. At present, around 30 percent of the farmers in the South-Central Coast have access to proper irrigation systems. In the Central Highlands, this is 28 percent. The large majority of farmers are therefore dependent on other water sources such as rain, rivers and streams, and groundwater to irrigate their trees and crops. Increasing climate risks of weather variability and extreme weather events adds pressure to this existing situation. Most poor and near-poor farmers in the Central Highlands and South-Central Coast regions have no access or very limited access to reliable sources of water and must cope with water scarcity under conditions of climate-driven rainfall variability and drought.

211. The current main source of water for farming during the wet season is rain, which is sufficient for most of the farmers. Still, during the wet season, an average of 1 out of 5 poor farmers also needs to pump additional water from reservoirs, nearby streams or small ponds, and a few also from wells. However, this

[130] Information for this section is based on the analysis in the sub-assessment reports, additional desk research, documentation from the ADB WEIDAP project, consultations with various organizations, and farmer consultations conducted in the five provinces. The main sources are as follows unless mentioned otherwise: ADB (July 2017). WEIDAP Project. Poverty and Social Assessment Report; Pham T. H., Chavanapoonphol Y., Jintrawet A. (2014). Farmers' Perception and Adaptation to Climate Pressure on Highland Robusta Coffee Production, Dak Lak Province, Vietnam; Nguyen T. D. T., Hoang D. H., Pham T. N., Tran T. T. G. (November 2016). Vulnerability and Adaptation to Drought of Ethnic Minority Women in the Krong No River Basin, Vietnam; Oxfam in Viet Nam (2006). Drought-Management Considerations for Climate Change Adaptation: Focus on the Mekong Region; FAO, MARD, UN Women and WFP (June 2016). Agriculture, food security and livelihood needs assessment in response to the drought and salt water intrusion effects, due to the El - Niño" event in Viet Nam, and CGIAR Research Centers in Southeast Asia (April 2016) (Ibid).

changes drastically during the dry season with rain being much more scarce and insufficient, with almost 1 out of 2 farmers using water from reservoirs, 1 out of 2 farmers using water from nearby streams or small ponds, and 1 out 4 pumping water from their household well. With climate change resulting in increasing rainfall variability, with more intensely wet and dry seasons, this demonstrates the need for adapted, flexible and more resilient irrigation and water storage systems to protect crops throughout the year, particularly during crucial nurturing, blossoming and harvesting stages.

212. In a normal dry season, farmers with no access to irrigation or water storage – the poorest in the majority of cases - deal with water scarcity for agricultural production up to one or two months but during a severe drought from four to six months, with significant differences between localities. Extreme droughts, such as in 2015-2016, are expected to occur more frequently, with a 22 percent chance of this type of event happening again in the next 25 years. Extreme droughts reduce the amount of rain for agricultural production in the dry as well as the wet season, but most significantly in the June-September period, with up to 40 percent less rainfall than usual in Dak Nong, 45 percent in Binh Thuan, 49 percent in Dak Nong and 70 percent in Binh Thuan and Khanh Hoa. [131]

213. In areas with irrigation systems, existing field irrigation practices for the most common high-value crops are as follows:

Table 8: indicators on existing field irrigation practices

	Unit	Mango	Dragon Fruit	Coffee	Pepper
Irrigation time per plant	minutes	5-20	½ to 1	1 - 2	1 – 2
Application method	-	Basin	Onto plant	Basin / sprinkler	
Number of trees/vines	no./ ha	180-210	+1,000	+1,100	+2,200
Irrigator flow	l/s	1.7 – 2.5	1.5 – 4.0	2 - 3	2 – 3
Irrigation application	mm	50 – 130	10 – 20	80 - 120	80 – 120
Time to irrigate 0.5-ha farm	hours	+21	5 – 8	20 - 26	20 – 26
Irrigation Interval	days	+10	2 - 5	10 - 15	10 - 15

214. The majority of the irrigation and water storage systems are outdated and over 50% of the systems are degraded or do not operate at the designed capacity. Water efficiency of irrigation systems is about 64% and 74% of the designed irrigation area in the South-Central Coast and Central Highlands respectively, which is again lower than the same rate in the Northern Region (83%); Southeast Region (82%), and the North Central Region (64%). Most irrigation systems were designed decades ago primarily for rice cultivation - as historically the key crop for food security in Viet Nam, receiving the most attention and investment - and without adequate consideration of climate risks and impact scenarios. With variations per location and per system, these existing irrigation and water storage schemes are currently not able to provide enough capacity during dry seasons and severe and prolonged droughts, and secondary sources such as rivers or streams, ponds and wells are also easily depleted or insufficient due to lack of rainfall. During the recent drought, the capacity of the reservoir and irrigation systems significantly decreased and river water levels were 35 to 60 percent less than the annual average. Similarly, groundwater levels declined with the water table falling to as deep as 50-60 meters in the South-Central Coast and 70 to 80 meters in the Central Highlands.

215. For the large majority of poor farmers, lack of irrigation and storage is one of their main constraints to protecting their crops, increasing agricultural productivity and ensuring a sustainable annual income.[132] This is particularly pertinent for vegetables that need regular watering and perennial crops such as coffee, pepper, apple, grape and dragon fruit. Perennial crops have relatively high water consumption rates across an annual cycle compared to rice, which has a mild level of water consumption comparable to other humid

[131] Wade S., Colledge F., Nguyen V. M., Hall J. and Parker D. (June 2017) (Ibid).

[132] 1 out of 3 also mentions insects and pests, and 1 out of 10 limited land, a lack of fertilizer and other agricultural inputs and shortage of labor. Rice and vegetables farmers also state a low selling price of their agricultural produce as a particular constraint. Insects and pests are a particular concern in the South-Central Coast. ADB (July 2017) (Ibid).

countries. Annual crop-per-drop rates for perennial crops are also significantly lower in Vietnam than the regional average.[133]

216. In addition to water scarcity during the dry season, land and soils are degrading across both regions, with significant impacts on agricultural productivity and a need for a major reduction of intensive fertilizer production and use practices. While the majority of land in the Central Highlands is more fertile (though degrading), land in the South-Central Coast, particularly in the lowlands, is made of sandy and rocky soils with very low organic matter content and low water holding capacity. Together with hot temperatures and high evaporation rates, this leads to desertification and more land left fallow. Desertification is an issue particularly in Binh Thuan, due to a combination of climate variability and change, unsustainable cultivation practices and land use, and inefficient water management. In 2012, more than 90,000ha were already affected.[134] In addition, in Binh Thuan, less and less land is cultivated during the dry season because of more extreme weather conditions in combination with limited or unreliable irrigation capacity during the dry season. Not using or not irrigating the land causes the land to revert back to its natural degraded state due to limited natural soil moisture and fertilization, which makes it even less attractive for further cultivation.[135]

217. Although infrastructure needs remain high, all districts in both regions have or are benefiting from investments in medium to large scale rural infrastructure such as irrigation, roads, bridges, rural water supply, waste management and drainage etc. The GoV also has comprehensive plans to build or modernize reservoirs, dams, sluices and other water and irrigation infrastructure, through Government investment. This includes large scale loan programs funded by the World Bank and ADB, including the modernization of irrigation schemes through the planned MARD-ADB WEIDAP project.

218. However, in terms of access to irrigation and water storage systems, support for connectivity especially for the poor is limited and expected to be covered by farmers themselves through farmers paying for it (full or a percentage contribution) or applying for a low-interest loan, the latter increasing poor farmers' financial insecurity. In addition, where irrigation schemes are not sufficient or absent, public or private sector investments in water storage options are limited and mainly driven by farmers' own initiatives through self-learning, for example constructing ponds, and digging household wells and small canals. Some local authorities, mainly in the South-Central Coast, did support the construction of communal ponds or have extensive plans but budgets are lacking or public resources are not meeting the high demand.

4.2 Insufficient application of appropriate climate-resilient water and agricultural management practices due to insufficient information and weak climate risk management skills

219. In both regions, a majority of farmers are aware of changing temperature and precipitation patterns and increasing intensity and frequency of extreme weather events such as droughts and rainfall-induced floods. They also understand the causes as well as major impacts, including the differential impact on men and women. For the Central Highlands, a majority of coffee farmers in Dak Lak and Dak Nong perceive the temperature to be increasing and observe changes in rainfall patterns with a decrease in the amount of rainfall. They also noticed a change in timing with rain coming later and the dry season lasting longer. A large majority of the farmers attributes the most recent drought to reduced rainfall and temperature, while half of them also link it to the low level of underground water. Most farmers also agree that there are linkages with the rapid expansion of high value crops such as coffee, rubber and pepper, deforestation, underperforming irrigation systems, hydropower development and operation, and inappropriate crop planting schedules. For the South-Central Coast, a majority of men and women farmers in Bac Ai and Ninh Phuoc districts in Ninh Thuan state that over the past thirty years droughts had started to last longer and that there was increasingly less rainfall. They also perceive an increased occurrence and intensity of

[133] Cai X., Bastiaanssen W., Nguyen V. M. (July 2017). Water Productivity Assessment for Improved Irrigation Performance and Water Security in the Asia-Pacific Region: Viet Nam. Technical Report. UNESCO Institute for Water Education.
[134] Gobin A., Le T. H., Pham H. L., Hens L., Ozer P., Le T. T. H., Nguyen T. B., Pham Q. V. (July 2012) (Ibid).
[135] Hien T. T. L., Thang N. N., Hens L. (November 2015) (Ibid).

disasters. The majority of farmers, more women than men, also believe that women are more impacted than men mainly because of the role women have in water collection.

220. In terms of their response, farmers currently carry out a variety of short-, medium- and long-term actions to cope with drought, changing precipitation patterns and water scarcity, with variations among farmers very much depending on their socio-economic status and access to resources. Most of the measures taken are short-term, reactive rather than proactive, autonomous rather than well-planned, particularly for the poor. However, a number of good practices exist among near-poor or better-off farmers with potential for improvement, intensification and replication.

221. Short-term coping actions during previous droughts, including the extreme drought of 2015-2016, focus on changing the crop watering schedule, digging wells or deepening existing ones, purchasing water or sharing it with other households. Some households also consume less water, ration food or sell assets. Livestock farmers, for example in the South-Central Coast, use alternative fodder sources or even salty water. In the medium and long term, farmers increasingly use more drought-resilient varieties, breeds or short-term crops, such as a hybrid maize variety in Dak Nong or rice, maize and vegetables in Ninh Thuan. Other farmers replace their crops, for example coffee by rice or pepper. Some farmers, for example rice and maize farmers from the upland Krong No district in Dak Nong, also set up water management groups to better manage their local irrigation and water-supply systems. Such groups mainly operate during the dry season when water scarcity is the highest. Many farmers also migrate; women temporarily and close to home to work on other farms as hired laborer, while men more longer term and further away, in cities, factories and on larger farms.[136]

222. Non-poor farmers in both regions increasingly apply inter-cropping to diversify their livelihoods and increase the resilience of their crops and incomes, for example coffee with durian fruit trees (Krong Pak, Dak Lak), coffee with pepper, vegetables, acacia or avocado, rubber with avocado and pepper (Cu M'gar, Dak Lak), rice with vegetables, dragon fruit, mango or grape (Ninh Thuan). Agroforestry and integrated farming systems are also increasingly applied: integrating trees (e.g. fruit and timber trees) with agricultural crops (Dak Lak, Binh Thuan), or mixed crop-livestock systems (Ninh Thuan). Good practice also exists on on-farm water management such as mulching, micro irrigation, direct root watering, shared ponds etc. The large majority of farmers who implement these measures obtain information and experience via self-organized peer-to-peer learning, through television, traders or internet, and via learning by doing.

223. While farmers increasingly apply good farming practices, the majority still use too much water, poorly balanced fertilizer inputs and improper pesticide applications. These practices are also progressively less and less effective in coping with the growing variability in rainfall and other climate hazards. Inter-cropping, agroforestry and integrated farming models are also not very advanced with limited knowledge among farmers on how to improve the composition, landscape, irrigation, soil and nutrient monitoring and management of the farm. [137]

4.3 Insufficient technical, financial and organizational resources for smallholders to invest in technologies and practices for climate resiliency of agro-ecosystems

224. In addition to lack of sufficient information, other reasons mentioned by farmers for not exercising or using climate resilient farming practices, inputs and technologies are: high costs and not enough low-cost options, technical complexity with limited adaptability to their crops or farm, and limited market incentives for sustainable production.[138]

225. Costs for irrigation, water storage, resilient varieties, fertilizers and agricultural labor, particularly in drier areas and periods, are high and a significant share of the farmers' input costs, especially for the

[136] Income from on-farm labor makes up 27 percent of the poor's total income and 15 percent for the indigenous ethnic minorities. Diversification into non-farm livelihoods is limited in both regions, with on average only 1 out of 10 poor ethnic minority farmers collecting income from these activities. ADB (July 2017) (Ibid).

[137] Expert consultations with IDH, 24th August 2017; and confirmed by community consultations in the five provinces.

[138] Farmer consultations in the five provinces.

poorest. These costs increase with more unpredictable rainfall and droughts. Across both regions the majority of poor farmers currently use moveable hand-held hoses and pumps to irrigate their crops, with this equipment either owned by them or rented from another farmer. Pump and hose renting costs and costs for using a neighbor's pond are high, on average VND 60,000-80,000 per hour of use, with many farms, for example for coffee, requiring 8 to 10 hours of irrigation per watering period. Better-off farmers also use dug-in or buried PVC pipes in combination with hoses, furrow irrigation, drip or sprinkler.

226. As described in section 3, above, there are a number of initiatives on climate-smart and water efficiency practices and technologies, through research, development projects or private sector initiatives, but primarily on coffee in the Central Highlands and a few on fruits in the South-Central Coast. Their scope and results are limited to a small number of farmers, mostly better-off, and the technologies promoted are still high-cost, very technical and not always applicable to the local context or increased inter-cropping practices. There are only very limited initiatives promoting the co-design and co-development of pro-poor adaptation solutions, including technologies.

227. For climate-, water- and energy-smart technologies, while they are available in both regions, they are often not affordable, too technical or not applicable to small-size or inter-cropped farms. For example, drip irrigation requires a high financial investment, is not cost-effective for small-sized farms or is too complex for farmers to apply compared to overhead sprinklers.[139] At the moment, only 1 out of 10 poor farmers uses micro-sprinklers, primarily in Binh Thuan, Khanh Hoa and Dak Lak, and none of them overhead sprinklers or drip irrigation. Overhead sprinklers are used mainly for coffee cultivation in Dak Nong and Dak Lak, and dragon fruit and grape cultivation in Ninh Thuan and Binh Thuan, but not by poor farmers due to the high investment cost. However, a number of poor and near-poor farmers have also designed their own low-cost system using locally available materials and through their own initiative or supported by traders, local authorities and NGOs (see chapter 5).

228. In terms of access to credit for investing in climate resilient technologies and inputs, only 1 out of 4 poor farmers in both regions have a loan through the formal system (see section 4.2), with main sources of these loans being the VBSP (managed by the VWU and the Farmers' Union) and the VBARD. The loans are primarily used for buying farming inputs or investing in livestock. The low number of poor farmers with these loans is mainly because of complex collateral and procedural requirements, the loan size being too high (up to VND 50million or approximately USD2,200) and limited repayment capacity of the poor household. The VWU also provides credit, mainly smaller-size and shorter duration loans via its TYM Fund or province-specific microfinance funds. However, only a small percentage of households are reached with this fund and the loans are primarily used for school fees, health costs, unexpected social or family events, small household investments or purchases for micro-businesses.

229. In addition to these formal mechanisms, the large majority of poor farmers in the both regions access credit informally through small scale local traders, collectors or agricultural input traders. Traders advance fertilizer, pesticide or other inputs, in the form of an in-kind loan, expecting to receive the payment with interest during the harvest season or in exchange for labor. This type of loan service can take off up to 25 percent of the gross profit from the poor farmers, compared to only 4 percent for the better off farmer.[140] At the same time, this system means that most poor farmers are already routinely in heavy debt and are therefore both reluctant, and ineligible for further credit even if it were available.

230. Loans entail financial risk, with 60 percent of poor farmers in debt, which is high but 15 percent lower than the proportion of indebtedness among non-poor, who tend to have more loans due to their higher financial capacity. In addition, there are a higher number of farmers with debts in regions where they grow high value crops such as coffee, pepper and dragon fruit, compared to low value crops, due to the higher investment costs for high value crops combined with price volatility.

[139] For example, the investment cost of overhead sprinklers is about VND 20- 25 million per hectare compared to VND 50- 60 million per hectare for micro sprinklers or drip irrigation.

[140] Poor coffee farmers in the Central Highlands produce on average 1.2tons per ha, while better off farmers 3.5tons per ha. The poorest produce annual revenues of about 20million VND per ha, while the better off farms' revenue stream is up to about 140million VND per ha. IFAD (October 2015) (Ibid.).

231. Markets in both regions are fairly well developed, particularly for major crops such as rice, coffee, pepper, cashew and fruits. Due to the value of coffee for export, its extensive cultivation and farmers' long experience, the majority of coffee farmers in the Central Highlands, including Dak Nong and Dak Lak, have access to commodity markets and can choose between a wide range of informal traders, registered business household and small size enterprises who compete with each other.[141] Nevertheless, information on pricing and market trends, while existing, is generally inaccessible to poor and near-poor smallholders. Access to market by poor and near-poor smallholders is impeded by this lack of timely and actionable information on demand, prices, logistics, etc., which can be a key to effectively managing the financial impacts of climate shocks.

232. An exception in terms of market access are farmers who grow low value crops such as cassava or maize, live in remote areas, have no or limited means of transport, need expensive agricultural labor, are not part of a farmer group or cooperative and are dependent on one or two traders. The higher the combination of these factors, the lower the access to markets. Markets are currently very focused on low quality but high volumes of agricultural produce, with limited on-farm processing, but private sector initiatives (see under chapter 3) and Government incentives are slowly shifting the market demand to sustainable resilient production.

4.4 Technical capacity and reach of agricultural extension agencies is limited on supporting pro-poor gender-responsive climate risk management and resilient agriculture

233. The GoV agricultural extension system was officially established in 1993. The main objectives of the current system are to: "raise producers' awareness through training in production and business knowledge and skills; provision of services to assist farmers in carrying out effective production and extension activities adapted to ecological, climate and market conditions; contribute to restructuring the agricultural economy towards commodity production, higher productivity and quality as well as food hygiene and safety; and accelerate agricultural and rural industrialization, ensuring national food security, socio-economic stability and environmental protection". The system is organized in five levels: a central-level National Agricultural Extension Centre (NAEC) within MARD, and a centre and/or staff at each administrative level below: province, district, commune and village. Across the country, there are approximately 36,000 extension staff working at subnational level, making an average of one public extension worker per 300 farming households. 59% of them work at the village level. 31.6% of all extension workers are women, 34.8% have an ethnic minority background and 15% have received a professional training in the field of extension.[142] Expenditure on extension services amounts to about US$ 3.80 per farming households, of which eighty percent is sourced from the local government.[143]

234. Trainings for farmers are also organized by the Communist Party's socio-political or so-called 'mass organizations', mainly the Farmers' Union and the VWU, the latter often combined with their credit facilities (see section 3.1.2). They have an extensive membership as well as network of staff at the grassroots level. For their trainings on technical topics related to agriculture, the mass organizations rely on the MARD extension services system for providing trainers.[144]

235. The current capacity and resources of the MARD agricultural extension services are constrained, particularly on regularly providing technical information and advice on climate resilient farming practices and technologies. The existing services are top-down, supply-driven, not interactive, have a limited technical focus, are oriented towards rice and high value crops for export, and mostly benefit better-off male farmers and farmers who are fluent in Vietnamese. Extension services have no systematic collaborations

[141] IFAD (October 2015). (Ibid).

[142] Data from 2012. Source: Nguyen V. B. (March 2012). Agricultural Extension in Vietnam: its roles, problems and opportunities. Vietnam Academy of Agricultural Sciences.

[143] OECD (2015) (Ibid).

[144] In addition, people can also receive vocational training on non-agricultural topics. This system is organized by MOLISA's General Department of Vocational Training and network of vocational schools.

or working relationships with research institutes. Trainings are often organized once or twice per year, with limited follow-up, and only for ten to twenty farmers per village. Lack of sufficient resources such as funding, demonstration and other materials and time are also constraints mentioned by the local authorities.[145]

236. Although the demand is very high, a majority of farmers have never received or participated in a training event on climate risk and vulnerability analysis and planning, resilient agricultural techniques, water efficient practices, or disaster risk reduction, due to the reasons mentioned above. Women and ethnic minority farmers are particularly disadvantaged. More than 60 percent of men farmers in both regions regularly attend community meetings or have received at least one training per year from extension workers, compared to a mere 15 percent of women farmers. Women participation in these events is considerably higher in female headed households - 40 percent - compared to male headed or mixed households. Ethnic minority farmers do not also equally benefit mainly due to the language of the trainings, inaccessible training materials and specialized information. [146]

237. In terms of the mass organizations, while many farmers are officially members of the Farmers' Union, they receive limited support, and the support is not tailored to their needs, similarly as with the GoV extension services. What trainings there are, are often organized once or twice per year, with limited follow-up, and only at a small scale i.e. for ten to twenty farmers per village. Membership of the VWU is lower, particularly in Dak Lak, Khanh Hoa and Binh Thuan. The main support received through the Women's Union is on access to low interest micro-credit and training on small-scale farming models such as vegetables through home gardens and livestock. For trainings on livelihoods, the Women's Union as well as the Farmers' Union often collaborates with technical staff from the DARD extension department.

238. Important to note is that where extension services or support from mass organizations is limited, farmer self-help groups or networks tend to be stronger, for example in upland self-reliant ethnic minority communities. Farmers in these areas also rely significantly more on informal traders to obtain new information or agricultural inputs, which provides an important entry-point for information dissemination and technology transfer.

239. Government, development partners and private sector support on value chain development and agricultural modernization are considerable, particularly for high value crops and in areas well connected to markets. For example, only a few years ago MARD has upgraded the Department of Agro-Processing and Trade to also focus on market development and agricultural innovation. However, farming practices still remain dependent on one or two markets only, lack long-term planning, and are more focused on volume of agricultural outputs instead of quality and the application of very resource-intensive and non-resilient practices that degrade natural resources such as water and soil. The shift to a more resilient and sustainable agricultural production has commenced but is still limited, with the inclusion of poor small-scale farmers a particular challenge.

240. Livelihood support to the poor and marginalized is small, limited to certain locations and insufficient to meet their needs. Considerable support has been provided through the GoV's poverty reduction programs, but in a top-down, non-participatory manner and delivering mostly in-kind support, indirectly creating a culture of dependency on state support. Other support is mainly provided through the VWU and NGO development projects and primarily focuses on income generation, establishment of farmer groups

[145] Oxfam in Vietnam (December 2014). Agricultural Extension and Poverty Reduction: Strategic Choices in Ethnic Minority Communities. Policy Brief; IPSARD, FAO, GACSA (July 2016) Climate Smart Agriculture (CSA): Towards Selecting Suitable Measures in Response to Climate Change in Vietnam; Nguyen V. B. (March 2012) (Ibid); OECD (2015) (Ibid); and confirmed by consultations in the five target provinces.

[146] Post-emergency evaluations for the drought 2015-2016 also confirmed that trainings on climate smart agriculture (as part of the emergency support for livelihood recovery) were appreciated, but not tailored enough to the poor, women or ethnic minority farmers. See: UN Viet Nam (January 2017). Viet Nam: drought and salt water intrusion emergency 2015/16. After Action Review, and Nguyen P. L. (November 2016). The Coping Strategies of Coffee Farmers in Response to Water Scarcity: A Case Study of Ethnic Groups in the Central Highlands of Vietnam. Paper for the International Conference on the Mekong, Salween and Red Rivers: Sharing Knowledge and Perspectives Across Borders.

and cooperatives, access to micro-credit and awareness raising. Although targeting the most marginalized, including ethnic minorities, the coverage of these latter projects is limited, especially in the Central Highlands.

4.5 Limited access to timely, integrated and actionable agro-climatic information for on-farm water management and agricultural planning

241. The meteorological observation network in the South-Central region and Central Highlands areas is comparatively thin, with each station covering an average of 3200 km2station. This is significantly less than the national average of 400 km2/station (according to HMS). Coverage in project provinces is as follows:

- Khanh Hoa province has two meteorological stations located in the coastal area and two rain gauges located in the northern part of the province. The meteorological stations are traditionally monitored by observers, running 4 times/day (1h, 7h, 13h and 19h), with rain gauges in automatic stations. It is able to store and update data hourly.
- Ninh Thuan province has one meteorological station located in the coastal area and five rain gauges located in the west of the province.
- Binh Thuan province has two meteorological stations located in the coastal area and two rain gauges located in the center of the province.
- Dac Lac province has one meteorological station, two climate stations and 16 rain gauges. The operation of these meteorological stations is similar to the stations in Khanh Hoa province. In 2017, Multimedia Agriculture Communications Joint Stock Company (AgriMedia) set up an automatic weather station for Agriculture only (iMetos). This consists of eight stations, one in each district of Dak Lak. The government has regular access to weather forecast information of the iMetos stations and assesses as well the sensor preformance of these stations. In general, these stations are evenly distributed throughout the province. The weather forecast information of AgriMedia is always shared on the following website: http://daklak.thoittietnhanong.vn/.
- Dak Nong province has one meteorological station, one climate station and 14 rain gauges These stations are evenly distributed at elevations below 1000m and operated like the meteorological stations in Khanh Hoa province.

242. Precise locations of these stations are provided in Annex II-c of this Feasibility Study. The Government is considering further investment in additional stations however this is not yet confirmed. They are also considering creating incentives for the extension of the Dak Lak AgriMedia company (http://agrimedia.vn/en/home/) pilot to other areas, and the project will make sure to closely coordinate with these efforts. Beyond availability of raw data, the challenge remains that while province level hydro met data is available, it often is not sufficiently accurate or well analysed to be well applied at commune level. The quality and dissemination of agricultural meteorological forecasting from the hydro-meteorological centres at regional and provincial levels does not match the significant demand for climate-resilient agricultural development in the region.

243. DARD provincial offices in charge of applying agricultural meteorological information are not sufficiently trained and educated to exploit and use the data effectively, when they develop seasonal crop calendars. While extensive and more developed in terms of equipment, technology and capacity than other similar low middle-income countries, Viet Nam's climate information services system has significant deficiencies in terms of data generation, processing, dissemination and use: outdated meteorological observation network, no downscaling to the agro-climate zone level, limited accuracy, limited monitoring of radiation, soil moisture and evapotranspiration, ineffective translation of scientific and technical weather and climate information for use at the local level, and lack of interest from Government staff in using it for agricultural planning leading to insufficient investment. [147]

[147] For details, see sub-assessment report on Climate Information.

244. Climate information services are rapidly expanding, and especially for the Central Highlands is very driven by the private sector. However, it is to a large extent in the demonstration stage for both regions and services are very tailored towards one crop, high-value crops, use of smart phone applications and dependent on user fees, which has its limitations for the poor and the most marginalized. Services, especially the GoV ones, are also very top down with limited farmer engagement. Except for a few private sector initiatives working with better-off farmers, there are limited examples of on-farm self-monitoring of weather, soil, nutrition and other factors.

245. As discussed in Section 3.2.3, across the country, projects on climate information have so far invested a lot in building capacity and information systems at the national level but have done limited work on building the capacity of provincial, district and commune meteorological and agricultural staff, and even less with mass organizations. These projects primarily focus on the improvement of forecasting infrastructure, modeling and top-down products, with very limited albeit successful work being done on participatory development of agro-climate advisories through farmer involvement.

246. Demand for localized, reliable, timely and integrated climate and agricultural information is very high, equally among poor as well as non-poor farmers. A recent information needs assessment[148] conducted with coffee farmers in Dak Lak confirms that 86% of farmers want weekly and monthly rainfall information and 81% early warning information for extreme rainfall and droughts. 59% of farmers want information on temperature minimum, maximum and averages and 57% on soil moisture and humidity. 74% wants regular information on groundwater levels and 49% information on water evaporation. 94% of farmers want to receive information on soil quality and 91% want to receive warnings on pests and diseases. However, even with the needs so high, the demand is barely met by the existing GoV and private initiatives, creating a considerable gap or constraint for climate risk-informed agricultural planning, and farm and natural resources management. In particular, poor and small-scale farmers with rain-fed crops who cannot cope with severe damages and loss from rainfall variability and extreme weather events, need adequate and regular information to limit their risks.

247. Currently, the main channels to receive information on weather, early warning and climate change for farmers in both regions is television, but for a minority also the village loudspeaker system and through community meetings. The more upland and remote the farmers live, the more they rely on the village leader and on fellow farmers to share information, for example for the Raglai communities in the upland areas of Ninh Thuan and Khanh Hoa. The near-poor and better-off farmers increasingly access this information through smart phones, with smartphone use also increasing among youth from poor households, who often migrate for seasonal labor. However, although text message services for weather, agricultural and market price information are increasingly used, it is still emerging and mainly reaching better-off farmers. For example, 31% of coffee farmers in Dak Lak use text messages for accessing price information, only 7% for weather forecasts and a mere 1% for information on farming techniques.[149]

248. Information received through television is very basic, not downscaled enough to the locality so too general or considered by farmers as very reliable. The information is also not linked to actionable advice on what to do to prevent damage or loss of crops or livelihoods from erratic weather or disasters. Information received through the loudspeaker system or GoV staff is perceived as not timely, unpredictable, scattered with limited integration, difficult to understand or interpret, and not reaching lots of farmers, particularly the most marginalized. In addition, most information is developed in a top-down manner without much involvement of farmers or without building on farmer learning and experience, resulting in a mismatch between available information and user requirements.[150]

249. While local authorities state that early warning messages, accompanied by technical advice on water saving, seasonal calendar changes or cropping techniques, are developed by the local authorities and distributed through the television and extension services system, consultations confirm that it does not

[148] Community Development Center (March 2016). Results report of Farmer Households Survey – Smart Beans G4AW Project.
[149] Community Development Center (March 2016) (Ibid).
[150] RIMES, CGIAR (2015). State of Climate Information Products and Services for Agriculture and Food Security in Vietnam.

reach all vulnerable groups nor is detailed enough or actionable. A majority of ethnic minority farmers confirms that they did not receive any information or advice from the local authorities during the recent drought. [151]

4.6 Constraints for women and ethnic minority farmers

250. A 2009 World Bank study identified three trends that account for different economic outcomes in ethnic minority and Kinh-majority communities: differences in assets, differences in capacity, and difference in voice. Within each broad trend, there are numerous specific causal factors for ethnic minority poverty, summarized as six '*pillars of disadvantage'*: i) lower levels of education; ii) less mobility; iii) less access to financial services; iv) less productive, lower-quality land; v) limited market access; and vi) stereotyping and other cultural barriers. No single factor explains the difference in outcomes among ethnic minorities and Kinh, even among those living in the same area. Instead, differences in these six areas combine to influence ethnic minority livelihood outcomes and lead both directly and indirectly to persistent poverty. The study concludes that poverty reduction depends on taking a comprehensive approach to removing each of these pillars of disadvantage. [152]

251. According to a 2012 World Bank study on poverty reduction in Viet Nam, ethnic minority farmers are skilled at producing crops, raising animals, and other agricultural activities. However, their relative position in the market has weakened over time; many of the benefits of economic growth have accrued to better off households and those working in industrial and commercial activities, with few ethnic minorities represented in these groups. The lower relative returns to agriculture are in part a result of policy decisions that have a disproportionate effect on ethnic minorities. Future growth in agricultural livelihoods is also threatened by risks and vulnerabilities such as changes in commodity market prices, natural disasters, climate change, and environmental degradation. However, certain key features of the agricultural economy have improved, with better access to price information and to credit, including for ethnic minorities. [153]

252. In terms of household incomes, nonagricultural wages make up a much smaller part of ethnic minority income compared to Kinh. Minority households earn very little from nonfarm enterprises, consistent with the dominance of Kinh traders. In addition, income transfers, including private remittances and public programs, are considerably lower among minority households, a result of lower domestic migration and access to public services.

253. Major barriers preventing women and marginalized farmers from adopting or influencing the household and communities' climate resilient strategies are factors such as: women's heavy workloads in terms of domestic and caring work as well as production; lower recognition of women's work; an imbalance towards lower-valued farming work with women and marginalized farmers proportionally over-represented at the production side of the value chain; limited decision-making power in the community and at governance level, with men and the Kinh majority playing the dominant role; significant differences between men and women, ethnic minorities and other marginalized groups in terms of education and literacy; lower participation of women compared to men, poor farmers and ethnic minorities in community meetings or attending extension trainings; and unequal access to and control over resources such as market and climate information, technical support, agricultural inputs, productive land, climate smart technologies, flexible finance, means of transport and communication etc. [154]

4.7 Institutional gaps and constraints

254. While Viet Nam has an extensive policy framework on climate change, gaps and constraints remain. The 2013 Communist Party Resolution 24-NQ/TW (see section 2.1.4) recognizes a number of

[151] UN Viet Nam (January 2017) (Ibid), and Nguyen P. L. (2016) (Ibid). Verified by field consultations.
[152] World Bank (January 2009). Country Social Analysis: Ethnicity and Development.
[153] World Bank (2012). Well Begun, Not Yet Done: Vietnam's Remarkable Progress on Poverty Reduction and the Emerging Challenges.
[154] ADB (July 2017). (Ibid), UN Women and Institute for Family and Gender Studies (2016). Female Farmers and Inclusive Growth in Vietnam; and CARE International in Vietnam (July 2015). Win-win results. Gender equality in climate change programming. Learning Series Issue 1. Verified by field consultations.

challenges on the national response to climate change as follows: insufficient awareness about climate risks, impacts and solutions; prioritization of economic development over sustainable development; an inconsistent legal and policy framework with limited prioritization and inadequate resources for implementation; poor integration and joint planning between sectors and regions; weak coordination between ministries, sectors and localities; and limited participation and investments, or incentives for, the private sector and civil society. The 2016 Action Plan for Implementation of the Paris Agreement (see section 2.1.8) reiterates these challenges and adds: inefficiencies and weak capacity at the lowest level where most work needs to be done; reactive addressing of climate change rather than proactive; and too much investment in structural measures with limited attention to non-structural measures.

255. A climate expenditure and investment review conducted by MPI, the World Bank and UNDP in 2015 acknowledges that Viet Nam developed a robust policy and institutional framework but that gaps still remain.[155] There is need for improved information systems and monitoring and evaluation of policies to ensure goals are met and policies are aligned towards the same goals, with the oversight role of the NCCC to be strengthened. More capacity is required, as well as resources, at the national level but particularly at the sub-national level. Mainstreaming of climate change response into sectoral policies has progressed in some but remains limited in others. Improvements need to be made also in the planning and budgeting process to deepen integration. The review also highlights that the majority of the GoV climate change response has so far focused on large-scale irrigation and transport infrastructure that have climate resilience as a co-benefit. This is reiterated again in Viet Nam's NDC where it is acknowledged that the state so far has had limited investment in full-fledged adaptation and can only meet 30 percent of the country's adaptation needs.[156]

256. The NGO CCWG stresses the following challenges in the limited uptake or replication of community-based climate change initiatives: budgetary constraints and limited funding channeled through local mechanisms; a diffuse policy framework; top-down policy and program development, planning and implementation with limited feedback options; insufficient available climate information to ensure adaptive decision-making at the local level, including by farmers; a focus on large scale hard infrastructure and significantly less on green infrastructure, livelihoods, capacity building and governance; low implementation capacities; and inadequate socialization or consensus at multiple levels.[157]

257. Mandates and resources on key resilience issues such as water resources management and climate information services are scattered across ministries and departments, mainly MARD and MONRE, with insufficient coordination between the different agencies. Policy development and implementation also remains very top-down, with limited resources available for implementation.

258. In terms of irrigation management, one of the main institutional challenges is the lack of budgetary resources, staff's low technical skills and limited staff to maintain efficient operations of irrigation infrastructure. Before 2008, PPCs and IMCs were collecting and using water service fees from farmers as their main source of operation and management budget, besides additional small transfers from central level. However, since GoV Decree 115/2008/ND-CP exempted farmers from paying these service fees, the PPCs and IMCs have to rely on their own budgets, which are very constrained, de facto leading to a significant reduction and neglect of irrigation infrastructure.[158] Other constraints, primarily at subnational level, are inadequate decentralization with unclear mandates, limited accountability mechanisms and incoherent policies and regulations, for example on participatory irrigation management.

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[155] MPI, World Bank and UNDP (April 2015). Financing Viet Nam's Response to Climate Change: Smart Investment for a Sustainable Future. Laying the foundation for resilient low-carbon development through the Climate Public Expenditure and Investment Review.

[156] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Viet%20Nam%20First/VIETNAM%27S%20INDC.pdf

[157] CCWG (2016). People know, people discuss, people do and people monitor. How community-based climate change initiatives help policy makers in Vietnam to address climate change through policy and programming. CCWG policy brief; CCWG (2016). Community-based Climate Change Initiatives in Vietnam. Experiences of the members of the Climate Change Working Group; and CCWG (2017). Fulfilling the promise. Making climate change resilience for all a reality in Vietnam.

[158] ADB, MARD (April 2017) (Ibid); OECD (2015) (Ibid) and the sub-assessment report on water.

259. On resilient agriculture, gaps and constraints are as follows: conflicts and trade-offs between environmental protection, climate change adaptation and improvement of livelihoods and incomes, between ensuring food security and the reduction of greenhouse gas emissions; overlapping mandates leading to a divergence in policy implementation; lack of solid scientific evidence; lack of financial mechanisms for integration; absence of criteria for environmental risk evaluation and level of integration; lack of mandatory integration of climate change into agricultural policies; limited incentives within policies for private sector to apply resilient technologies and practices; insufficient private sector investments with resilient agriculture technologies often being too costly or requiring high upfront investments (for example in water saving irrigation systems and solar powered irrigation systems).[159]

260. In terms of mainstreaming and addressing gender issues within climate change policy and programming, NGOs have highlighted a number of key barriers.[160] Commonly, gender is addressed in climate change and disaster risk reduction as an after-thought, addressed only under the 'cross-cutting issues' category of a policy document or action plan leading to mainstreaming fatigue and a 'ticking-the-box' attitude. Women are repeatedly labelled as among the most vulnerable to climate change and are too often 'victimized', together with other groups such as people with disabilities, ethnic minorities, children, etc. The VWU – and in some cases MoLISA – is too often the Government institution solely tasked with addressing gender equality in a climate change context. Also, the potential of the VWU in co-implementing work on livelihoods and natural resources management is overlooked. An understanding of the gender-climate nexus and gender analysis and mainstreaming skills are limited across all levels of Government, nor are these topics systematically prioritized in trainings or capacity building on climate change and disaster risk reduction.

261. On the policy and legal framework towards improving the socio-economic situation of ethnic minorities, NGOs through the Ethnic Minority Working Group have identified the following major gaps and constraints: strategies, policies, plans and investments focus more on 'economic growth engine' areas and less on remote areas where most ethnic minorities live; policies and programs do not reflect or support the diversity, different needs and vulnerabilities among ethnic minorities; Government authorities do not sufficiently engage ethnic minorities, and in particular ethnic minority women, in program, project or investment design, decision-making, management and M&E, making them 'reactive receivers' instead of 'active contributors'; policies are fragmented and incoherent; and there is a lack of knowledge and institutionalization of good practices on ethnic minority poverty reduction. In addition, CEMA who is mandated to provide policy and technical advice to other ministries and local authorities, has limited institutional capacity, resources and power or influence.[161]

4.8 Knowledge management gaps

262. In terms of knowledge management or the creation, sharing, use and management of knowledge and information, considerable efforts have been undertaken by Government and non-Government organizations on developing an enabling environment for supporting climate resilient water resources management, agriculture and value chains. Most of these efforts have focused on the national level leading to improved institutional capacity of mainly MARD and MoNRE. However, there is a significant gap between the national and subnational capacities and capacity of mass organizations such as the Farmers' Union and the VWU, limited transfer and flow of information from national to provincial and even more to sub-provincial level, limited use of new information technologies and insufficient peer-to-peer and upward sharing of farmer good practice. Evidence and recommendations on issues such as participatory agro-climate information services and gender, vulnerability and resilience are also insufficiently documented through Government regulations, guidelines, training materials or other documentation.

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[159] IPSARD, FAO, GACSA (July 2016) (Ibid).

[160] CARE International in Vietnam, Oxfam, SNV, Save the Children, Australian Red Cross, EDF, Plan International (December 2015). Beyond Words. Advancing Gender Equality in Climate Change Policy and Programming in Vietnam. And confirmed through the Gender sub-assessment (see annex).

[161] Ethnic Minority Working Group (June 2014). Critical issues in achieving sustainable development of ethnic minorities in Vietnam. At the World Bank International Conference on 'Sustainable Development and Ethnic Minority Poverty Reduction in Mountainous Regions'.

263. The GoV has a comprehensive policy framework on socio-economic development, agriculture, water resources management and climate change adaptation and mitigation, and has developed a number of explanatory decisions, circulars, directives, operational guidelines or manuals to provide detailed guidance and support its implementation at subnational level. A few notable examples are the: Prime Minister Decision on the Restructuring of the Agricultural Sector (899/QD-TTG); MARD Decision on Restructuring Scheme of the Irrigation Sector (794/QD-BNN-TCTL); MARD Decree on Agricultural Extension (02/ND-CP); MPI Adaptation Prioritization manual (1485/QD-BKHDT); MARD Guidelines on Community-Based Disaster Risk Assessment; and MARD training-of-trainers material on disaster risk management and climate change adaptation (583/QĐ-TCTL-ĐĐ). However, while comprehensive, these materials often do not reach the subnational level, particularly the communes and districts where most work is done or are not often combined with proper training or mentoring.

264. Trainings for Government staff on irrigation (including participatory irrigation management), water resources management, disaster risk management and climate change are mainly provided through the Vietnam Academy for Water Resources and its Center for Training and International Cooperation. The trainings are high quality, professional and comprehensive but primarily target national level staff.

265. The MARD NAEC and the Plant Protection Department provide trainings to agricultural extension workers. They have a number of training manuals and materials available for their national and subnational staff, for example a National Sustainability Curriculum on coffee cultivation or a Technical Guideline on Resilient Livelihoods. Trainings are provided annually but are insufficient to meet the demand due to limited resources.

266. Over the years, United Nations agencies, NGOs, research institutions and development partners have documented various good practice and lessons learned on resilient agriculture, community-based disaster risk reduction, climate change adaptation, natural resources management, livelihoods and rural development. In addition, lessons learned and good practice on working with ethnic minorities and on addressing gender issues within a climate change context have also been documented. For some examples, see chapter 5 and the bibliography section. These publications primarily target GoV decision-makers and planners, donors and peers at national and international level with limited dissemination at subnational level.

267. In addition, several online good practice databases have been supported by NGOs and research centers, for example: a *Climate Smart Agriculture database* (http://csa.mard.gov.vn/General/home.aspx), managed by the MARD Institute of Policy and Strategy for Agricultural and Rural Development and supported by SNV, Winrock, American Red Cross and SRD; and the *Spatially Characterized Agroforestry or SCAF database* (http://scafs.worldagroforestry.org/), managed by ICRAF World Agroforestry Centre and a number of Vietnamese research institutes. Both databases are relevant and to a certain extent user friendly but have considerable limitations: incomplete data and information, using an outdated interface and design, limited mobile functionality, limited interaction or user-input and not targeted for use by farmers.

5. GOOD PRACTICES AND LESSONS LEARNED

268. Past and on-going programs and projects, as described in chapter 3, as well as initiatives from other parts or outside Viet Nam generated a number of good practices and learning that will help the project to design adequate and well-informed responses to the key gaps and barriers as described in chapter 4. This chapter provides an overview of those good practices and lessons learned on the issues of water security in the context of climate change, linked to strengthening agricultural resilience and improved agro-climate information services. It also looks at good practice and learning on engagement with small-scale farmers, mechanisms to support them to improve their resilience and on addressing gender and ethnic minority barriers and constraints through climate change programming.

5.1 Water security in the context of climate variability and change

269. Lessons learned on water and irrigation management in the context of climate change context in Viet Nam include:[162]

- Irrigation systems have to be organized to cater to multiple crops and co-existing cropping systems rather than be focused on mono-crops such as rice. This facilitates more effective climate risk management and more stable incomes, as when climate conditions heavily impact one crop, other crop revenues can compensate any income gap;
- Both irrigation management and agricultural production should be oriented towards integrated resilient agricultural systems and become more flexible in order to deal with fluctuations in weather, water resources availability but also fluctuating market demands;
- Irrigation systems should be able to deal with multiple hazard risks and not solely focus on flood-resilience or drought-resilience;
- Overall, productivity of irrigation water can be improved by: enhanced farmer awareness on water shortage and climate change risks, improved soil and water conservation practices, wider application of water-efficiency technologies, better access to extension services, combined use of irrigated water with alternative water sources such as wells, and a more equal role for men and women in water utilization and management;
- From an institutional perspective, water efficiency can be improved through better water supply monitoring, modern water information management systems, and improved management and decision-making processes.

270. Learning from three World Bank-supported projects on irrigation, agricultural development and climate change implemented in China over 2006-2010 point out that:[163]

- The concept of evapotranspiration management can underpin sustainable water management. Three simple but powerful ideas - that water is only used up by evapotranspiration, that allowable evapotranspiration has to be capped at a sustainable level, and that the goal is to minimize non-beneficial evapotranspiration - can transform the way water is managed;
- It is possible to simultaneously boost water productivity, land productivity and resilience. Usually, more agricultural productivity requires more water. In the projects, intensive agricultural extension, community management of irrigation, environmental improvements, and promotion of higher value crops and commercialization managed to conserve water while boosting crop quantity and quality. This was done in significant part by reducing non-beneficial evapotranspiration;
- Water-saving agricultural projects could in principle provide immense economic benefits. In water-scarce regions, there is a substantial economic value to water savings;
- Climate change adaptation interventions are easily adopted when they bring immediate benefits under current climate conditions and variability. Measures introduced were deemed resilient to future conditions but already made good farming sense given current risks. Substantial outreach to farmers and policymakers helped with adoption, as did incorporation of the innovations in a larger project;

[162] Sub-assessment report on water.

[163] World Bank Independent Evaluation Group (June 2015). Project Performance Assessment Report. People's Republic of China. Irrigated Agriculture Intensification III Project. Mainstreaming Climate Change Adaptation in Irrigated Agriculture Project. Hai Basin Integrated Water and Environment Management Project.

- Multi-agency, technically based, integrated water management is possible. Under the projects, environment and water authorities worked together, in consultation with stakeholders to develop plans. The plans were informed by hydrological models that helped prioritize ways to meet water quality and quantity goals;
- Field-level and basin level approaches are complementary. Holistic management at the basin level depended on the ability to deploy field level techniques for increasing water efficiency. But promoting irrigation efficiency can lead to continued groundwater depletion unless total consumption is capped;
- Climate modeling is best used to test adaptation policies for robustness against different scenarios, rather than to predict 'what will be.' There are limits to the ability of climate models to predict future cropping conditions, because of fundamental uncertainties about the effect of more carbon dioxide on crop growth, and inability of models to accurately predict precipitation;
- Sharing of data is a key to success. Progress was made when the relevant ministries pooled information from their formerly separate monitoring stations and worked together to solve problems, and when basin authorities shared information with counties. Coordination is hindered when counties found it hard to share information with upstream or downstream neighbors, and when information flows from the center diminished.

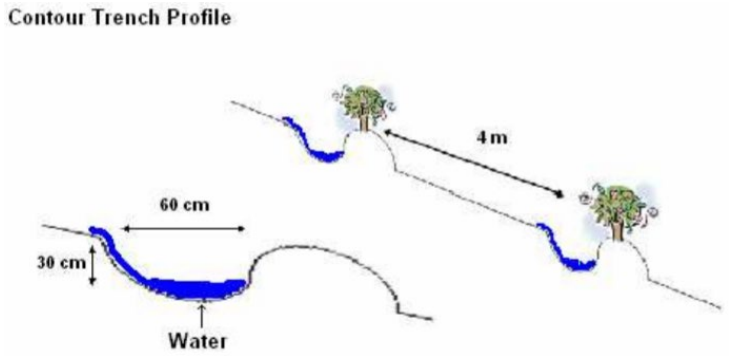
271. There are multiple good practices in Viet Nam and in the Central Highlands and South-Central Coast on on-farm rain, surface and shallow ground water storage and management. The following table provides an overview of these common practices:[164]

[164] Farmer consultations conducted all five provinces.

Table 9: Examples of water harvesting and management techniques for irrigation purpose		
Technique:	**Description:**	**Picture:**
▪ Water storage tanks	Water tanks are containers of variable sizes and materials (concrete, PVC, stone or ceramic) for storing water, often connected to a house or building's roof to enlarge the rainwater catchment surface. They can be elevated above ground to avoid the need for pumping but can also be dug in the soil to reduce evaporation or to receive groundwater. Water tanks are often used to provide water for consumption or domestic use but can also be used for irrigation purposes. They are used for rainwater harvesting, turning peak rainfall events into opportunities for improved irrigation and risk management.	 
▪ Groundwater wells	A water well is an excavation or structure created in the ground by digging, driving, boring or drilling to access groundwater in underground aquifers. The well water is drawn by a pump or by using containers such as buckets that are raised mechanically or by hand. Wells are small-scale, when used by one household, or medium-scale when shared by a number of households.	 
▪ Ponds	A pond is a body of standing water, artificially created by digging out a pit to catch rainwater or shallow groundwater. Depending on the land available, ponds can be small to large-scale with different volumes. They can also be temporary or permanent, depending on the local water availability and crop water requirements. Simple ponds require regular maintenance due to siltation and sedimentation and potential degradation of borders.	 

▪ Bioengineered ponds [165]	Ponds are bio-engineered when specific 'green' measures are taken to reduce water loss due to evaporation and filtration. The 'green' measures are based on natural materials, such as using compact clay bottom to reduce filtration, using shade trees against the wind and sun, using grasses (such as vetivers) to protect the banks against erosion etc. Often, additional income can be obtained from using fruit trees such as banana.	
▪ Temporary ponds in flood plains or riverbeds	Provisional ponds or small-scale basins are, with machines or manually, dug out at the end of the dry season to create an artificial reservoir in lowland flood plains or riverbeds. At the beginning of the dry season, when the river water levels decline significantly, the basins serve as a temporary water reservoir used for agricultural production and livestock. This measure is labor intensive and short term but is a traditional method to preserve water in dry zones.	
▪ Weir	A weir is an impervious barrier constructed across a river to raise the water level on the upstream side. Weirs can be built of wood, concrete or moraine material (rocks, gravel, boulders). The water is raised up to the required height and the water then flows over the weir. In a weir the water overflows the weir, but in a (check) dam the water flows out over a spillway. Weirs have traditionally been used to create ponds. They are also used to prevent flooding, measure discharge, and help render a river navigable.	 

[165] MARD Institute of Water Resources Planning (June 2017). Promoting the Application of Green Water Management in Rain-fed Agriculture in Vietnam. Progress Report.

▪ Field or contour trenches or contour farming [166]	Field trenches can be described as a form of extensive ploughing to the right angle of a field's slope. By breaking the slope of the ground, it increases rainfall harvesting and hence reduces soil degradation and enhances infiltration of surface runoff and soil moisture. It's applicable to both relatively level land and steep slopes, and to all soil and rainfall conditions. For optimal performance, trenches are constructed along contour lines. When digging the trench, the excavated soil is placed downslope along the edge of the trench and crops are then planted on this elevated land.	
▪ Planting pit [167]	Planting pits are a form of micro-catchment for precipitation harvesting to prevent water runoff and thereby preserve soil and soil moisture, increase infiltration and reduce erosion. The water collected is provided for various crops planted within or close to them. To further increase crop production, organic matter can be placed in the pits as fertilizer. When heavy rainfall occurs, the organic matter can additionally help to soak up and retain excess water. They are applicable for semi-arid and arid areas and for annual and perennial crops.	
▪ Vetiver grass application to combat bank erosion [168]	Vetiver grass (*Chrysopogon zizanioides*) is planted as a hedgerow along the contours of sloping land to form a very dense vegetative barrier that slows down run-off, helps the water soak into the soil rather than washing off the slope, and provides significant soil reinforcement with its roots. It helps to reduce erosion, reduce and conserve rainfall runoff, improve ground water recharge, remove pollutants from water, and reduce the risk of flooding.	

[166] www.sswm.info/content/field-trenches
[167] www.cgiar.org/?attachment_id=2106
[168] Truong P., Tran T. V., Pinners E. Vetiver System Applications. Technical Reference Manual.

272. Recharge of groundwater has also been promoted via a method called 'Managed Aquifer Recharge'. While it has been applied in other countries for decades, it was only tested for the first time in Viet Nam as part of the UNESCO supported project '*Augmenting groundwater resources by artificial recharge in Binh Thuan province, Viet Nam'*, from 2004 to 2010 (see under section 3.3.1). [169] Trials are also about to start in Dak Lak in areas where intensive groundwater pumping for coffee production has led to declining groundwater availability. A new means of implementing Managed Aquifer Recharge - referred to as 'underground taming of floods for irrigation' - has been proposed by the International Water Management Institute and is being tested in the Ganges Basin. [170] As this technique is in the piloting stage, it is worth monitoring its progress and effectiveness, but currently not yet ready for scaling.

273. Lessons learned on participatory irrigation management, including operations and maintenance (O&M), from ADB-supported irrigation and drainage projects, indicate that:[171]

- The participatory approach to O&M is a viable and effective option for sustaining irrigation investments. Farmer managed irrigation schemes are considered more sustainable because they are generally small, and they can have cohesive links with farmer beneficiaries. This approach to O&M should be considered in the project design and appropriate resources provided to enhance and promote participation;
- Stakeholders have to be involved as early as possible, rather than in a residual activity after physical facilities are completed. In addition, farmers' existing structures and traditional practices must be closely studied and considered while designing irrigation facilities;
- Stakeholder identification and assessment – for example through community profiling - are a key foundation for participation. Stakeholder analysis is fundamental to participation work at any level and provides an understanding of the interests of individuals, groups, and institutions that have something to win or lose from a project;
- Good governance of community organizations is important in ensuring the participation of beneficiaries and affected groups and in preventing any dominant authority from taking control of water resources. For example, situations where large landowners and certain ethnic groups dominate water user associations to their advantage may not be conducive to participation;
- During implementation, ownership is enhanced when farmers provide in-kind and voluntary labor support and co-share the cost of irrigation improvements. The quality of construction work undertaken by the farmers is considered better than works built by contractors, possibly because farmers better appreciate the value of the constructed works and participation in construction gives the farmers a sense of pride and ownership;
- Irrigation leaders and ordinary farmers both need training on the O&M of newly built structures but improving the skills and awareness of farmers is even more important because they are directly involved in O&M of the canal systems;
- Aside from collecting water user fees for routine O&M, water user associations' roles can be broadened for social mobilization, repair, and farmer-level agriculture extension services;
- The participatory process takes time. Irrigation development through farmers' participation is demanding and time-consuming;
- One alternative to participatory irrigation management is to involve the private sector in publicly managed irrigation and drainage schemes.

274. Experience with water user groups in Viet Nam teaches that:[172]

- There are limited incentives for participatory irrigation management among local government staff and limited good practice;
- The majority of water user groups were specifically set up for a project and the large majority of them failed to be sustained after the project finished. Most small-scale irrigation structures are

[169] Nguyen T. K. T., Nguyen V. G., Phan T. K. V., Ardulno G., Bono P., Bui T. V. (October 2008). Management of aquifer recharge. Groundwater storage in the sand dunes of Viet Nam. Tech Monitor Special Feature: Water Harvesting Technologies.

[170] http://utfi.iwmi.org. In: CGIAR Research Program on Climate Change, Agriculture and Food Security- Southeast Asia (2017). Assessment of potential CSA options for future agriculture production in the South-Central region of Vietnam.

[171] ADB Independent Evaluation Department (March 2012). Participatory Irrigation Management. How can participation contribute to the sustainable management of irrigation and drainage systems for agriculture? Learning Lessons.

[172] Sub-assessment report on water.

solely managed through the commune PPC and village leaders, but not effectively, leading to infrastructure deterioration;
- A good practice for self-managed water user groups is where communities decide on their own code-of-conduct, and receive supervision and technical support from the commune authorities, but keeping the management and O&M responsibility within the group;
- Water user groups are not entitled to loans from the GoV credit institutions, which would provide them with a more stable source of finance for O&M. Government policies or regulations on this are absent.

275. A World Bank rural transport infrastructure development project in North-Viet Nam in 2015 introduced a novel approach to O&M of rural infrastructure, building on ideas from the communities themselves. The project supported ethnic minority women in forming and operating road maintenance crews, as an alternative to costly and inefficient O&M by local contractors. The women receive a remuneration for regular road maintenance (requiring around five to ten days of work per month) and technical assistance, including initial training, is provided by the local authorities. To deal with the high interest among the community members, the women designed a self-managed rotating schedule. This rotation allowed everyone to participate, resulted in greater buy-in from the communities, and created an environment of trust and mutual support.[173]

276. On ensuring irrigation management is pro-poor, lessons from Viet Nam and China highlight that:[174]
- The multidimensional nature of poverty is not sufficiently supported or addressed in irrigation management, and poverty is seen too much as a production or income issue ignoring poor irrigation performance;
- Inadequate funding is identified as the largest constraint to better management;
- To try to increase the willingness of farmers to pay water user fees, the sharing of information between management and farmers is important. Regular communication with farmers created a more transparent management system, which fostered farmer compliance. Particularly important seemed to be discussions between farmers and management on the specific use of collected water fees and problems facing management;
- Another method for encouraging farmer compliance with payment of fees was the use of social pressure, with non-payment by one farmer resulting in all farmers being cut off from canal water; and
- Better management and better infrastructure go together. If the canals are badly damaged, then better management cannot be effective.

277. Water-efficiency technologies, for example drip irrigation, overhead sprinklers, spray irrigation or precision irrigation, have also been sporadically promoted by local authorities and the private sector, but at very small scale, with limited technical extension support, with a high to very high investment cost and therefore low uptake, particularly among the poor. They are also improperly applied, especially in the case of sprinkler irrigation, so the water consumption remains high and the water-efficiency questionable. Investment in these technologies is feasible, but preferably through risk-sharing group mechanisms such as via agricultural cooperatives, farmer groups or water user committees to share the investment, technology and O&M costs. Recently, MARD and the Directorate of Water Resources have issued a handbook on water-efficiency irrigation for a number of crops such as coffee, pepper, dragon fruit, cashew nut, banana and fruit trees, but materials are not yet available for other common crops in the targeted regions such as mango, apple, grapes or vegetables.[175]

278. An exception to the poor unable to invest in expensive systems is an initiative by the NGO International Development Enterprises, that promoted a low-cost micro-irrigation technology option affordable for the poor and near-poor, co-designed between farmers, local suppliers and technical facilitators and resulting from a 'participatory technology development' approach (see above under section

[173] Tran P. T. M. (August 2015). Empowering local women to build a more equitable future in Vietnam. Blogpost. See: http://blogs.worldbank.org/transport/empowering-local-women-build-more-equitable-future-vietnam
[174] Biltonen E., Doan D. T., Wang J. (January 2002). Making irrigation management pro-poor: lessons from China and Vietnam.
[175] For details, see sub-assessment report on water.

3.1.4). The co-designed micro-irrigation led to increased water productivity, profitability and water-efficiency in comparison to traditional practices. It saved labor, land space, electricity costs, reduced the need for pesticides and was therefore also more suitable for women compared to the existing technologies. On average, the investment cost of micro-irrigation is US$150 per 1,000m2. Farmers using the new micro-irrigation technology earned US$17 of profit per square meter in comparison to non-users who earned US$8 per square meter of land. Farmers with micro-irrigation used 32 percent less water than other farmers, across all stages of crop production. The main learning from this good practice is that to ensure uptake and benefit among the poorest, it is crucial to engage them throughout the entire process of market and needs assessment, product design, market development and replication, as potential buyers as well as sellers. [176]

5.2 Strengthening agricultural resilience

279. Two studies carried out to assess the efficiency and effectiveness of the implementation of the major NTPs (see section 2.1) have identified a number of overall lessons on implementing livelihood and rural development programs in Viet Nam:[177]

- It is critical to invest in the implementation and coordination capacity of commune officials, ethnic minority communities and leaders;
- Civil society and private sector can be included as potential service providers to deliver livelihood training and capacity support;
- Improving access to, and quality of investments and services that support the transformation of agriculture is critical for improving rural incomes;
- The success of the NTPs in increasing rural livelihoods, also hinges on diversification of livelihood options beyond on-farm production, by investing in off-farm and non-farm livelihood choices;
- Initiatives to reduce the gender gap through NTP investments are required; and
- Socio-economic development plans are an important basis for investment decisions.

280. Lessons learned from within the ASEAN region on integrated farming systems within a climate change context include:[178]

- There is no one-size-fits-all model. Each system is dependent upon the given landscape and micro-climate. Identifying ideal combinations of integrated farming systems for the area will require close coordination with agricultural extension officers and experts from local universities with a focus on agro-ecology;
- The technical design of each integrated farming system requires a combination of experts with knowledge of each sub-production system;
- Achieving harmony among the various production systems may require limiting the quantity of a sub-system. However, asking a farmer to reduce his/her rice production or quantity of livestock to introduce a new system can be a risk that many farmers are reluctant to take;
- Adding in any production system with a longer return-on-investment horizon (versus the current cropping system) can be a barrier for a risk-averse farmer. Incorporating grants, small loans or co-investment from cooperatives are a few of the many strategies to help finance a transition to an integrated farming system;
- A country's agricultural or land use policy incentives can themselves be a barrier to introducing new integrated farming systems. Subsidized inputs for rice farming or credits for fertilizers and herbicides may encourage the expansion of a mono-cropping model and make the transition appear like a costly investment.
- Many of the challenges can be overcome if a systems approach is applied and a comprehensive package of support is delivered, mixing capacity building, policy incentives and financial risk reduction strategies.

[176] Rose R., Bui, T., Nicoletti, C. (September 2016). iDE Vietnam – SDC Evaluation Report; and expert consultation with iDE, 6th September 2017.
[177] World Bank (June 2017) (Ibid).
[178] ASEAN (September 2017). ASEAN Regional Guidelines for Promoting Climate Smart Agriculture (CSA) Practices. Volume II.

281. Various climate resilient livelihood models or good practices, including for the poor, have been promoted and documented by MARD, research organizations, NGOs and private sector. These include, among others: [179]

- Rice: Alternate Wetting and Drying, System of Rice Intensification, 1-must-5-reductions (1P5G)
- Efficient water management: water and input saving, moisture-preserving practices, mulching
- Improved crop varieties, i.e. drought, flood, salt and disease tolerant
- Inter-cropping models or rotational cropping
- Agro-forestry: Sloping Agricultural Land Technology, mixed crop-tree systems [180]
- Other crops: organic and green vegetables, integrated food-energy systems
- Integrated farming models: rice-fish, rice-shrimp, rice-duck, vermiculture, Garden-Pond-Shed
- Livestock: feed and fodder management, manure management, bio-bedding, biogas
- Closed loop agriculture: agricultural waste management, bio-char, bio-fertilizer

282. Particularly for soil and land management, good practices in Viet Nam are: [181]

- *Intercropping systems* – incorporate trees into agricultural cultivation systems to improve productivity, resiliency, profitability, and sustainability. For example, in the Central Highlands region, multi-strata agroforestry systems with durian, pepper, coffee, green bean and maize are very popular. During the first two years, income is earned mainly from green beans and maize, while coffee is harvested in the third year, and durian and pepper in the fifth year. The net income of this system is approximately 73 million VND/hectare/year. Other systems include cashew, squash, green bean and maize, with cashew harvested in the fifth year. The net income from this latter system is approximately 48 million VND/hectare/year;
- *Contour farming* - is a widely practiced method to control erosion, which is done by ploughing and/or planting across a slope following the contour lines. These contour lines are delineated by grass strips or dense vegetation which create water break points and reduce the formation of rills and gullies from heavy water runoff. Planting *Fallopia japonica* or double vetiver grasses along the contour line can prevent soil erosion, reduce soil loss by 50 to 60 percent, and supply 7.47 tons of biomass/hectare/year;
- *Mulching* - protects the soil against rain splash and maintains a favorable soil microclimate such as higher moisture or reduced heat by using vegetative residues and organic materials to form a protective surface layer;
- *Cover cropping* - provides a valuable management tool to improve soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in an agroecosystem. The cover crop species may be chosen for nitrogen fixation capabilities, such as a legume, or for economic diversification purposes;
- *Minimum tillage systems* - combined with a legume cover are also effective in controlling erosion in Viet Nam. In contrast to intensive tillage of the soil, minimum tillage includes reduced disruption of the soil which improves soil fertility, structure and infiltration.

283. Lessons from successful and sustainable agricultural models in ethnic minority areas show that these models work for the poor and marginalized when they are: easy to do, use less labor and investment, are suitable to local soil conditions and irrigation, produce products that are easy to sell, receive continuous support over the years, receive close monitoring, and promote farmer-to-farmer cooperation in the community. In contrast, models that are difficult to sustain or replicate normally, require intensive investment that is unaffordable to ethnic minority households, are not suitable to local soil and irrigation conditions, do not link to markets and receive one-time support without close monitoring and evaluation. [182]

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[179] See for example: MARD Action Plan in Response to Climate Change in Agriculture and Rural Development; MARD Extension Services Department (December 2015). Tài liệu hướng dẫn lựa chọn và triển khai sinh kế thích ứng với biến đổi khí hậu (only available in Vietnamese); IPSARD, FAO, GACSA (July 2016) (Ibid); UTZ (January 2016). Climate Change and Vietnamese Coffee Production. Manual on Climate Change Adaptation and Mitigation in the Coffee Sector for Local Trainers and Coffee Farmers; CCWG (November 2015). Community-based Climate Change Initiatives in Vietnam.

[180] Examples of agroforestry systems practiced in Vietnam can be consulted in the ICRAF Vietnam database: http://scafs.worldagroforestry.org/

[181] For more details, see sub-assessment report on climate resilient agriculture.

[182] Oxfam (December 2014) (Ibid).

284. The relatively low level of technology use among farmers highlights the persistence of several challenges and barriers to adoption of the resilient practices. Barriers often relate to low availability of required inputs (such as seeds for improved varieties, or water scarcity during droughts), high costs of installation (e.g. of improved irrigation facilities) with limited access to credit and markets, high labor costs and a limited level of technical knowledge and skills. Addressing those barriers is a key requirement for successful out-scaling of climate resilient agricultural practices.[183]

285. Recognizing that each context and specific practice are different, ICRAF World Agroforestry Centre developed eight steps or 'features' towards implementing and scaling climate smart agriculture: (i) engage local authorities, communities and technical partners throughout the process; (ii) review local land use, land use plans, policies and support programs; (iii) prepare a portfolio of scalable climate smart agricultural practices; (iv) participatory prioritization of scalable climate smart agricultural practice; (v) awareness raising and information events; (vi) capacity building; (vii) information provision and technical support; and (viii) follow-up, monitor and report.[184] A similar process has been promoted by MARD with technical support from a number of NGOs: (i) learn about local climate risks; (ii) analyze the impacts on people's livelihoods; (iii) identify the most vulnerable; (iv) identify available adaptive livelihood options; (v) review the requirements and conditions to apply each adaptive livelihood solution; (vi) assess the suitability of each to the local context and vulnerable groups; (vii) select options to implement or scale; and (viii) plan, implement and monitor.[185] In addition, CARE in support of MoNRE has developed a user-friendly tool to assess and rank livelihood options for various categories of resilience: climate change adaptation, climate change mitigation, economic feasibility, institutional feasibility, social and cultural feasibility, environmental sustainability and replication potential.[186]

286. In response to the severe drought of 2015-2016, the CGIAR research consortium recommended the replication of the following good practice to improve the resilience of crop systems in the Central Highlands: [187]

- Deploy available drought-tolerant crop varieties during the dry season.
- Integrate appropriate drought-tolerant and economically useful tree species within existing farming systems and to stabilize slopes. At the farm level, these: (i) provide shade for crops and animals; (ii) ameliorate micro-climate conditions; and (iii) provide additional biomass and income for farmers.
- Develop crop-livestock–landscape simulation models that can demonstrate a range of scenarios and conduct landscape modeling with farm profitability scenarios. This helps farmers find optimal strategies for maintaining production and profits in the context of climate change.
- Feed crop residues to livestock when feed is scarce and external inputs not accessible.
- Establish fodder banks in contour hedgerows. This provides additional biomass for livestock and at the same time helps maintain soil quality by reducing erosion and cushioning the impact of drought and other climate-related events from mono-cropping in the short term.
- Develop community-based water availability maps based on the systematic recording of groundwater levels in wells and surface water level by community observation networks.
- Promote and incentivize broader private sector involvement. For instance, supply chain initiatives could be utilized as entry-points where large buyers of agricultural commodities support farmers in adapting to climate change and reducing their emissions.

287. For the South-Central Coast, recommended good practices are as follows:

- Promote crop diversification to market-oriented crops that are suitable for the different drought risk conditions. There is, however, a need to redesign the irrigation system to facilitate crop diversification, for more efficient distribution of water, and for better drainage.

[183] MARD, IPSARD, FAO, USAID, Winrock and CIAT (in preparation). Climate-Smart Agriculture in Viet Nam.
[184] Simelton E., Le T. T., Bac V. D., Tuan M. D., Hoa D. L. (in preparation). 8 features towards scaling Climate-Smart Agriculture. Manual for scaling out climate-smart agriculture on the ground, with experiences from My Loi climate-smart village, Vietnam.
[185] MARD Extension Services Department (December 2015) (Ibid).
[186] CARE International in Vietnam (January 2016). Climate Resilient Livelihood Assessment Matrix.
[187] CGIAR Research Centers in Southeast Asia (April 2016) (Ibid).

- To increase the resilience of the poor, who may have more limited capacity to diversify into commercial crops or are located in less productive degraded areas, integrated farming systems with inclusion of small ruminants can be promoted. Including small livestock for smallholders who have limited land also helps buffer the shocks from extreme weather-related events.
- Changing to direct dry seeding with the use of available irrigation facilities, using drought tolerant rice varieties and applying alternate wetting-drying methods can help optimize water use during the dry season.
- Opportunities to reduce demand and increase water productivity can be achieved through improved organic matter management, increasing water holding capacity and fertility of root zone soil, and minimizing leaching of water and nitrate to groundwater. Utilization of organic soil amendments and mulching can increase soil water holding capacity, improve soil physical parameters, and ameliorate soil nutrient deficiencies.
- Farmer-managed natural tree regeneration could be promoted to allow for native tree species to regenerate on farmlands. Otherwise, intercropping with high-value tree species for timber, fruits, or fodder is also an option. Tree planting around farm plots should also be promoted to serve as windbreaks, thus protecting crops from damage by strong winds, and mitigating wind erosion.

288. Across the world, including in Viet Nam, governments and development organizations have supported so-called *'innovation platforms'* as a good practice to improve agricultural value chains and farming practice. An innovation platform is an assembly of key actors – farmers, NGOs, service providers, traders, agro-dealers, researchers and policy makers – with different backgrounds and interests who come together on a regular basis around a shared agenda or to solve a common problem, to interact and share ideas and negotiate collective or coordinate action as a solution. They can operate at national level and be policy-oriented but are mostly at more local levels where they can deliver practical solutions to pertinent issues with a particular value chain, for example improving its resilience or making it more pro-poor. The platforms are not a mechanism for transfer of top-down predetermined information or technologies but a space for negotiation and collaboration. They don't need to be officially formalized so they can keep their flexibility and dynamics, particularly at local levels. Importantly, the platform needs to be well facilitated, underpinned by action planning and monitoring of the plan, be steered towards action to avoid becoming a vehicle only for discussion, have benefits for all participants, and be guided by realistic objectives with a minimum level of ambition. Depending on their purpose and results achieved, the platform can be dissolved once the objectives have been reached.[188]

289. In 2014, the CGIAR-affiliated research organization Humidtropics set up an innovation platform on vegetables to promote coordinated action on the part of farmers, input suppliers, government agencies, and vegetable traders. The platform was chaired by DARD and had 50 members. The entire platform met annually, while a smaller group of core members met quarterly. Platform activities focused on organic vegetables production and marketing in Son La province in northern Vietnam. Learning from the project stresses: the importance of the Government as instrumental facilitator in engaging private sector; the need to focus the platform around one or similar value chains guided by a shared work plan; the higher interest generated by working on high-value crops; and the usefulness of subgroups to advance certain actions through a more technical group that meets regularly. [189]

290. Innovation platforms are commonly made operational and functional through the following typical phases:[190]

i) Platform initiation or identification of existing platforms with which to align;
ii) Decide on focus and vision;

[188] Posthumus H., Wongtschowski M. (2014). Innovation Platforms. Note 1. GFRAS Good Practice Notes for Extension and Advisory Services, and CGIAR-ILRI Innovation Platform Practice Briefs, see: https://cgspace.cgiar.org/handle/10568/33667/recent-submissions?offset=0

[189] To Thi Thu Ha (March 2016). Vegetable Innovation Platform in Vietnam Bears Fruit – and Vegetables!, http://humidtropics.cgiar.org/vegetable-innovation-platform-in-vietnam-bears-fruit-and-vegetables/

[190] Shut M., Andersson J.A., Dror I., Lundy M. (June 2017). Guidelines for Innovation Platforms in Agricultural Research for Development. Decision support for research, development and funding agencies on how to design, budget and implement impactful Innovation Platforms.

iii) Create joint-understanding of the problem and identify entry points;
iv) Test and refine innovation, often through a subset of platform members;
v) Develop capacity in the platform, for example through the integration of a Farmer Field School program;
vi) Outscaling and upscaling;
vii) Transition for sustainability.

291. The CGIAR 'Challenge Program on Water and Food', implemented over 2002-2012 in six river basins globally, including the Mekong, generated the following seven lessons on innovation platforms:[191]

- The most successful platforms are self-reliant, demand-driven, evolve over time and embrace multiple perspectives. A platform is not a committee but is very dynamic. While there tends to be a core team that actively facilitates interactions among its members, those members interact more or less closely as the problem definition changes and different skill sets are required. Different stakeholders can be involved at different times, depending upon the issues to be discussed. While no one should be excluded, not everyone need be involved at the same time;
- Platforms are useful for dealing with complex problems that require people to work together. They can address a single issue or complex problems involving a wide range of actors. Engagement is used to bring people together to solve complex problems where institutional innovations can help catalyze uptake of new technologies or approaches;
- Build on what is already there rather than set up new platforms and systems. It takes time to set up platforms, to get members to understand what they are and how they function, to build trust and develop a collective vision and agenda. Inviting multiple perspectives also means there is a need to understand different agendas and sometimes conflicting mandates. For all these reasons, platforms are best developed around existing relationships, networks and structures;
- Platforms are not neutral mechanisms. They aim to promote change so they are disruptive by nature. Changing existing dynamics may result in winners and losers and may have unknown consequences that could shift dynamics among the actors. Addressing power and representation during the setting up stage helps make engagement platforms more equitable and effective;
- Establishing a set of connected platforms horizontally and vertically stimulates better integration and chances for scaling up processes and impact. Horizontal links refer to cooperation between platforms situated at the same level (e.g. at district level). Vertical links refer to cooperation from local levels (e.g. a village, a community) to district, regional, national and sometimes international level. Cooperation does not necessarily mean establishing multiple platforms. Sometimes it may be better to link a single engagement platform to other organizations, networks or individuals that evolve at other scales. Engagement at the national level tends to focus on policy dialogue and ensuring evidence is feeding into policy processes;
- Platforms can empower local actors to hold higher levels of government to account. Giving stakeholders a voice is one of the prime functions of a platform;
- Markets provide clear incentives for investments in production. Platforms help reduce the cost of searching for and reaching markets and allow actors who understand the challenges and opportunities in the local system to devise and test solutions. Platforms are tools for pooling knowledge across the agricultural business, education, research and extension systems to generate, disseminate and use engagement to reduce transaction costs.

5.3 Farmer learning processes

292. There have been different modes in Viet Nam of engaging farmers in project activities on agriculture, rural development and climate resilience, with the most successful approach being a group-based learning process called Farmer Field Schools (FFS). FFS are implemented differently in each context, but overall apply the following process: a combination of training-of-master-trainers/training-of-trainers (usually of the agricultural extension department, by external technical experts from MARD, research organizations or NGOs), followed by a training-of-farmers targeting 'farmer champions', 'lead

[191] CGIAR Challenge Program on Water and Food (June 2013). Seven lessons learned to catalyze African innovation through engagement platforms.

farmers', 'farmer-promoters' or leaders of farmer groups, farmer-led on-site demonstration, testing and learning following crop cycles, and on-going mentoring support to continue the farmer peer-to-peer learning and sharing. Although FFS clearly have demonstrated their effectiveness and influenced GoV extension services and mass organizations, these latter services still operate based on a traditional top-down farmer education model of lectures, technical training materials, demonstration plots at better-off farms or on public land and limited to no follow-up at the farmer level.[192]

293. Another similar approach is the 'participatory technology development' approach, where technology is co-developed by farmers, technical experts and private sector, through participatory studies and farmer-led experiments. The new technologies or practices developed through this method are more adjusted to the local context and the needs and resources of poor and near-poor farmers, and therefore ensure a larger uptake among this group (see section 5.1).

294. Experiences with implementing FFS across the world, including in Viet Nam, generated the following lessons:[193]

- In contrast to traditional extension approaches, FFS result in better application of good farming practices and technologies and improved agricultural productivity and incomes, and also to a certain extent lead to improved farmer cohesiveness, networking and information sharing, and self-confidence;
- FFS are better suited for marginalized populations such as the poor and ethnic minorities;
- The key objective of FFS are to foster farmer-to-farmer experiential learning, and not a vehicle for top-down transferring of technology, messages or to raise awareness;
- The content and methodologies of the FFS should be adapted to the needs and interests of the community, in particular the target groups, but also to the cropping system or technique promoted;
- The FFS should be organized in line with the crop seasonality;
- Farmers should take part in the design, selection and M&E of the FFS topics, methodologies and schedule but also the promoted farming techniques and cropping systems. The less participation and the less relevant the new technique or technology, the less sustained uptake will occur;
- Recruitment of facilitators should take into account personal attitude, maturity, literacy, leadership skills, knowledge in local language and experience with farming. In many contexts the gender of the facilitator should also be carefully considered;
- A FFS cannot be carried out without facilitators properly trained in the FFS bottom-up approach, including in gender and outreach to marginalized groups. Often the scaling of FFS is limited due to problems in recruiting and training appropriate facilitators at scale;
- Facilitators should have access to ongoing support and backstopping from supervisors and technical experts connected to local research centres. Regular monitoring of facilitators may help to identify schools where additional support is required;
- Special attention is needed to avoid turning the learning field into a competition between farmers and facilitators or simply a demonstration of the superiority of a new technology;
- Exchange between FFS should be encouraged;
- The FFS should also integrate training and learning on skills such as experimentation, communication, information analysis, decision-making, problem-solving etc.;

[192] Van de Fliert E., Ngo T. D., Henrikse O., Dalsgaard J. P. T. (June 2007). From Collectives to Collective Decision-making and Action: Farmer Field Schools in Vietnam; Dalsgaard J.P.T., ea. (2005). Introducing a farmers' livestock school training approach into the national extension system in Vietnam; Oxfam (December 2014) (Ibid); and expert consultation with ICRAF, 5th September 2017.

[193] IFAD (2017). Agriculture, Famers and Rural Areas Support Project. Project completion report, Ninh Thuan Province; Waddington H., Snilstveit B. ea. (September 2014). Farmer Fields Schools for Improving Farming Practice and Farmer Outcomes: A Systematic Review; Mariyono J., Luther G.C. ea. (September 2013). Farmer Field Schools on Chili Peppers in Aceh, Indonesia: Activities and Impacts; Mvena Z. S. K., Mattee A. Z., Wambura R. M., ea. (December 2010). Farmer Field Schools as a Springboard for Enhanced Uptake of New Agricultural Technologies: Lessons for Tanzania; Dzeco C., Amilai C. and Cristovao A. (2010). Farm field schools and farmer's empowerment in Mozambique: a pilot study; Praneetvatakul S. and Waibel, H., (2006). Farm Level and Environmental Impacts of Farmer Field Schools in Thailand; Nederlof E. S., Odonkor E. N. (December 2006). Lessons from an Experiential Learning Process: The Case of Cowpea Farmer Field Schools in Ghana; Thiele G., Nelson R., Ortiz O. and Sherwood S. (2001) Participatory Research and Training: Ten Lessons from the Farmer Field Schools (FFS) in the Andes.

- Selection criteria for FFS facilitators and participants should guarantee participation of all social and economic groups, aiming for a balanced social, economic and gender mix. Better-off, more educated farmers and farmers with decision-making power and more resources to do outreach to non-participants should also be included;
- Specific measures should be taken to ensure the FFS' reach is not confined to the immediate participants but also extends to other farmers. Often the latter are poor farmers, women farmers and farmers from marginalized groups. Safeguards should also be in place to avoid elite capture;
- Common barriers to out-scaling of FFS's knowledge and practice are: a complex curriculum, lecture-based training not building on experiential learning, low levels of social capital and social networking, and targeting approaches;
- Farmer's participation should also pay off, and the FFS should be cost-beneficial to them in the first place. The program should be designed so it doesn't require unreasonable amounts of time and costs to the male and female farmers without immediate benefits;
- FFS's key learners or lead farmers can develop simple work plans to commit to conduct outreach and farmer-run learning sessions to scale out the FFS;
- NGOs and research institutes can be valuable partners as technical and organizational resource;
- Sustainability of the FFS should be considered from the onset of its implementation, as often they stop working as soon as the project funding runs out.

295. Farmer learning has also been proven to be more effective when using videos that are made with farmers, so-called 'farmer-learning videos'. A project on cassava pest management in Viet Nam applied a method called 'farmer-to-farmer video extension' as part of their FFS. Using educational videos made by extension workers and farmers and distributed through farmer networks, the local extension network, mass organizations and agro-enterprises, the project was able to reach a significantly higher number of farmers than through conventional extension methods such as training. Important to note is the need for integration into other existing advisory services for farmers to follow-up and get more advice or support where needed. In addition, technological constraints can inhibit the distribution of videos in very remote areas.[194] Similar good practice on farmer-learning videos or video-mediated learning is available in Bangladesh[195], Benin[196], Uganda, Ghana[197] and various other countries. Toolkits[198] and example videos are also available online through organizations like Digital Green[199], Agro Insight and Access Agriculture.[200]

296. Other good practice on facilitating farmer-to-farmer learning is through the organization of farmer fairs. Farmer fairs are local to regional, annual or more regular gatherings of farmers demonstrating new resilient crop varieties, advances in irrigation or water-efficiency technologies, machinery, crop and livestock management, post-harvest and food processing techniques, etc. Farmers fairs are regularly organized in South Asia, for example in India[201], but have also been organized at the smaller scale in North-Central Vietnam.[202]

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[194] The project is currently testing the distribution of videos through smart phones and providing voice advice through cell phones or fixed lines. Le N. L., Parker L., Wyckhuys K., CIAT (October 2015). Farmer to Farmer video extension for cassava pest management in the SE Asia region. Power point presentation.

[195] Chowdhury A., Odame H. H., Thompson S., Hauser M. (January 2015). Enhancing farmers' capacity for botanical pesticide innovation through video-mediated learning in Bangladesh.

[196] Zoundji G. C., Okry F., Vodouhe S. D., Bentley J. W. (January 2018). Towards sustainable vegetable growing with farmer learning videos in Benin.

[197] Bentley, J., Chowdhury A., David S. (August 2015). Videos for Agricultural Extension. Global Forum for Rural Advisory Services Good Practice Note for Extension and Advisory Services. CGIAR, GIZ, BMZ, FAO and Agro Insight.

[198] FHI360, USAID (2012). Integrating Low-Cost Video into Agricultural Development Projects. A Toolkit for Practitioners. See: http://ictforag.org/toolkits/video/index.html

[199] Digital Green also developed a digital platform for farmer-to-farmer exchange in rural India called '*Farmerbook'*: http://solutions.digitalgreen.org/coco/farmerbook/

[200] http://www.digitalgreen.org/videos/, http://www.agroinsight.com and https://www.accessagriculture.org.

[201] McCandless L. (October 2017). Cornell supports South Asia's largest farmer-to-farmer fair. http://news.cornell.edu/stories/2017/10/cornell-supports-south-asias-largest-farmer-farmer-fair

[202] In Ha Tinh province, supported by ICRAF World Agroforestry Centre https://www.youtube.com/watch?v=Y6jhmUFCYcw&t=

297. In terms of community social capital, farmer groups that have been most effective and sustainable in Viet Nam are pre-existing, self-managed or independent groups that have strong cohesion, trust, commitment and a shared financial or livelihood interest, for example cooperatives, farmer interest groups or village saving and loan associations. These groups have proven to be functional platforms for climate risk assessment and planning; access to technical and market information; improving buying and selling power; and building social cohesion. The least effective are groups that are created specifically for project activities, where membership is remunerated from outside sources rather than voluntary or where there are limited tangible benefits such as groups or clubs centered primarily around information sharing, awareness raising and behavior change.[203]

298. Critical factors for the adoption of new agricultural practices or technologies by farmers have been identified in Viet Nam as follows: personal experience, talking with other farmers and experts, gaining personal experience through experimentation, follow-up support, availability, including physical accessibility, of knowledge and skills, having financial resources, flexible land use regulations, and social networks. To reach women farmers, it is important to encourage women trainers, hold women-only learning events, or offer opportunities for gendered breakout group discussions.[204]

5.4 Agro-climate information services

299. CGIAR has formulated eight key lessons learned in scaling up climate services for farmers, based on 18 case studies in Asia and South Africa: [205]

- Rural climate services are enabled and sustained by institutional arrangements and investment in capacity at multiple levels that support sustained interaction between climate and agricultural organizations and farmers.
- Climate services must be delivered at a local scale to be relevant to farm decision-making.
- A seamless suite of forecast, advisory and early warning products, with a range of lead times, enables farmers to manage evolving risks through the season.
- Giving farmers an effective voice in the design, production and evaluation of climate services increases uptake, legitimacy, and sustainability.
- Integration of meteorological information with local indigenous knowledge may foster trust, local relevance and use.
- Face-to-face dialogue between farmers and service providers is an effective way to communicate historic and predicted seasonal climate information.
- Information and Communication Technologies, in combination with other communication channels, offer expanding opportunities to reach farmers with relevant information, at scale.
- Proactive targeting of women and other socially marginalized groups can help ensure inclusiveness in the design and delivery of climate information services for rural communities.

300. Good practices on agro-climate information products and services in the ASEAN region include: integrated cropping calendars in Laos and dynamic cropping calendars in Indonesia; monthly climate impact assessment bulletins for rice and corn, 10-day regional agro-weather information and a daily farm weather forecast and advisory in the Philippines; seasonal climate forecasts in Indonesia and Thailand; Climate Field Schools in Indonesia and the Philippines; Forest Application for Risk Management in Agriculture (FARM) schools in Myanmar; climate information services by radio broadcasts in the Philippines; dedicated farmer TV channels in Myanmar and Viet Nam; national Climate Outlook Forums in

[203] The exceptions are religious and cultural groups. Farmer consultations conducted in Dak Lak and Dak Nong (9-15 August 2017) and Binh Thuan, Ninh Thuan and Khanh Hoa (11-19 September 2017)

[204] Tran H., Simelton E., Quinn C. (2017). Roles of social learning for the adoption of Climate-Smart Agriculture innovations. CCAFS Working Paper no. 194.

[205] Tall A., Hansen J., Jay A., Campbell B., Kinyangi J., Aggarwal P. K. and Zougmoré R. (2014). Scaling up climate services for farmers: Mission Possible. Learning from good practice in Africa and South Asia. CCAFS Report No. 13. CGIAR Research Program on Climate Change, Agriculture and Food Security.

the Philippines and Indonesia; Monsoon Forums in Cambodia, Myanmar and Lao PDR; and the regional biannual ASEAN Climate Outlook Forum. [206]

301. The most successful farmer-driven agro-climate information services in Viet Nam are from the experience of ICRAF and CARE in their on-going '*Agro-Climate Information Services for Women and Ethnic Minority farmers in South-East Asia'* project. The project is continuously engaging men and women farmers in various stages of the project: during the baseline to understand the current situation, needs and scope, during the Participatory Scenario Planning or design, testing and adapting actionable agro-advisories, and throughout the project M&E. Important learning so far includes:[207]

- Climate information providers (for example forecasters) should improve their understanding of farmers' needs and more often directly engage with farmers for them to better tailor their services to farmers;
- The coordination between the operators of the local meteorological stations and the DARD is essential. While information exchange is mandatory, this however often does not automatically happen and even has to be budgeted;
- Weather forecasts available online or through Government sources are useful if combined with face-to-face interaction with other farmers, extension workers or meteorologists to discuss its interpretation and use;
- There is a significant number of farmers willing to pay for weather forecast services;
- Community boards used to share agro-climate information should be placed at more communal locations such as markets and schools;
- Podcasts have strong potential for large areas with internet, are appreciated by extension services who can watch it repeatedly but are time- and budget-consuming to maintain;
- Farmers, and in particular illiterate farmers, should be engaged in the design and testing of the format of the advisories so these can be adapted to various audiences, in terms of format, iconography, pictography and use of words;
- Participatory Scenario Planning workshops are crucial social learning opportunities but more likely to be sustained if combined with other local activities on credit and savings or agricultural training;
- Constant feedback loops between extension workers and the farmers is essential for relevant and effective advisories. In addition, different groups of farmers (social, economic, geographic, gender) should be engaged to enrich the feedback and learning;
- Institutional arrangements to implement or scale up climate services should complement ongoing rural development projects and build on existing community groups such as cooperatives, farmer interest groups, savings and loans groups etc.

302. In Viet Nam, besides television, short term weather forecasts are also available for free via smartphone applications or the internet, often with animated maps. With smartphone usage increasing, including among the youth from poor communities (see under section 4.5), promoting these free forecasts and weather apps as integral part of pro-poor agro-climate information services is a must. Experience from North Central Viet Nam teaches that with proper mentoring support these can be a valuable addition for farmers along with investing in improving the GoV's forecasting system.[208]

5.5 Mechanisms for initial financial support to farmers in adopting new practices

303. A variety of options have been used in Viet Nam to deliver financial support to farmers to strengthen agricultural production and climate resilience. These are often combined with technical information and training and have specific conditions per their purpose:

[206] ASEAN (September 2017) (Ibid).

[207] Simelton E., Le T. T. (ICRAF Vietnam), Hieu X. L. (CARE Vietnam) (September 2017). Talking toolkits and Participatory Scenario Planning (PSP) - methods for communicating agricultural climate services in Vietnam, Lao PDR and Cambodia. Powerpoint presentation at: Participatory and Institutional Approaches to Agricultural Climate Services Development: a South and South East Asia Regional Technical and Learning Exchange; and expert consultations with ICRAF and CARE, September 2017.

[208] Roy A., Simelton E., Quinn C. (2017). Which forecast represents the local weather best? Preliminary case study findings from My Loi village, northcentral Vietnam. CCAFS Info Note. CGIAR Research Program on Climate Change, Agriculture and Food Security.

- In-kind support.
- Conditional grants to purchase a certain good, with the grant providing full coverage or a certain percentage of the total amount ('seed grants'), depending on the farmers' socio-economic background.
- Vouchers, mostly conditional or limited to a list of agricultural input supplies or goods that can be obtained from small to medium-size local suppliers (based on a market assessment), with more options for the farmers to choose from than with the grant system.[209]
- Micro-credit or loans, conditional or non-conditional, often with a lower total amount, lower interest and different repayment schedules than loans provided by private banks.
- Community development funds, combining local state budget, external funds and community contributions, with funds allocated to activities resulting from participatory community-based plans.[210]
- Competitive grants for farmer groups, where farmers apply as a group for a grant (full or a percentage) after submitting a brief proposal in response to a call-for-proposals. Often the call has specific conditions in order for the farmer group investment to be eligible for the small grant.[211]
- Competitive grants for small and medium rural enterprises, with the same principles as the farmer group competitive grant. However, co-investment from the private enterprises is considerably higher percentage-wise than what is expected from the farmer group.[212]
- Preferential pricing schemes for farmer's access to climate-, water- and energy-smart technologies, negotiated with the private sector, to ensure access and encourage entry of the poor or near-poor into the market.[213]

304. All the above options have advantages and disadvantages, depending on the purpose of the support, the existence or non-existence of GoV regulations and enabling conditions. Mechanisms where farmers have a range of options to choose from or where they can propose themselves what to do with the financial support, are most empowering. Mechanisms for farmer support through engagement with the small, medium and large scale private sector are more difficult or time-consuming to set up in Viet Nam but can potentially reach more farmers.

305. There are two major ways voucher systems are being used for promoting agriculture practices, raising productivity and contributing to resilience objectives: 1) closed voucher systems and 2) flexible, open voucher systems.[214] With closed vouchers systems, farmers redeem coupons for a prescribed input packet from government-run or designated outlets. These types of systems tend to limit farmers' choice of inputs, are rarely attentive to agro-ecological and livelihood variations across space, crowd out private sector participation, and are frequently characterized by elite capture of inputs. Open voucher systems allow farmers to redeem vouchers for a wide range of inputs sold by registered private sector suppliers. In terms of contributing to resilience, experience from Africa teaches that closed voucher systems tend to undermine the development of private sector market channels, encourage monocropping and incentivize the production of crops in regions where they are poorly suited. On the other hand, flexible voucher-based systems can lower the fiscal cost of agricultural input support programs or subsidies borne by government and thereby create budget space for other important public investments in agriculture, encourage private

[209] See section 3.2.3 for FAO's experience with a voucher-for-drought recovery program in in Gia Lai, Dak Lak and Dak Nong. Expert consultation with FAO, 21st August 2017.
[210] Expert consultation with Oxfam, 25th August 2017.
[211] IFAD has extensive experience in promoting this kind of grants, including in Ninh Thuan and Dak Nong. Expert consultation with IFAD, 28th August 2017.
[212] Both IFAD and SNV have applied these competitive grant schemes in their projects. See: IFAD (2017). Co-Investment with Enterprises and Farmers. Guidance note for investment preparation; and SNV (2015). Vietnam Business Challenge Fund. Final Report.
[213] Applied for example by the NGO GreenID in their Local Energy Planning project in Thai Binh. See: CCWG (November 2015) (Ibid), p.78.
[214] Voucher programs used to be paper-based but increasingly use mobile phones to save even more costs, improve efficiency and to act as a safeguard against corruption. Examples of e-voucher systems can be found in Malawi, Zambia, Tanzania and Zimbabwe. Another system, also in Tanzania, lets communities manage the voucher program themselves through Village Voucher Committees and Village Executive Offices. See: Finmark Trust (May 2016). Agricultural Subsidies in SADC: Final Report.

investments in input supply systems and extension, and allow farmers to choose inputs that are appropriate for their farm systems. Traditional input subsidies or grants have either no effect on or have reduced smallholders' use of resilient agricultural practices.[215]

306. Lessons from across the world on utilizing vouchers as input subsidy programs for agricultural resilience, disaster recovery and overall rural development include:[216]

- Farmers have a higher preference for a voucher system compared to direct input distribution;
- The voucher system (instruction, conditions, validity, training materials, monitoring systems) needs to be very simple for farmers, agricultural input suppliers and facilitators;
- Both beneficiaries and traders should be sensitized to the use of vouchers, so that voucher redemption, reconciliation and reimbursement can happen smoothly.
- The list of options for agricultural inputs needs to be long and diverse enough to cater to all the cropping systems, farmer preferences and intended target groups. A participatory market assessment and participatory beneficiary selection are very useful processes in ensuring an adequate design of the voucher system;
- A 50:50 farmer contribution with a menu approach is an acceptable and effective approach that encourages inclusive intervention support to communities recovering from major stress periods;
- To reduce dependency and encourage market-based approaches in (re)building the asset base of farmers, farmer contributions should be gradually increased towards the end of the project or program;
- The voucher system should involve plenty of agricultural input suppliers and include provisions to avoid monopolies or oligopolies. On the other hand, criteria for selecting input suppliers shouldn't be too restrictive to avoid cancelling out the small rural enterprises, which often are more closely located to farmers;
- Contracts with traders should include some key voucher-specific aspects (e.g. commodity specification, trader payment terms, quality inspection and acceptance);
- Price negotiations with the suppliers should be based on a market price survey that is done on a regular, for example seasonal, basis;
- Reconciliation and trader payment should be based on voucher redemption summary forms submitted by traders;
- Voucher programme monitoring should be based upon information gathered from both beneficiaries and traders;
- Voucher schemes can be part of input trade fairs, particularly in areas with ineffective or no markets, to expedite the use of the vouchers, provide a farmer-to-supplier exchange platform, and enlarge the menu of options for farmers to choose from.

307. Common steps for designing and implementing a voucher scheme are as follows: i) consultations or sensitization with local authorities and communities to ensure buy-in; ii) conduct a market, traders' capacity, supply chain and price assessment; iii) select agricultural inputs; iv) beneficiary selection; v) selection and contracting of suppliers, with quality control of inputs; vi) design vouchers (value, logos, serial numbers, date of validity etc.), including anti-corruption measures; vii) train beneficiaries, suppliers and other stakeholders; viii) voucher distribution; ix) voucher redemption; and x) monitor use of vouchers, and monitor prices.[217]

5.6 Working with ethnic minorities

[215] Jayne T.S., Sitko N. J., Mason, M. N., Skole D. (July 2016). Can Input Subsidy Programs Promote Climate Smart Agriculture in Africa? USAID Policy Synthesis Number 93.

[216] Guo H. (September 2011). Analysis on the Influencing Factors of Farmers' Satisfaction to Vouchers, Based on FAO Post-earthquake Assistance Program in Sichuan, China; IFRC (2017). Roadmap for Voucher Issues in the Programme Cycle. Cash in Emergencies Toolkit; Mukorera O., Dengu E., Machisvo A. (September 2014). Improved food and nutrition security of vulnerable households in Zimbabwe through market-based input assistance. FAO Agricultural Inputs Provision Programme 2012-14. UKAid, Australian Aid and EU.

[217] FAO (April 2013). Guidelines for Input Trade Fairs and Voucher Schemes; and IFRC (2017) (Ibid).

308. A 2012 research analyzing good practice examples of ethnic minority poverty reduction in Viet Nam, identifies a path to successful rural development or poverty reduction by ethnic minorities, comprised of the following four steps or stages:[218]

1) Shift from semi-subsistence agriculture to cash crop production on part of the land or for one season. Key requirements to make the shift into cash crop production are capital to purchase fertilizers, water for irrigation, and technical knowledge to achieve a decent yield. Risk factors such as fluctuating prices, poor land quality and climate conditions means some poor households may stay in this stage for up to five years;
2) Focus on intensive agriculture, once the household can amass some savings and experience in cash crop production. In most cases, farmers who made this shift, have bought or leased small amounts of additional land where possible and access higher-interest loans using the land as collateral. They take part in technical training organized by agricultural extension services or the Farmer's Union and monitor market information constantly;
3) Invest in agricultural diversification or move to trading and services as a risk diversification strategy. Households at this level have above-average landholdings and are eligible for larger loans. As experienced, successful farmers, they are well-known and respected members of their communities with good connections with commune- and district-level authorities; and
4) Consolidation, and investment in children's education, for households with resources and savings above the national average.

309. Building on its work with ethnic minorities on climate smart agriculture in the northern mountainous regions of Viet Nam, CARE International in Vietnam and local NGO ADC have developed a '*Guideline for Indigenous Knowledge Identification and Use in Community Based Adaptation Practices*'. The guideline proposes the following steps to capitalize on local ethnic minority knowledge in terms of good agricultural practices: 1) identify appropriate indigenous knowledge on varieties, techniques and other measures; 2) evaluate their suitability and effectiveness for climate change adaptation; 3) further develop the indigenous knowledge practice and combine, if needed, with scientific knowledge and new techniques into one new indigenous knowledge-based resilient agricultural practice; 4) on-farm demonstration and replication, for example through FFS, demonstration plots, etc.

310. Additional good practice on working with ethnic minorities in Vietnam recommends the following:

- Thoroughly understand the local culture, norms and practices of the various ethnic groups to inform the design, planning and implementation of project activities. Integrate specific measures to address ethnic minority discrimination or marginalization into a project Gender and Inclusion Action Plan;
- Use local ethnic minority languages in training courses and project activities, including translation services, even if it is assumed that some of the participants speak the Vietnamese language. Particularly in terms of the more vulnerable ethnic group members, the use of the local ethnic language is considered essential and empowering;
- Use local ethnic minority language in training and communication materials or pictorial imagery customized to the local ethnic cultures – beyond the usual cultural folkloristic representation to also realistically represent their most common social and economic practices and customs;
- Engage Government staff (extension workers, mass organizations, village leaders, planners and decision-makers) with an ethnic minority affiliation in project activities, including in leadership positions. In addition, men and women community volunteers from ethnic community groups should also be mobilized, with appropriate support (transport or small allowance);
- Train project implementers, local authorities and other actors involved on community facilitation and inclusion approaches and action;
- Document and disseminate evidence and good practice on addressing ethnic minority marginalization issues through climate change policy and programming.

5.7 Working on gender within climate change programming

[218] Wells-Dang A. (2012). Ethnic Minority Development in Vietnam: What Leads to Success? Background paper for the World Bank 2012. Poverty Assessment.

311. Key lessons learned on addressing gender issues within rural poverty reduction and climate change programming have been identified as follows: [219]

- Understand gender and other sources of inequality to plan appropriate resilience and gender transformative actions; conduct a gender and power analysis at the beginning of a new project to inform the development of a Gender Action Plan.
- Monitor changes in gender inequality throughout climate change project implementation and act on issues that arise: (i) set up systems to track progress towards gender equality, including the collection of sex disaggregated data, use of indicators that measure changes in gender norms, and inclusion of women and men in project M&E; (ii) consider how activities may impact a range of gendered dimensions, monitor change such as on workloads, levels of decision-making, roles and responsibilities, rights awareness etc., and apply 'do no harm' principles in all the work; (iii) allocate budget for gender integration, gender tracking and for specific actions that promote gender equality and women's empowerment.
- For lasting change and resilience, address power and resources imbalances in the household and community and transform gendered roles and responsibilities. Implement interventions that support access and agency, not only focusing on the types of livelihood opportunities an intervention creates but also whether the process of creating that opportunity promotes women's increased self-confidence and decision-making abilities.
- Promoting unconventional and new roles for women helps shifting mindsets and commonly held beliefs. For example, supporting income-generating activities outside the traditional division of labor or training women as extension workers, community or trainers helps create new role models and challenges stereotypes.
- Integrated activities that promote improved livelihood security (through diversification as well as resilience), community-based natural resource management and women-led economic development: (i) facilitate equal access to and control over productive resources, markets and services including land, water, inputs, agro-climate information and both financial and extension services; (ii) organize men-only activities as an entry point to talk with them about men and women's roles in resilient livelihoods and how men can support the women to apply new techniques; (iii) women's groups, women-only trainings or meetings are a first step to build women's confidence in a safe space. However, it is important that these groups are brought into contact with the broader community to ensure that improvements in confidence are not limited to women-only spaces.
- Support to women's organizations, e.g. for credit, marketing and community planning is conducive to gender equality and women's empowerment because it can provide platforms for mutual support and interest. Social mobilization and enhanced leadership may also help women claim political spaces.
- Working with men is critical as they are often the gatekeepers of customary practices that limit women's access to resources or public spaces. Cultural sensitivity is required for discussing and promoting gender equality and women's empowerment with local men and traditional leaders, in particular in challenging contexts.
- A transformative approach must reach out to decision makers to ensure that positive changes on the ground are sustainable and are scaled up.
- What "gender transformative change" means depends on the context. Different benchmarks are needed for different contexts, but good contextual analysis is a general prerequisite.

312. Since 2009, IFAD and Oxfam Novib have promoted a household-based women's empowerment methodology in the context of livelihood and rural development called the '*Gender Action Learning System'* or GALS.[220] GALS aims to strengthen the role and decision-making capacity of women within the household and social networks for women and men at all levels. By forming a 'family vision' for the household livelihood strategy – or at the level of the farmer group - the family can conceptualize and work towards shared and measurable goals, including on women's empowerment. During the process of planning a livelihood

[219] CARE International in Vietnam (July 2015) (Ibid); IFAD Independent Office of Evaluation (March 2017). What works for gender equality and women's empowerment – a review of practices and results. Evaluation synthesis; and USAID (2014). Women's Economic Empowerment: Pushing the Frontiers of Inclusive Market Development.

[220] IFAD and FAO (December 2015). Promoting the leadership of women in producers' organizations: Lessons from the experiences of FAO and IFAD; and also see for the dedicated website: http://www.galsatscale.net/

strategy, all participants come to realize that working together is a win-win solution that benefits everyone. Men start to recognize the gap between the role that women play in agriculture and the home or community and the benefits that they receive. The implementation of GALS is often combined with capacity building and specific project activities so they also increase women's capacities and roles, confidence and skills to take up leadership roles in their households, communities and organizations. Currently, Oxfam, CARE and SNV are applying the GALS methodology with ethnic minority communities in northern Viet Nam (Bac Kan and Lao Cai) through the 'Women's Economic Empowerment through Agriculture Value Chain Enhancement' or WEAVE project.

313. On addressing gender within agro-climate information services, the most recent experience by ICRAF and CARE in North and Central Viet Nam shows that women and men farmers' needs and preferences must be considered to most effectively disseminate agro-climate information. Empowering women and men with access to information that they can understand, act upon, and share, can augment the productivity and resilience of farming systems. Understanding the nuances of unique gendered challenges and opportunities in terms of labor distribution, information dissemination, and collaboration is essential for identifying actionable adaptation strategies. Specifically, opportunities exist to improve intra-household information sharing. Gender factors must be integrated into project design, policy formulation and implementation at all levels.[221]

[221] Tuan D.M., Smith A., Le T.T., Simelton E., Coulier M. (2017). Gender-differences in Agro-Climate Information Services (Findings from ACIS baseline survey in Ha Tinh and Dien Bien provinces, Vietnam). CCAFS Info Note. CGIAR Research Program on Climate Change, Agriculture and Food Security.

6. RECOMMENDATIONS

314. This chapter proposes in detail activities and implementation modalities to address the major climate risks and impacts on water availability and agricultural resilience for small-scale farmers in the five target provinces (chapter 1). Recommendations are formulated to directly address the identified key gaps and barriers for small-scale farmers to build resiliency (chapter 4), such as unreliable sources of water for agricultural production and out of date adaptation systems, weak capacities on climate risk management, limited access to timely, integrated and actionable agro-climatic information for on-farm water management and agricultural planning, limited technical, financial and organizational resources for smallholders to invest in technologies and practices for climate resilient agro-ecosystems, inadequate extension services, multiple gender constraints and barriers specific to ethnic minorities, and institutional capacity, policy and knowledge management gaps. The recommendations are based on replicating or scaling good practices and lessons learned from past and on-going projects in Viet Nam (chapter 3 and 5) and are formulated in line with national and local policy priorities (chapter 2).

6.1 Targeting approach and beneficiary criteria

315. The starting point for the geographical targeting in the proposed MARD-UNDP project for the GCF is the recently approved MARD-ADB WEIDAP project that will be implemented in five provinces most affected by the severe drought in 2015-2016 in terms of agricultural losses: Dak Lak and Dak Nong in the Central Highlands, and Khanh Hoa, Ninh Thuan and Binh Thuan in the South-Central Coast. Within these provinces, eight sites/sub-projects have been selected by MARD with technical support from ADB for upgrading of the existing irrigation systems and support to water use efficiency; sites have been selected for their exposure to climate risks and potential for shifts from lower-value to higher-value crop systems.

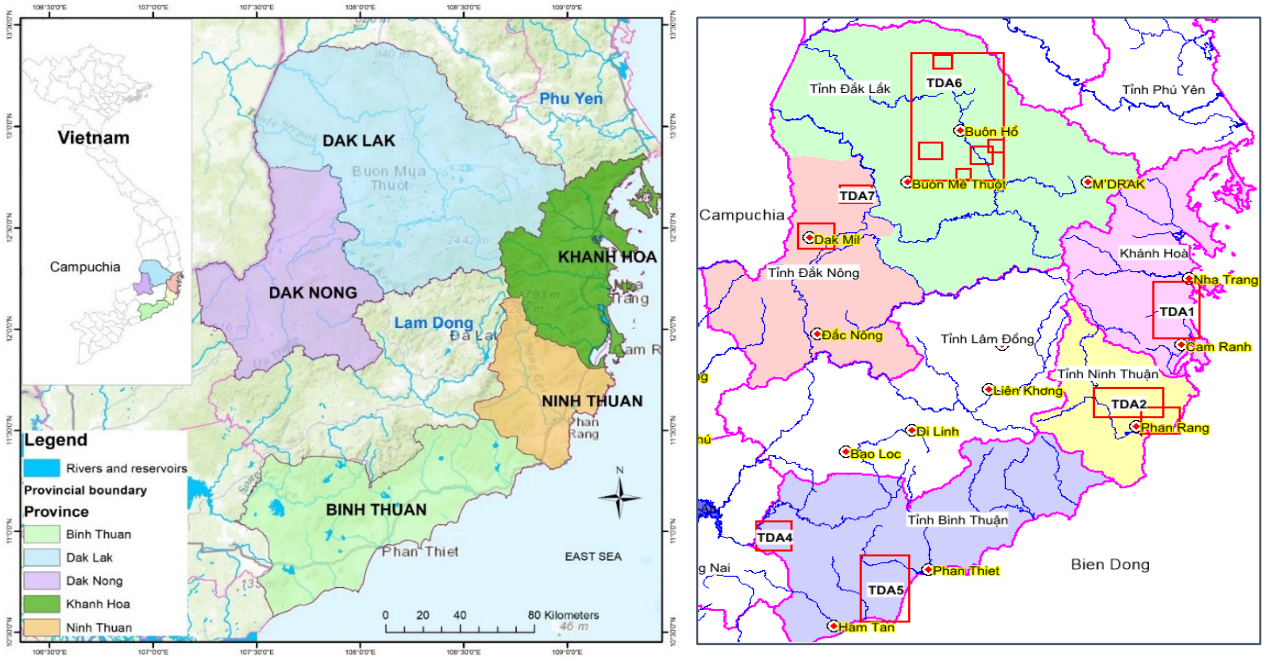


Figure 45: Provinces (left) and sub-project locations (right) selected in the MARD-ADB WEIDAP project. 'TDA' indicates one sub-project in the MARD-WEIDAP project, totaling eight: one in Khanh Hoa, two in Ninh Thuan, two in Binh Thuan, one in Dak Lak and two in Dak Nong.

316. Within those five provinces and with the WEIDAP sub-projects as a starting point, an intersecting approach should be used to guide the geographical targeting for the MARD-UNDP project proposed to the GCF, with the following filters applied, as informed by the climate risk analysis in previous chapters:

i) Areas that are prone to identified climate risks: seasonal variability and drought and flood risk;

ii) Areas that are most affected by major climate change impacts on water and agriculture, currently and as projected: increasing imbalance in surface and ground water availability (for production); with longer periods of severe water scarcity during dry season and increased intensity of droughts; and reduced crop productivity (in terms of yields, incomes);
iii) A combination of rainfed and irrigated areas: with upland and lowland areas with rain-fed cultivation most vulnerable to wetter wet seasons and drier dry seasons and an increased risk of extreme droughts, while irrigated areas mainly impacted by extreme droughts. Both will be severely affected under the hottest climate change scenario;
iv) Areas with high social vulnerability factors or density of at-risk populations, such as ethnic minority population, poor and near-poor, and number of women-headed households.

317. Overlaying these filters in the 5 selected provinces results in the following priority geographical selection of 14 districts and 60 communes for the proposed MARD-UNDP GCF project:

Figure 46: Map of five target provinces (in red) for the proposed MARD-UNDP GCF project, highlighting the 14 districts (in purple) and 60 communes (in grey shading)

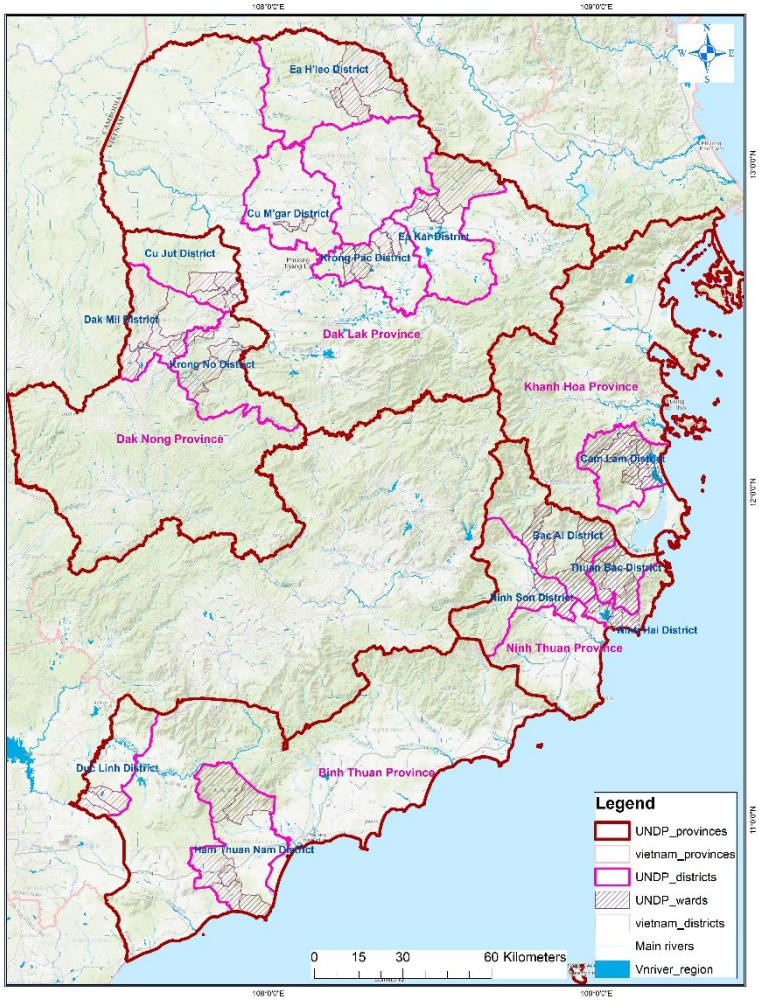


Figure 47a-e: Selected provinces with proposed districts and communes for the MARD-UNDP project, indicating climate risks. The map on the left shows the administrative boundaries, the maps on the right the historical agricultural drought risk (2001-2016).

Figure 47a. Khánh Hòa province	Very severe to severe drought risk
	Wetter dry and wetter wet seasons

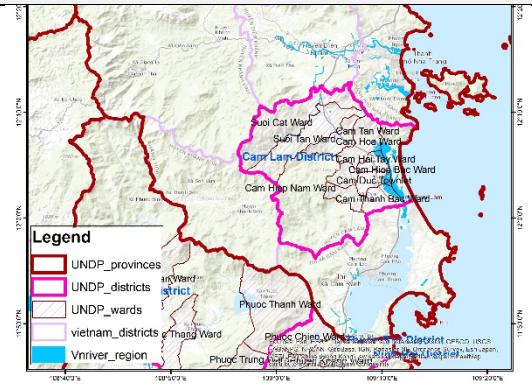
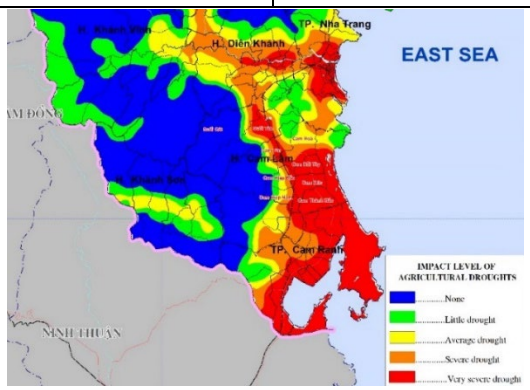
	Flood risk	No flood risk
Cam Lâm district	Cam Đức Cam Hải Tây Cam Hiệp Bắc Cam Tân Suối Cát Suối Tân	Cam Hiệp Nam Cam Thành Bắc Cam Hoà
		

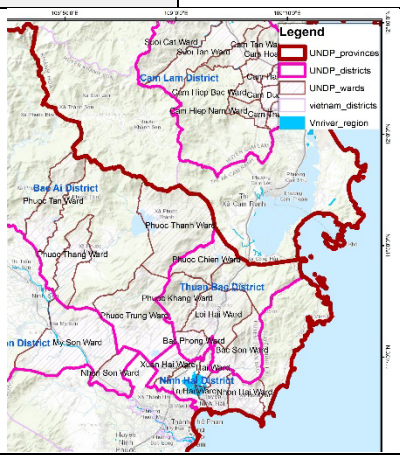
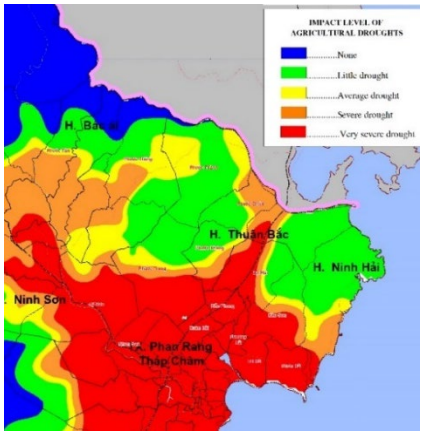
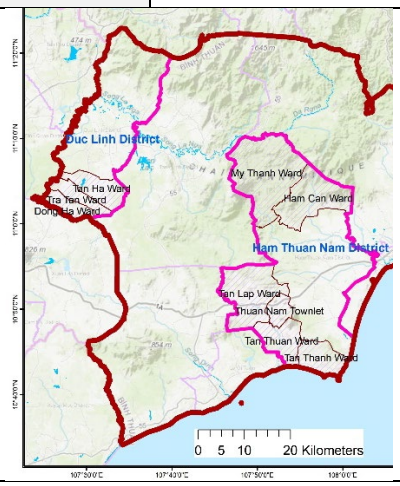
Figure 47b. Ninh Thuận province	Very severe to severe drought risk		Medium to low drought risk
	Drier dry and wetter wet seasons		Wetter dry and wetter wet seasons
	Flood risk	No flood risk	No flood risk
Ninh Hải district	Phương Hải Xuân Hải Tri Hải	Nhơn Hải	
Ninh Sơn district	Nhơn Sơn	Mỹ Sơn (*)	
Thuận Bắc district	Bắc Phong	Phước Kháng (*) Lợi Hải Bắc Sơn	Phước Chiến (*)
Bác Ái district		Phước Trung	Phước Tân (*) Phước Thắng (*) Phước Thành (*)
		

Figure 47c. Bình Thuận province	Very severe to severe drought risk		Medium to low drought risk
	Wetter dry and wetter wet seasons		Wetter dry and wetter wet seasons
	Flood risk	No flood risk	No flood risk

Hàm Thuận Nam district	Hàm Cần (*) Thuận Quí (*)	Tân Thuận Tân Thành	Mỹ Thạnh (*) Tân Lập
Đức Linh district		Tân Hà Đông Hà Trà Tân	



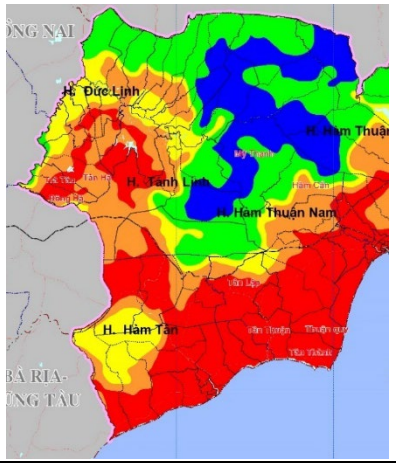
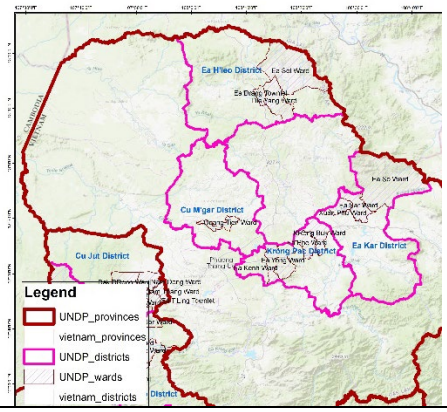


Figure 47d. Đăk Lăk province	Very severe to severe drought risk		Medium to low drought risk
	Wetter dry and wetter wet seasons		Wetter dry and drier wet seasons
	Flood risk	No flood risk	No flood risk
Ea Hleo district	Ea Sol (*)	Ea Khal Đliê Yang	
Cư M'Gar district		Quảng Tiến	
Ea Kar district	Ea Sar (*) Xuân Phú		Ea Sô (*)
Krông Păc district	Krông Buk Ea Phê Ea Yông Ea Kênh		



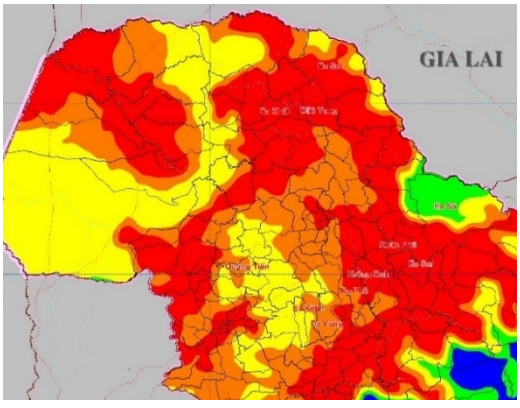
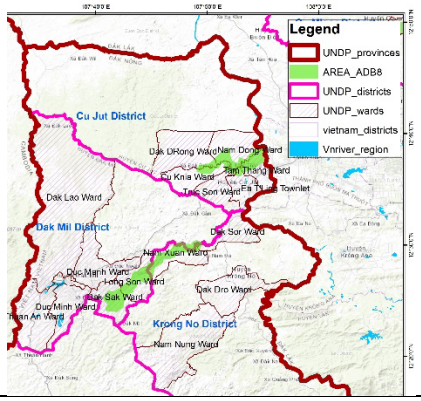
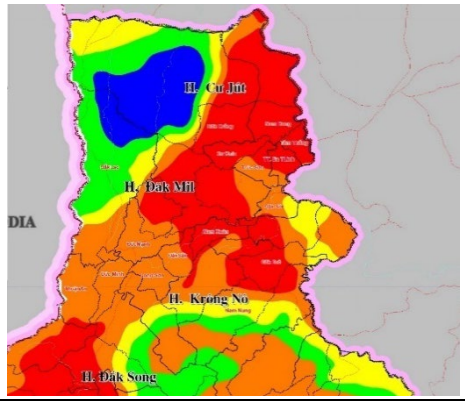


Figure 47e. Dak Nong province	Very severe to severe drought risk		Medium to low drought risk
	Wetter dry and wetter wet seasons		Wetter dry and wetter wet seasons
	Flood risk	No flood risk	No flood risk
Cư Jut district	Ea T'Linh	Đăk Drông	

	Nam Dong Tâm Thắng	Cư Knia Trúc Sơn	
Đăk Mil district		Đức Mạnh Long Sơn Đắk Sắk Thuận An Đức Minh	Đắk Lao
Krông Nô district	Đăk Sôr (*)	Nam Xuân Đăk Drô (*) Nam Nung (*)	





318. The majority of the 60 communes (including all WEIDAP project areas) are a combination of irrigated and rainfed cropping systems, with 17 communes more irrigated than rainfed, and 43 communes more rainfed than irrigated: as per the analysis of climate risks in section 1.4, rainfed areas are more vulnerable to the identified climate risks than irrigated areas, so the share of rainfed areas within the total number of selected areas is higher.

Table 10: Level of irrigated and rainfed areas for the selected communes. Most of the communes are fully or partly WEIDAP project areas, while the others, marked with a 'star', are adjacent.

	0-25% rainfed 75-100% irrigated	25-50% rainfed 50-75% irrigated	50-75% rainfed 25-50% rainfed	75-100% rainfed 0-25% irrigated
Khánh Hòa	Cam Đức	Cam Hải Tây; Cam Hiệp Bắc; Cam Tân; Suối Cát; Suối Tân; Cam Hiệp Nam; Cam Thành Bắc; Cam Hoà		
Ninh Thuận		Xuân Hải; Nhơn Hải; Nhơn Sơn; Bắc Sơn; Bắc Phong; Phước Trung	Mỹ Sơn (*)	Phương Hải; Tri Hải; Phước Chiến (*); Phước Kháng (*); Lợi Hải; Phước Tân (*); Phước Thắng (*); Phước Thành (*)
Bình Thuận		Tân Thuận	Trà Tân	Mỹ Thạnh (*); Hàm Cần (*); Tân Lập; Thuận Quí (*); Tân Thành; Tân Hà; Đông Hà
Đăk Lăk		Ea Yông	Quảng Tiến; Krông Buk	Ea Khal; Đliê Yang; Ea Sol (*); Ea Sô (*); Ea Sar (*); Xuân Phú; Ea Phê; Ea Kênh

Dak Nong			Cư Knia; Nam Xuân	Ea T'Linh; Nam Dong; Tâm Thắng; Đăk Drông; Trúc Sơn; Đức Mạnh; Long Sơn; Đắk Sắk; Thuận An; Đức Minh; Đắk Lao; Đăk Sôr (*); Đăk Drô (*); Nam Nung (*)

319. In terms of selecting direct beneficiaries within the selected communes, the targeting will be in line with key social vulnerability factors identified in previous analyses. The people who are the most vulnerable and have the least resources to deal with increasing climate risks should be prioritized. Government statistical indicators for these factors are available – to commune level – and can be used for quantitative targeting, while additional qualitative targeting and monitoring should be applied throughout project implementation as verification and additional quality control;

i) Small-scale farmers, with one hectare or less of farming land;[222]
ii) Indigenous ethnic minorities;
iii) Poor and near-poor households;
iv) Most vulnerable women: women-headed households, poor women, ethnic minority women, and women in families with high dependency rates.

320. Before 2016, the GoV used an income-based national poverty line for targeting of beneficiaries in poverty reduction programs. However, since then the GoV has adopted a 'rights-based multi-dimensional poverty approach' for targeting beneficiaries, which should be applied by the project. This new multi-dimensional poverty measurement measures a combination of deprivation of income and ten indicators on access to basic services. Provinces are requested to monitor and report the list of poor and near poor three times a year (early, mid and late period).

321. Social vulnerability indicators for the selected communes are as follows:

Table 11: Socio-economic vulnerability indicators for the 60 communes

		Total household (2017)	**Percentage of poor and near poor households (%)**	**Percentage of ethnic households (%)**
No	**Commune**			
	TOTAL	**139,416**	**18.8%**	**27.6%**
I	**Khánh Hòa province**	**22,153**	**14.0%**	**2.0%**
	Cam Lâm district	**22,153**	**14.0%**	**2.0%**
1	Cam Đức	4,195	6.8%	0.0%
2	Cam Tân	2,127	11.2%	3.8%
3	Cam Hoà	3,589	10.4%	1.3%
4	Cam Hải Tây	1,421	6.3%	0.1%
5	Cam Hiệp Bắc	800	16.6%	1.6%
6	Cam Hiệp Nam	1,375	16.0%	0.0%
7	Cam Thành Bắc	3,621	9.9%	0.0%
8	Suối Cát	2,489	31.4%	10.9%

[222] While indirectly also affected by the identified climate risks and impacts, landless people will only be indirectly targeted by the project through better access to information on weather, climate risks, credit, opportunities for agricultural labor and other information.

9	Suối Tân	2,537	22.4%	0.8%
II	**Ninh Thuận province**	**30,980**	31.3%	40.1%
	Ninh Hải district	**12,909**	**11.2%**	**16.1%**
10	Phương Hải	1,783	16.0%	0.0%
11	Xuân Hải	4,245	8.5%	49.0%
12	Tri Hải	3,130	11.8%	0.0%
13	Nhơn Hải	3,751	11.6%	0.0%
	Ninh Sơn district	**6,534**	**29.7%**	**28.0%**
14	Mỹ Sơn	2,815	50.1%	30.0%
15	Nhơn Sơn	3,719	14.3%	26.4%
	Thuận Bắc district	**8,427**	**50.1%**	**64.3%**
16	Phước Chiến	1,155	82.3%	96.8%
17	Phước Kháng	614	88.1%	100.0%
18	Lợi Hải	2,974	44.1%	75.5%
19	Bắc Sơn	1,983	58.7%	72.5%
20	Bắc Phong	1,701	15.2%	0.0%
	Bác Ái district	**3,110**	**66.8%**	**99.4%**
21	Phước Tân	743	72.7%	100.0%
22	Phước Thắng	944	63.6%	99.1%
23	Phước Thành	853	77.0%	99.6%
24	Phước Trung	570	49.0%	99.1%
III	**Bình Thuận province**	**17,125**	9%	12.6%
	Hàm Thuận Nam	**11,627**	**8.2%**	**14.9%**
25	TT Thuận Nam	3,329	5.2%	**0.5%**
26	Mỹ Thạnh	227	68.7%	95.0%
27	Hàm Cần	891	31.5%	90.0%
28	Tân Lập	2,187	6.2%	20.0%
29	Tân Thuận	3,593	3.5%	7.3%
30	Tân Thành	1,400	5.9%	0.0%
	Đức Linh district	**5,498**	**10.0%**	**7.6%**
31	Tân Hà	1,402	11.8%	0.29%
32	Đông Hà	2,029	9.1%	1.43%
33	Trà Tân	2,067	9.6%	18.58%
IV	**Đăk Lăk province**	**29,980**	**21.3%**	**39.16%**
	Ea Hleo district	**9,405**	**14.0%**	**35.1%**
34	TT. EaĐRăng	4,372	11.0%	13.0%
35	EaSol	2,838	18.6%	57.8%
36	Đliê Yang	2,195	14.2%	49.6%
	Cư M'Gar district	**1,601**	**12.5%**	**9.4%**
37	Quảng Tiến	1,601	12.5%	9.4%
	Ea Kar district	**4,280**	**39.5%**	**37.6%**
38	Ea Sô	889	60.5%	47.2%
39	Ea Sar	1,928	48.0%	49.8%
40	Xuân Phú	1,463	15.5%	15.7%

	Krông Păc district	**14,694**	**21.7%**	**45.5%**
41	Krông Buk	3,023	40.8%	51.5%
42	Ea Phê	5,152	13.9%	41.4%
43	Ea Yông	3,744	17.0%	48.2%
44	Ea Kênh	2,775	21.7%	42.8%
V	**Dak Nong province**	**39,177**	**14.1%**	**29.8%**
	Cư Jut district	**16,715**	**17.0%**	**41.6%**
45	Ea T'Ling	3,858	19.7%	16.6%
46	Nam Dong	4,026	14.5%	29.4%
47	Đăk DRông	3,316	14.9%	84.1%
48	Tâm Thắng	2,928	17.9%	27.7%
49	Cư Knia	1,835	19.9%	74.5%
50	Trúc Sơn	752	16.1%	21.0%
	Đăk Mil district	**15,925**	**6.4%**	**11.4%**
51	Đắk Lao	1,981	4.6%	5.7%
52	Đức Mạnh	3,653	3.8%	1.9%
53	Long Sơn	373	26.3%	91.2%
54	Đắk Sắk	3,559	9.9%	8.6%
55	Thuận An	2,629	2.9%	26.7%
56	Đức Minh	3,730	7.1%	7.5%
	Krông Nô district	**6,537**	**25.6%**	**44.5%**
57	Đăk Sôr	1,124	28.8%	35.3%
58	Nam Xuân	1,558	27.4%	74.4%
59	Đăk Drô	2,186	19.7%	30.8%
60	Nam Nung	1,669	29.7%	40.7%

322. Direct beneficiaries will mainly be targeted with support for last-mile connection to mainline irrigation systems, upgrading or construction of shared or household-level water storage ponds, improved water resources management, application of climate-smart water efficiency technologies and vouchers for new or improved resilient agricultural practices.

323. All small-scale farmers, including the above direct beneficiaries, in the selected districts will be targeted with improved access to information, and peer-to-peer learning platforms, mainly on climate risk assessment, agro-weather and climate advisory information, seasonal and long-term agricultural planning, information on climate-smart water efficiency technologies and resilient agricultural cropping systems and practices, and information on market and credit opportunities to facilitate farmer investments for resilient agricultural production. Climate innovation platforms at province and sub-project level will facilitate extensive outreach, information sharing, advocacy and improved access for farmers to market, credit and other support opportunities provided by public and private stakeholders active in the target locations.

6.2 Recommendations to improve water security and resilience

324. Irrigation system capacities, design and management gaps in response to increasing and future climate risks and impacts on water and agricultural production will be addressed by the MARD-ADB WEIDAP project through major rehabilitation and development of resilient, modern, demand-oriented and multi-crop **irrigation systems**. In terms of reach, all farmland within 500 meters of the pipelines ('command area') is served by the WEIDAP project supported irrigated systems, and the typical density of the pipes is 15 to 20 meters per hectare. However, *the WEIDAP project is not addressing issues of connectivity to irrigation schemes, with farmers in the WEIDAP project areas required to invest their own resources in obtaining 'last-mile' connection of the surface canal, weir or pipe irrigation system to their plots*. This

presents a significant challenge to poor and near-poor farmers and is therefore a specific need that should be addressed in the proposed MARD-UNDP project. Water storage issues in the remaining WEIDAP project or adjacent communes, irrigated and rainfed areas, are not addressed either through the WEIDAP project.[223]

325. WEIDAP's eight small and medium irrigation systems that will be upgraded, rehabilitated and expanded are described in the table below and can be grouped into three categories (i) main pipeline systems connected to current reservoirs (either pumped or gravity fed); (ii) upgraded canals; and (iii) new weirs to provide improved pumping ponds from which farmers will extract water suited to their own requirements. The capacity of these irrigation systems takes into account the hydrology of the catchments supplying water and the potential coverage areas of the various crops and their respective water requirements as well as the requirement to sustain environmental river flows downstream of off-take or management structures. Modernization and expansion of irrigation systems will provide a higher level of resilience and water security to farmers allowing them to diversify, spread risk and expand the area of higher value crops.

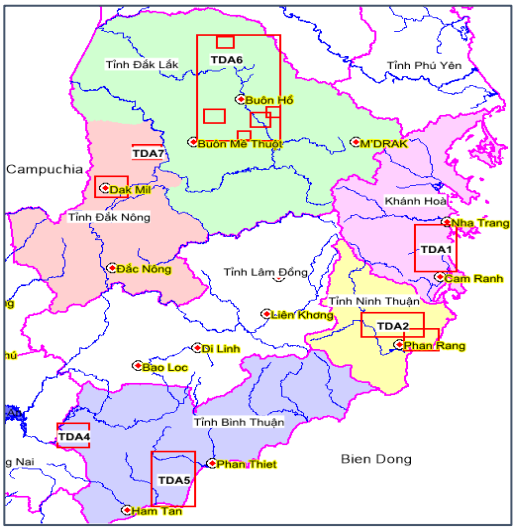


Table 12: List of small and medium resilient irrigation systems supported by the WEIDAP project in the five target provinces. For details, including detailed maps, see sub-assessment report on water.

Province	Subproject	Technical specifications
Khánh Hòa	1. Cam Ranh - Suoi Dau	- 2 separate storage irrigation systems supplied from existing Suoi Dau and Cam Ranh reservoirs. Both combine rehabilitation of existing gravity canal systems and new pumped pipe systems. - 5 subsystems with pumping stations and ring main distribution pipelines to meet the adopted level of irrigation service.
Ninh Thuận	2. Nhon Hai – Thanh Hai	- Each 1 new pumped pipe system consisting of 6 subsystems with standard hydrant manifolds, with the entire pipe system connected to the existing Tan My pipeline which is supplied by the Tan My weir and runs through the two sub-project sites.
	3. Thanh Son – Phuoc Nhon	
Bình Thuận	4. Tra Tan	- 1 new pumped pipe system linked to an existing storage reservoir and canal system
	5. Du Du – Tan Thanh	- 1 single new gravity pipe system, at existing Tan Lap reservoir - Ring main distribution pipelines with hydrant manifolds - Paved inspection roads
Đăk Lăk	6. Doi 500 – Buon Yong – Krong Buk Ha – Ea H'Leo – Ea Kuang	- 8 new storage irrigation systems (pumping stations, pipes, hydrant manifolds), to be supplied from five existing reservoirs
Dak Nong	7. Cu Jut	- 10 permanent weirs to replace farmers' temporary weirs, supplied from the existing Dak Dier and Dak Drong Reservoirs, - 2 pump-pipe demonstration irrigation systems, supplied from new weirs 2 and 9, each serving 50 ha, and - Upgrading of 10.95km of access road.
	8. Dak Mil	- Upstream: rehabilitation of 24 existing structures, including structures on 4 existing storage reservoirs, 5 existing diversion weirs, construction

[223] MARD, ADB (April 2017) (Ibid).

Province	Subproject	Technical specifications
		of 2.75km of reinforced concrete box culvert, construction of a new pumping station, to replace a temporary one, on Reservoir #1; - Downstream: replacement of farmers' temporary weirs with 3 permanent un-gated weir structures; and - Road upgrading together with bridge/culvert crossings.

326. In addition to the infrastructural investments, the WEIDAP project will also: i) improve the irrigation water management information system of the local authorities and IMCs for improved water monitoring, allocation, risk-informed management and decision-making; ii) pilot a water delivery charging mechanism; and iii) support O&M of the WEIDAP project infrastructure.

327. In terms of O&M, the irrigation schemes supported through the WEIDAP project are maintained by the IMCs. The IMCs are in charge of: registering farmers, monitoring meters and charging farmers for water use (with at a minimum recovering O&M costs), flush sediment, and management of overall water flow release from the reservoirs to avoid wastage and irregulated use. The WEIDAP project will pilot a water delivery charging system to secure on-going resources for this O&M.

328. The WEIDAP project irrigation infrastructure in each of the eight sub-project areas will be monitored and managed by the local IMC through a simple 'SCADA' system. For each scheme, a basic *Supervisory Control And Data Acquisition* (SCADA) system will be installed for IMCs to monitor operations for both pipe and canal systems. For pipe systems, remote monitoring of pump operations, pressures, and flows are currently proposed. For canal systems, water levels and flows will be monitored at a few selected points: reservoir, head of main canal, and balancing storage at the end of the system. Sensors will be installed with alarm systems if the level of pressure readings are significantly different from each other. The SCADA system is established and maintained through the WEIDAP project.

329. To ensure **last-mile connectivity** to WEIDAP project irrigation systems, the MARD-UNDP project should support the most vulnerable people such as poor and near-poor households, ethnic minorities and female headed households with a combination of locally available mobile pipes, pumps, water meters, shifting valves and small-scale on-farm water storage for last-mile connection to GoV invested irrigation schemes ensuring reliable water supply during drought periods ('last-mile connectivity support packages'). As the water supply will be regulated, farmers require on-farm storage systems as part of this support package to cover the gap between receiving the water from the irrigation system and using it for on-farm irrigation as well as to cope with weather variability and extreme weather events. Technical expertise for the detailed design of the distribution systems also needs to be provided alongside the actual in-kind support. Details on the recommended last-mile connectivity support packages for each location are provided in the table below.

Table 13: Proposed last-mile connectivity support to be provided by the MARD-UNDP project. For technical details, see sub-assessment report on water.

Province	District	Last-mile connectivity support:
Khánh Hòa	Cam Lam	- Shared/private pumps and pipelines to connect to the improved canal system' manifolds (up to 2000m, but mainly within 1000m) - Water meter, control valves, transit tanks, shared/private pumps and pipelines, and on-farm storage systems to connect to the new ring main pipeline system (up to 500m, but mainly within 300m)
Ninh Thuận	Ninh Hai, Ninh Son, Thuan Bac and Bac Ai	- Water meter, control valves, transit tanks, and shared/private pipelines, to connect to the improved canal system' manifolds (up to 500m, but mainly within 350m)
Bình Thuận	Duc Linh and Ham Thuan Nam	- Water meter, control valves, transit tanks, and shared/private pipelines, to connect to the gravity branched and new ring main pipeline system (up to 500m, but mainly within 300m)

Province	District	Last-mile connectivity support:
	Duc Linh	- Shared/private pumps and pipelines, water meters, control valves and transit tanks, to connect to the gravity canal system (up to 1000m, but mainly within 700m)
Đăk Lăk	Ea Hleo, Cu M'Gar, Ea Kar and Krong Pac	- Water meter, control valves, transit tanks, and shared/private pipelines, to connect to the improved canal system' manifolds (up to 500m, but mainly within 300m)
Dak Nong	Cu Jut, Dak Mil and Krong No	- Shared/private pumps, control valves, transit tanks, and pipelines, to connect to the improved weir-canal system (up to 1000m, but mainly within 700m) - Water meter, control valves, transit tanks, and shared/private pumps and pipelines, to connect to the new ring main pipeline system (up to 1000m, but mainly within 700m)

330. To ensure ownership, benefiting households should be required to provide in-kind contributions meaning labor and small locally available construction tools, as part of the design, construction and maintenance phases. The main connectivity supplies should be provided – combined with technical guidance, manuals and mentoring - since the poor and near-poor are unable to afford this additional cost. Not doing so will leave them at a significant disadvantage and higher risk of water insecurity compared to the non-poor, particularly during extreme weather events.

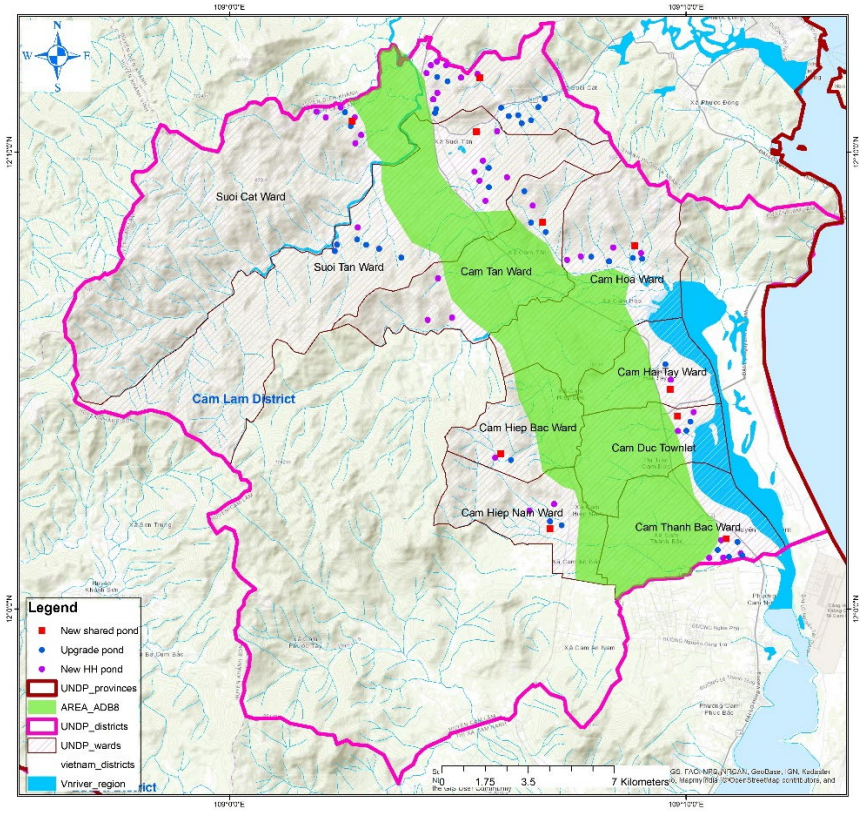
331. In terms of O&M of the last-mile connectivity support packages, the connectivity systems do not require high maintenance and can therefore be self-maintained by the benefitting households. For shared systems a water user group will be set-up or an existing farmer group engaged. In line with good practice on irrigation management in Viet Nam (see section 5.1), this group will be self-selected and manage their own code of conduct and be mentored by the local commune technical staff. Pictorial and local language O&M guidance notes and manuals will be developed and disseminated alongside the in-kind support. The DARD Irrigation Department and IMC's technical staff will provide on-going technical support to all households with private and shared systems and throughout the project timeframe and immediately after.

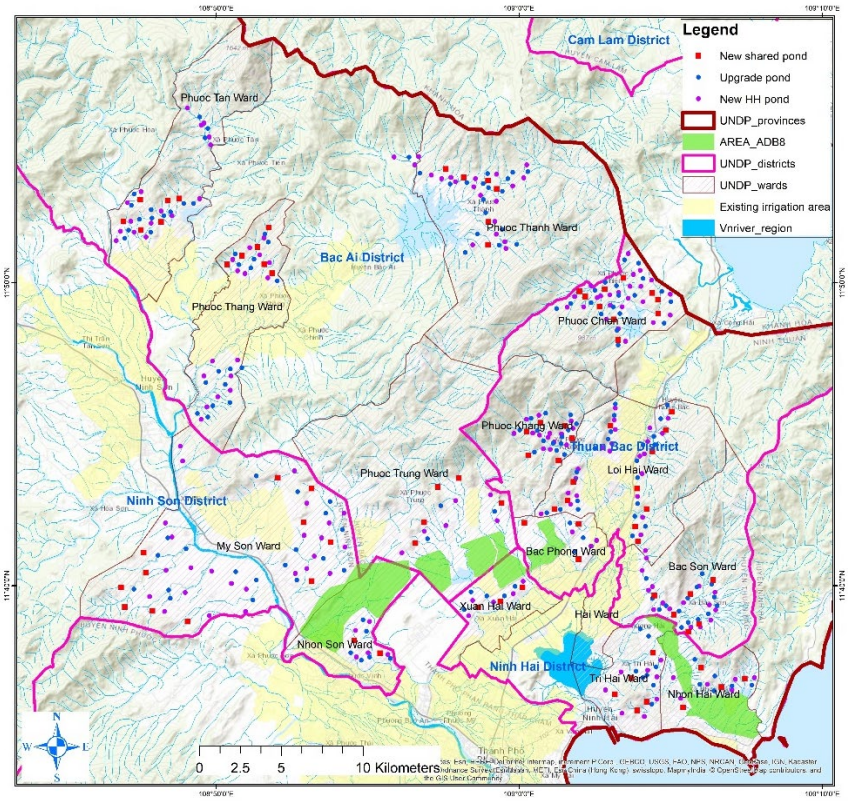
332. In areas adjacent to the WEIDAP irrigation 'command areas', i.e. agricultural land that is primarily rainfed or out-of-reach of irrigation systems, the MARD-UNDP project should support **on-farm water storage systems for collecting rainwater or surface water**. The storage facilities or ponds will help farmers to store water in the wet season for use at critical times during the dry season and as much as possible during extreme droughts. Support for resilient water storage systems should be combined with community awareness raising or training on climate-resilient water resources management.

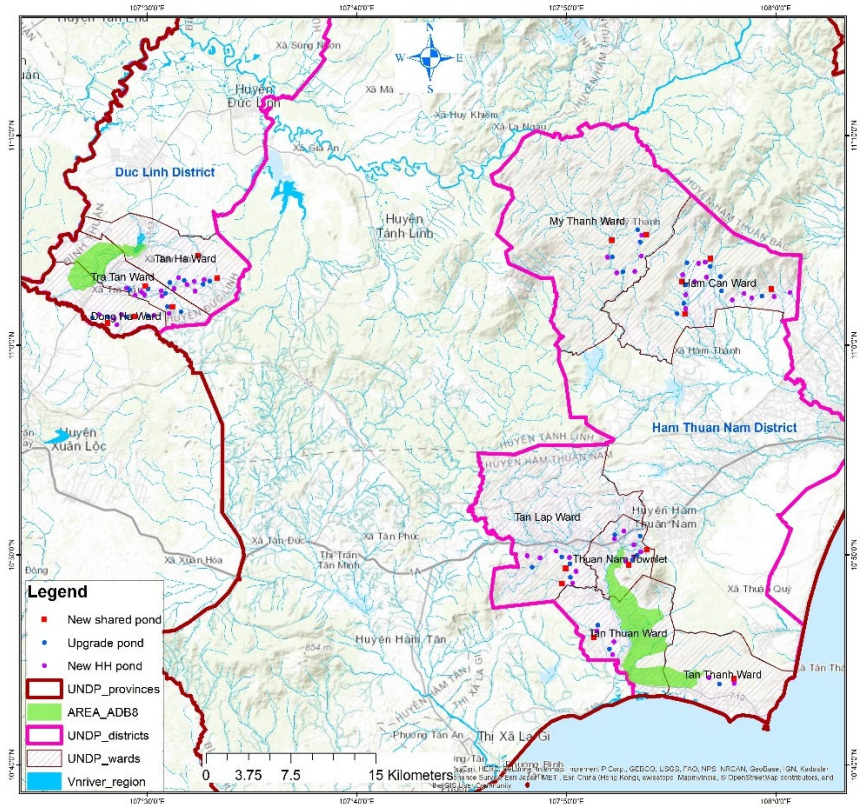
333. Criteria for selection of pond location are: options for upland, midland or flatland area; in reach of the most vulnerable people; arranged in accordance with the overall layout of the existing water collection system; ensuring maximum and sustainable water catchment within all climate scenarios; increasing the ability of gravity irrigation; and not unnecessarily disrupting farming activities. Criteria for the design of ponds are: ensuring sufficient supply of water for crops in the dry season; simple construction with easy maintenance; limited evaporation and permeability to avoid loss of stored water; include a water distribution system; integration with surface water collection if possible; preventing sedimentation; adaptability to changing water and climate conditions; based on bioengineering principles; and suitability for ethnic minorities and women, for example not creating additional workload.

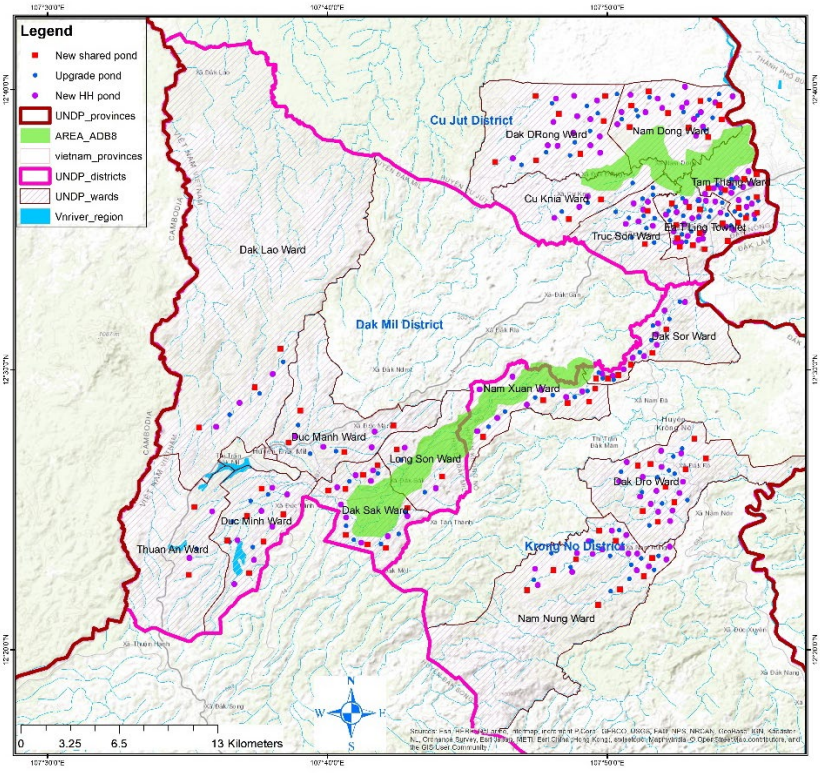
334. An initial mapping applying these criteria have resulted in the following proposed locations of the climate resilient ponds per target province:

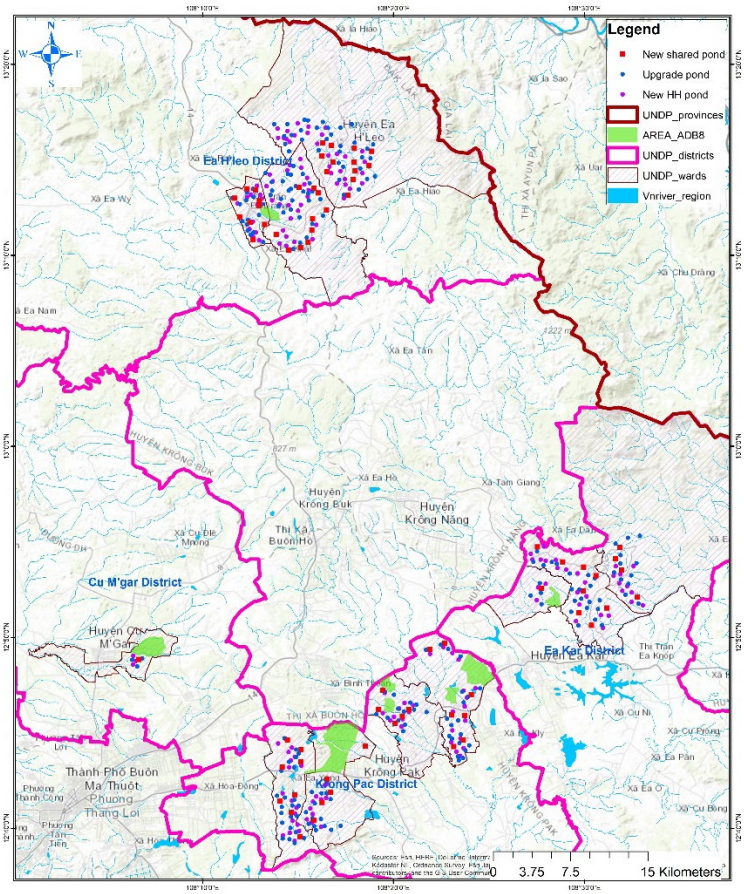
Figure 48: Proposed selection of climate resilient ponds (new, upgraded, shared or household) in each of the five provinces: Khanh Hoa, Ninh Thuan, Binh Thuan, Dak Nong and Dak Lak.




Legend
New shared pond
Upgrade pond
New HH pond
UNDP_provinces
AREA_ADB8
UNDP_districts
UNDP_wards
Existing irrigation area
Vnriver_region
Cam Lam District
Phuoc Tan Ward
Phuoc Thanh Ward
Bac Ai District
Phuoc Thang Ward
Phuoc Chien Ward
Phuoc Khanh Ward
Thuan Bac District
Loi Hai Ward
Phuoc Trung Ward
Ninh Son District
My Son Ward
Bac Phong Ward
Bac Son Ward
Xuan Hai Ward
Hai Ward
Nhon Son Ward
Ninh Hai District
Tri Hai Ward
Nhon Hai Ward
0 2.5 5 10 Kilometers


Duc Linh District
Huyện Đức Linh
Huyện Tánh Linh
Tan Hai Ward
Tra Tan Ward
Dong Kho Ward
My Thanh Ward
Ham Can Ward
Ham Thuan Nam District
Huyện Xuân Lộc
Tan Lap Ward
Huyện Hàm Thuận Nam
Thuan Nam Township
Tan Thuan Ward
Tan Thanh Ward
Huyện Hàm Tân
Thị Xã La Gi
Legend
New shared pond
Upgrade pond
New HH pond
UNDP_provinces
AREA_ADB8
UNDP_districts
UNDP_wards
Vnriver_region
0 3.75 7.5 15 Kilometers


Legend
New shared pond
Upgrade pond
New HH pond
UNDP_provinces
AREA_ADB8
vietnam_provinces
UNDP_districts
UNDP_wards
Vnriver_region
Cu Jut District
Dak Lao Ward
Dak Mil District
Nam Xuan Ward
Buc Manh Ward
Long Son Ward
Dak Sak Ward
Buc Minh Ward
Thuan An Ward
Dak Sor Ward
Dak Dro Ward
Krong No District
Nam Nung Ward
Dak DRong Ward
Cu Knia Ward
Truc Son Ward
Tam Thang Ward
0 3.25 6.5 13 Kilometers


Legend
New shared pond
Upgrade pond
New HH pond
UNDP_provinces
AREA_ADB8
UNDP_districts
UNDP_wards
Vnriver_region
Ea H'leo District
Cu M'gar District
Krong Pac District
Ea Kar District
Thành Phố Buôn Ma Thuột
0 3.75 7.5 15 Kilometers

335. Pond design specifications based on initial water balance modeling conducted at the project feasibility stage resulted in the following details: see the sub-assessment report on water for more details;

Table 14: Pond design specifications per province and pond category

No	Pond type	Catchment area (ha)	Maximum crop area (ha)	Minimum storage (m3)	Dimension (LxWxH, m)
I	**House hold pond in flatland**				
1	*Khánh Hòa*	0.5 - 2	0.2	900	16x16x3.5
2	*Ninh Thuận*	0.5 - 2	0.2	900	16x16x3.5
3	*Bình Thuận*	0.5 - 2	0.2	900	16x16x3.5
II	**Shared pond in flatland**				
1	*Khánh Hòa*	5-10	1	4500	30x30x5
2	*Ninh Thuận*	5-10	1	4500	30x30x5
3	*Bình Thuận*	5-10	1	4500	30x30x5
III	**House hold pond in midland**				
1	*Khánh Hòa*	1-3	0.2	800	15x15x3.5
2	*Ninh Thuận*	1-3	0.2	800	15x15x3.5
3	*Bình Thuận*	1-3	0.2	800	15x15x3.5
4	*Đăk Lăk*	1-3	0.3	1000	18x18x3.5
5	*Dak Nong*	1-3	0.3	1000	18x18x3.5
IV	**Shared pond in midland**				
1	*Khánh Hòa*	5-15	1.8	4000	28x28x5
2	*Ninh Thuận*	5-15	1.8	4000	28x28x5
3	*Bình Thuận*	5-15	1.8	4000	28x28x5
4	*Đăk Lăk*	5-15	2	4500	30x30x5
5	*Dak Nong*	5-15	2	4500	30x30x5
III	**House hold pond in upland**				
1	*Khánh Hòa*	2-5	0.3	900	16x16x3.5
2	*Ninh Thuận*	2-5	0.3	900	16x16x3.5
3	*Bình Thuận*	2-5	0.3	900	16x16x3.5
4	*Đăk Lăk*	2-5	0.4	1000	18x18x3.5
5	*Dak Nong*	2-5	0.4	1000	18x18x3.5
IV	**Shared pond in upland**				
1	*Khánh Hòa*	10-20	2	4500	30x30x5
2	*Ninh Thuận*	10-20	2	4500	30x30x5
3	*Bình Thuận*	10-20	2	4500	30x30x5
4	*Đăk Lăk*	10-20	3	6500	35x35x5
5	*Dak Nong*	10-20	3	6500	35x35x5

336. Additional water balance modeling should be conducted in rainfed areas to confirm or ensure the most appropriate design and management for each pond and each location. The water balance modeling should use comprehensive mathematical tools and models and entail a detailed assessment of the available surface and rainwater sources, current status of existing ponds, soil conditions, local cropping systems and tree portfolio, linked to climate risk and impact scenarios. It should ensure risk-informed, science-based and effective design and water resources sustainability under the different climate scenarios.

337. Building on good practice, the following water balance modeling method should be applied: i) water resources assessment under different climate change scenarios (until 2050) based on current and past water availability trends; ii) water demand assessment under climate change (until 2050), for different crops and groups of users; and iii) water balance assessment spatially and over time, including appropriate technical design of ponds and water management practices. The modeling should engage international and national hydrological and water resources management specialists, but also be used as a capacity building exercise of the local DARD irrigation staff. To build on local knowledge but also increase ownership, farmers should be involved in this assessment as well as the pond design as much as possible, in line with participatory technology development good practice.

338. Based on the water balance modeling results, the initial design of the rainwater harvesting ponds conducted for this study should be further detailed or streamlined and outline the following components: precise location selection; dimension and storage; water collection system; treatment of pond bottom losses; treatment of pond surface losses; water distribution system and resilience assurances for different climate scenarios.

339. External technical expertise is required for the co-design and landscaping of bioengineered climate-resilient ponds, including the training and mentoring of DARD Irrigation Department and other staff, and benefiting farmers. These bioengineering techniques have been proven to maximize and sustainably manage available natural water sources, significantly reduce evaporation rates and increase pond resiliency through well planned use of protection measures such as the planting of locally suitable plants (vetiver grass, bamboo) and trees or the pre-treatment of ponds (such as clay pellets or rare clay). These techniques can also provide co-benefits such as increasing available cattle fodder during droughts or by providing additional income from using fruit trees such as banana. Pictorial and local language O&M guidance notes and manuals should be developed and disseminated alongside the technical support.

340. O&M of the shared ponds should be assured through the establishment of a farmer-led ‘pond management group’, comprised of a gender balanced and inclusive (poor, near-poor and ethnic minority) representation of the households benefiting from the pond. The group should be assembled at the pond design stage so they can be involved throughout the entire design, construction or rehabilitation, use and management process. This includes monitoring and evaluating the construction phase. Pond management groups should be based on existing farmer interest groups, cooperatives or other community sharing mechanisms, to attract active community members and build on existing farmer-to-farmer networks. Rules and regulations for the use, management and O&M of the pond should be proposed, adopted and enforced by the members themselves, through majority agreement and ensuring gender equality and inclusiveness. The establishment of the pond management groups should be facilitated by the commune PPC, with technical and mentoring support provided by the commune DARD technical staff.

341. In addition to the above support on last-mile connection and in light of the identified climate risks and impacts on water productivity, the project should apply a holistic approach to on-farm water management and therefore also support farmers with affordable climate resilient **on-farm water efficiency technologies**, also called high-efficiency irrigation. This will lower the water demand and increase the application of water efficiency and crop water productivity technologies and practices for agricultural systems to be able to withstand drought and precipitation shocks and stresses. The project should target the most vulnerable farmers who unlike the better-off farmers cannot afford the available technologies. Replicating good practice, a participatory technology development approach should be applied.

342. The participatory technology development for promotion of climate resilient on-farm water efficiency should apply the following steps: i) establish a technical support team comprised of experts from local authorities (DARD Departments of Irrigation, Agricultural Extension and Crop Production, Farmers’ Union and VWU) and local private sector (material input suppliers, buyers of agricultural produce); ii) organize orientation sessions with existing male/female farmer groups to explain the objectives of the activity and gain interest (by technical support team); iii) farmers self-select or identify early adopters or farmer champions among poor and near-poor to engage in technology development process (facilitated by technical support team); iv) conduct technology co-development process through adaptation of existing

technologies and iterations of trial-and-error, including detailed documentation of what works and what doesn't, costing, material availability, impact on yields and water productivity, etc. (farmer champions with technical support team); v) peer-to-peer presentation of test results to other farmer champions and participatory selection or agreement on most suitable and resilient option(s) (facilitated by technical support team, and integrated into the Farmer Field School program); vi) official endorsement by the commune and/or district PPC to support the replication process; vii) development of pictorial and local language information sheets (by technical support team, with farmer champions' input); viii) development of a dissemination or communication strategy for promotion of the technology (by mass organizations, with support of technical departments); ix) roll-out of the climate resilient on-farm water efficiency technologies, with support to the most vulnerable and the provision of information to all farmers.

343. The technology developed should be flexible and applicable to the crops grown by the poor and near-poor, cost-effective for one hectare or less of farming land, suitable for women and ethnic minorities to apply, not labor-intensive, use locally available materials and be easily maintained. It should increase water efficiency, reduce farming input costs and ensure resilience to the identified climate risks. The co-developed technology will likely not be as water-efficient as the more expensive technology but will meet a minimum efficiency rate and serve as a stepping stone for the poor and near-poor to incrementally increase water productivity and income, allowing them to afford the more efficient technology in the medium or long term.

344. In places such as Ninh Thuan where low-cost micro-irrigation technologies have already been developed through the above process (for example by the NGO International Development Enterprises, see section 3.1.4), the participatory technology process should be shortened and exclude the co-development component. Where these technologies are not yet available, the process should be conducted fully as described above and focus on adjusting existing technologies to adapt them for the most vulnerable farmers to be able to apply and afford.

345. Criteria for selecting early adopters or farmer champions should be as follows: i) small-scale farmers, with one hectare or less of farming land; ii) representing most vulnerable groups (poor and near-poor, ethnic minorities and vulnerable women); iii) benefiting from the project support on last-mile connectivity or on-farm water storage; iv) high confidence, interest and enthusiasm; and v) availability to be engaged in the co-development process.

346. For the roll-out of the technology once developed, the project should provide grant support through vouchers to individual poor and near-poor smallholders conditional on: (i) farmers' in-kind contribution in installing the system, for example through labor or minor materials; (ii) commitment to maintaining the system; and (iii) participation in Farmer Field School training courses on climate-resilient farming (including water efficiency practices) conducted in the village (see further).

6.3 Recommendations to improve agricultural resilience

347. Given the impacts of changing weather patterns, social vulnerabilities and future estimated needs for increased agricultural production in Viet Nam, an integrated approach to addressing agricultural productivity, community resilience and climate change is critical. The project should therefore apply an agro-ecological or integrated socio-ecological farming approach to improving agricultural resilience. This includes for example the promotion of multi-crop and tree systems instead of monocultures, innovative and sustainable water, soil and nutrient management, inclusive processes to engage and support the most vulnerable, and flexible and equitable risk-informed agricultural planning and management.

348. To advance such an agro-ecological approach to agricultural resilience in the selected provinces, the project should replicate and adapt a global good practice by establishing **Climate Innovation Platforms (CIP)**. These multi-stakeholder platforms should create space for relevant project and non-project partners to collaboratively discuss the challenges of climate change and its impact on water resources and agricultural productivity in their locality and to pool and promote innovative solutions towards resilient agricultural systems. The primary objective of the CIPs is to promote coordinated action to make the agro-ecological systems more resilient to climate change. As a secondary objective, the CIPs will focus on

improving the agricultural systems towards pro-poor, ethnic minority inclusion and gender-responsiveness. The CIPs should be created at two levels that will be linked to enhance information flow and coordination:

- Provincial CIPs: higher level, as policy dialogue, information sharing and scaling platform;
- Sub-project CIPs: at sub-project or climate-agro-ecological system level, as technical collaboration, information sharing and monitoring platform.

349. The provincial CIPs meet biennially, are chaired by the provincial DARD and bring together decision-makers, policy experts and technical advisors from the following organizations:

- Government representatives: PPC, DARD (Agricultural Extension Centre, Crop Production, Irrigation), Hydrometeorological Services, DoNRE, DoLISA, DPI;
- Mass organizations: Farmers' Union, VWU;
- Research institutions;
- NGOs and other development partners working on the same issues in the respective provinces;
- Private sector partners;
- Credit providers.

The platform should develop a common vision of how to achieve agricultural resilience in the province, integrating existing public and private plans and investments. The platform should identify, develop and promote straightforward and integrated strategies for developing climate-resilient and inclusive value chains, including equitable market access and credit. It should be a platform to engage other programs and projects and therefore facilitate coordination and synergies, information exchange and scaling of good practice from the UNDP-MARD project. The platform should bring together partners who would otherwise have limited opportunities for exchange and collaboration.

350. The sub-project CIPs should be located at the agro-ecological zone level and group the 60 selected communes within the provinces that have similar climate risks and agricultural profiles (key annual and perennial cropping systems, soil types and rainfed/irrigated areas). This type of clustering of communes results in the following proposed 11 sub-project CIPs:

Table 15: Proposed sub-project Climate Innovation Platforms:

No.	Climate vulnerability:	Main perennial:	Main annual:	Soil types:	Communes:
1	Very severe to severe drought risk, with drier dry seasons and wetter wet seasons	None	Onion, garlic, maize and beans	Fluvisols and acrisols	Phương Hải; Tri Hải; Xuân Hải; Nhơn Hải
2		Apple	Maize, cassava, sugarcane, rice	Acrisols	Nhơn Sơn; Mỹ Sơn
3		Custard apple	Rice	Acrisols	Bắc Phong
4		Cashewnut, Custard apple	Maize, cassava, beans, rice	Ferralsols	Phước Kháng; Bắc Sơn; Lợi Hải
5		Mango, cashewnut	Maize, beans, sesame, rice	Ferralsols	Phước Trung

No.	Climate vulnerability:	Main perennial:	Main annual:	Soil types:	Communes:
6	Very severe to severe drought risk, with wetter wet and wetter dry seasons	Mango	Maize, cassava, beans	Acrisols, Ferralsols	Cam Đức; Cam Tân; Cam Hải Tây; Cam Hoà; Cam Thành Bắc; Cam Hiệp Bắc; Cam Hiệp Nam
7		Mango	Maize, cassava, beans	Ferralsols	Suối Cát; Suối Tân
8		Dragonfruit, cashewnut	Maize, cassava, rice	Ferralsols, Acrisol	Mỹ Thạnh; Hàm Cần; Tân Lập
9		Dragonfruit, cashewnut	Rice	Arenosol, Acrisols	Thuận Quí; Tân Thành; Tân Thuận
10		Coffee, pepper	Maize, cassava, rice, beans, vegetables	Rhodic, Ferralsols, Luvisols	Tân Hà; Thuận An; Đức Mạnh; Nam Nung; Nam Xuân; Tâm Thắng; Đăk Drông; Đông Hà; Đức Minh; Long Sơn; Trà Tân; Dắk Sắk; Krông Buk; Quảng Tiến
11		Coffee, pepper, cashewnut	Maize, cassava, rice, beans, vegetables	Ferralsols, Rhodic	Nam Dong; Trúc Sơn; Ea T'Linh; Đăk Sôr; Ea Sol; Đăk Drô; Cư Knia; Đliê Yang; Ea Sar; Ea Khal; Ea Sô
12		Coffee, pepper, avocado/ orange/ durian/ cocoa	Maize, beans	Rhodic	Xuân Phú; Ea Phê; Ea Kênh; Ea Yông
13	Medium to low drought risk, with wetter wet and wetter dry seasons	cashewnut, pomelo	Maize, cassava, beans, rice	Ferralsols, Leptosols	Phước Thành; Phước Tân; Phước Chiến; Phước Thắng
14		Coffee, pepper, cocoa	Maize, cassava, rice	Rhodic	Đắk Lao

351. The sub-project CIPs should be more active, meet on a six-monthly or annual basis and focus more on assembling technical specialists. Their strategic goal is to jointly achieve tangible changes to the local

agro-ecological systems so they become more resilient to climate change. The specific objectives of the sub-project CIPs are:

- Improved understanding and collaboration among stakeholders across the various value chains within the agro-ecological zones;
- Implementation of solutions to challenges and bottlenecks for achieving climate resilient value chains, based on participatory analysis and mutual interests;
- Establishment and nurturing of partnerships, including contractual relationships;
- Coordination and synergy of various activities dealing with issues related to capacity building, access to input and services, local policies for promoting climate resilient agriculture options; linkages to market and engagement of potential private sectors;
- Periodic exchange of experiences and knowledge to promote learning and refine activities among the stakeholders;
- Scaling up and out of best practices and lessons from the project's sites through meetings, fairs and other networks.

352. The sub-project CIPS should be chaired by the district DARD and involve similar organizations as at provincial level. The DARD chairpersons and a representative number of sub-project CIP members as required should also participate in the provincial CIP to ensure institutional linkage and two-way reporting and information exchange. At the project initiation stage, the sub-project CIPs should develop a five-year action plan for achieving climate resilient value chains, in line with the vision of the provincial CIPs, and incorporating activities as planned through the UNDP-MARD project, WEIDAP project and from other GoV and non-GoV projects and programs. The work plan should be monitored and updated on an annual basis and progress towards inclusive agricultural resilience should be reported upon, including in the provincial CIPs.

353. To strengthen the resilience and productivity of crop systems and increase access to and use of information, technical support and other resources and services on climate resilient agriculture (CRA) technologies and practices, the project should implement comprehensive **Farmer Field School programs**, with one program per sub-project CIP with multiple FFS. The Farmer Field School programs should be demand-driven, practical and specific per agro-climate zone or sub-project CIP level. Specific attention should be paid to reach women farmers and ethnic minorities, for example by setting up women-only classes, engaging women lead farmers and trainers, using local languages, applying flexible time and location of trainings and using visual materials and interactive formats.

354. The provincial DARD AEC should be leading the implementation of the FFS for the province and the district DARD AEC the implementation in the respective sub-project. Technical support for the design, content, training and organization of the FFS should be provided by an external non-Government agricultural expert organization, research institute or NGO, and private sector partners should be engaged as trainers where the expertise is not available within DARD. The Farmers' Union and the VWU should provide organizational support to DARD, use their vast networks to ensure outreach, and ensure gender and inclusion mainstreaming.

355. The FFS program should apply the following steps:

i) *Sensitization of communities and local authorities on the objectives and implementation of the FFS program, with establishment (or re-activation) of FFS groups*. One FFS should include a group of 25 to 30 poor, near-poor to non-poor farmers with a common livelihood interest and farming land size of one hectare or less. Each FFS should have a minimum of 30 percent women, and a representation of all ethnic groups in the locality and female-headed households. The FFS participants, the lead farmers and a minimum of three learning sites per FFS should be self-selected based on the above criteria and through a community meeting facilitated by DARD AEC staff, with support from the village leader and the mass organizations;

ii) *Improvement of existing agricultural extension training materials and tools to incorporate climate risk and impact information, integrate technical details on CRA packages and ensure gender and inclusion mainstreaming*. The materials (handbook, leaflets, posters, facilitation notes etc.) should be developed with support from an external non-Government research institute or NGO;

iii) *Participatory finalization of CRA packages for implementation through FFS*. The CRA packages as developed for the feasibility study should be presented in the sub-project CIPs for potential final revision and updating. This should be done in a consultation workshop setting led by DARD AEC and with representation of farmer groups, mass organizations, private sector and development partners operating in the locality;

iv) *Training of core facilitators*. Technical staff from the provincial and district DARD AEC and Departments of Crop Production, Plant Protection, Rural Development and Irrigation, Commune Agricultural Staff, Farmers' Union and VWU should be selected and trained as core facilitators to conduct the subsequent trainings of lead farmers and implement the FFS. Selection of facilitators should be based on personal attitude, maturity, literacy, leadership skills, gender, knowledge of local language and experience with farming. About 25 to 30 people per province should be trained, with 30 percent women and a representation of all ethnic groups. They should receive training on the CRA packages as well as on gender and inclusion mainstreaming and facilitation and adult learning techniques. The training should be organized by the provincial DARD AEC with support from an external non-Government research institute or NGO, and engage private sector as master trainers where needed;

v) *Training of lead farmers*. Around 30 lead farmers per commune (with 30 percent women and a representation of all ethnic groups) should be trained on the respective CRA packages for their commune and on gender and inclusion mainstreaming and facilitation techniques. The training should be provided by the core facilitators, with technical support from the external partner. Once the training has been successfully completed, lead farmers should receive a certification and be allowed to organize the actual FFS or farmer-to-farmer training sessions;

vi) *Farmer-to-farmers training* or the core activity of the FFS. Minimum two lead farmers per FFS should facilitate seasonal learning sessions for other farmers (poor and near-poor and a limited number of non-poor) on various topics within the CRA packages (see below). To ensure the FFS are delivered effectively, timely and completely, the lead farmers should sign a performance-based contract with the FFS participants, including a simple work plan and scaling plan, which should be monitored by the commune DARD with support from the village leader. This way, the cascading effect of the FFS, from core facilitators to lead farmers to farmers in the field, both irrigated and rainfed and specifically targeting the most vulnerable farmers, will be facilitated. A beneficiary accountability mechanism should be set-up to allow farmers to provide feedback on the lead farmers' performance and to solve any issues that might arise. Throughout this activity, the lead farmers should continue to receive technical and mentoring support by the core facilitators;

vii) *Farmer investment in CRA packages through the use of performance-based vouchers*. Poor and near-poor farmers should be supported to implement the CRA packages through conditional but open vouchers, contingent on their continuing participation in the FFS (see below);

viii) *Participatory monitoring of FFS and CRA*. Every year, the district DARD AEC through the sub-project CIPs should conduct a specific meeting on the implementation progress, level of outreach and effectiveness of the FFS program for enhancing agricultural resilience. Lead farmers, FFS representatives, core facilitators and village leaders should present progress and results on the FFS and the CRA packages, discuss issues and make recommendations for the following year. This will also allow for peer-to-peer exchange and learning between the lead farmers. Every two years, the progress should be reported upon in the provincial CIPs;

ix) *Refresher or additional training* where required, for FFS participants (prioritizing the most vulnerable), core facilitators, lead farmers and value chain actors; and

x) *Documentation of FFS results and CRA packages for scaling through CIPs and other platforms*. Towards the end of the project, the project should consolidate all the evidence, refine the CRA training packages and disseminate the learning and good practices information through the sub-project and provincial CIPs, national and international working groups, workshops, meetings and other channels where suitable for scaling purposes.

356. The FFS program should focus on the promotion of **CRA packages** customized per sub-project CIP and for the target beneficiaries. These CRA packages have been developed based on an in-depth analysis of current and projected climate risks and impacts on water and agricultural productivity, baseline perennial and annual crop or tree systems, soil types, extent of rainfed or irrigated agriculture, local

Government priorities, and existing farmer good practices (including practices already successfully applied by the poor and near-poor). All CRA packages are also suitable for the most vulnerable farmers to apply, in particular poor and near poor, ethnic minorities and women farmers. The CRA packages have been presented to communities (men and women groups, ethnic minorities, poor, near-poor and non-poor smallholders) and local authorities, discussed and refined, with the following priorities as a result (see the sub-assessment report on climate resilient agriculture for more details):

Table 16: Proposed climate resilient agriculture packages per communes:

Provinces	CRA packages	CRA packages apply for the CRA clusters in Table 16	Commune
Khanh Hoa	Package 5: intercropping of Cashew nuts and beans	4, 5	Suoi Cat, Suoi Tan, Cam Hiep Nam
	Package 6: intercropping of Mango trees and beans	6; 7	Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân
	Package 7: Intercropping of Mango and banana trees	6; 7	Cam Đức, Cam Tân, Cam Hoà. Cam Hải Tây, Cam Hiệp Bắc, Cam Hiệp Nam, Cam Thành Bắc, Suối Cát, Suối Tân
Ninh Thuan	Package 1: safe vegetables (onions)	1	Nhon Hai
	Package 2: safe vegetables (garlic)	1	Nhon Hai
	Package 3: Intercropping of custard apple and beans	3	Bac Phong, bac son, loi hai
	Package 4: intercropping of apple + beans	2	My Son, Nhon Son, Xuan Hai
	Package 5: intercropping of Cashew nuts and beans	13	Phuoc chien, Phuoc khang, Loi Hai, Bac Son in Thuan Bac; Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai
	Package 12: Crop rotation of maize and beans	2	My Son, Nhon Son, Xuan Hai
	Package 13: Intercropping of cassava and beans	13	Phuoc Tan, Phuoc Thanh, Phuoc Thanh, Phuoc Trung in Bac Ai
Binh Thuan	Package 8: Intercropping of dragon fruit and beans	8; 9	Mỹ Thạnh, Hàm Cần , Tân Lập, Thuận Nam, Tân Thuận, Tân Thành
	Package 10: Intercropping of coffee and avocado	10	Tân Hà, Đông Hà, Trà Tân
	Package 11: intercropping of coffee and durian	10	Tân Hà, Đông Hà, Trà Tân

Dak Nong	Package 9: Intercropping of coffee and pepper	10; 11; 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung
	Package 10: Intercropping of coffee and avocado	10; 11, 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung
	Package 11: intercropping of coffee and durian	10; 11; 12; 14	Ea T'Linh, Nam Dong, Đăk DRông, Tâm Thắng, Cư Knia, Trúc Sơn, Đắk Lao, Đức Mạnh, Long Sơn, Đắk Sắk, Thuận An, Đức Minh, Đăk Sôr , Nam Xuân, Đăk Drô , Nam Nung
Dak Lak	Package 9: Intercropping of coffee and pepper	10; 11; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh
	Package 10: Intercropping of coffee and avocado	10; 11; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh
	Package 11: intercropping of coffee and durian	10; 12; 14	Ea Drang, EaSol, Đliê Yang, Quảng Tiến, Ea Sô, Ea Sar, Xuân Phú, Krông Buk, Ea Phê, Ea Yông, Ea Kênh

357. For poor and near-poor farmers, particularly ethnic minorities and women, their perception of the risk involved in borrowing money to implement a series of new CRA practices is expected to limit their interest in engaging with the project and participating in the FFS, affecting any subsequent adoption of the CRA practices and systems. To address this obstacle to full adoption and application of the CRA package, a conditional and **performance-based voucher system** should be set up and integrated within the FFS to support poor and near poor farmers with financial incentives to participate in and complete the FFS program aimed at adopting the CRA packages. The system should allow farmers to redeem vouchers for a wide range of agricultural inputs sold by registered local private sector suppliers and required as per the proposed CRA packages. After one or two years of this kind of support tied to performance at the FFS and on-farm, the development of a simple business plan and depending on the crop cycles and seasonal calendar, a farmer's participation in the voucher system should be phased out. Compared to traditional input subsidies or in-kind support, the voucher system is more cost effective, easier to implement, more flexible and tailored to different farmer profiles, stimulating local markets and private sector growth, limiting the risk of crowding out private sector, and empowering farmers to make their own informed decisions on what they need in light of their specific household situation.

358. The district DARD AEC should be in charge of developing, implementing and monitoring the voucher system, with technical support from an agricultural expert organization, research organization or NGO, and organizational support from the Farmers' Union and the VWU. It should be implemented at sub-project CIP level, and linked to the FFS program and the CRA packages.

359. The voucher system should be developed and implemented through the following steps, replicating global good practice and experience from FAO Viet Nam during the recent drought recovery (see section 5.5):

i) *Orientation of lead facilitators* on the objectives, process and components of the voucher program, with the facilitators selected from the group of FFS core facilitators and lead farmers (see above);
ii) *Consultations or sensitization with local authorities, agricultural suppliers and communities* to ensure buy-in. If required, implementation or operational regulations should be devised by the province and/or district PPC to ensure a smooth operation of the program;
iii) *Participatory market mapping and assessment*, including a mapping and assessment of the local suppliers (number, profile, capacity, distance to farmers, interest), supply chain (quantity, quality, capacity trends), household financial analysis, and market prices and price trends, with involvement of the lead facilitators;
iv) *Select list of agricultural supplies eligible for vouchers*, intersecting the requirements for implementation of the CRA packages with the results of the local market assessment. The list should be long and diverse enough to cater to all cropping systems, CRA packages, farmer preferences and intended target beneficiaries;
v) *Participatory beneficiary selection*, conducted by the lead facilitators through village meetings, and based on the following criteria: social vulnerability to climate change, interest in adopting the CRA packages, and commitment to participating in the complete FFS;
vi) *Selection and contracting of suppliers* ensuring a diverse number of small and medium size suppliers operating in proximity to the farmers. Suppliers should be selected through an open-bidding process managed by the district DARD AEC, with quality control from the external partner. Contracts between local authorities and suppliers should include some key voucher-specific aspects such as commodity specification, trader payment terms, quality inspection and acceptance;
vii) *Participatory design of vouchers* in terms of monetary value, serial numbers, colors, logos, date of validity etc. The value of the vouchers can be different per sub-project and should depend on the CRA clusters proposed and the cost of the required agricultural inputs (per the results of the market assessment). Farmers should not receive the full value of the agricultural supplies and should be required to contribute their own financial resources, for example a minimum of twenty percent. The value should represent only a portion of the costs to offset the farmer's perceived risk. The voucher design should also include measures to avoid corruption and should be designed to ensure appropriate use by ethnic groups, illiterate farmers and other marginalized groups. The design should be tested with different farmers and suppliers and refined if needed;

viii) *Set up of beneficiary accountability mechanism.* The mechanism should be established to allow farmers and suppliers to provide positive or negative feedback on the performance of the voucher system and to solve any issues that might arise;
ix) *Train facilitators, suppliers and farmers* on use of vouchers, distribution and redemption system. Simple, pictorial and local language handbooks, training materials and monitoring tools should be developed by the technical organizations assisting the DARD AEC and the lead facilitators;
x) *Voucher distribution*, linked to participation in FFS and the development of a simple business plan, with one voucher received per FFS class attended. Farmers should be able to use each voucher separately or save them up and accumulate them to buy more expensive inputs. Farmer group members should also be allowed to pool all their vouchers to conduct a group investment;
xi) *Voucher redemption, reconciliation and reimbursement*, between farmers, agricultural input suppliers and district DARD AEC;
xii) *Monitoring of use of vouchers and market prices*, by lead facilitators, based on information from the farmers as well as the suppliers. Progress on the use of the vouchers should be reported and discussed in the sub-project CIPs as part of the monitoring of the FFS program. Market prices should be monitored through regular simple market price surveys to ensure the voucher program has no negative impacts on local inflation or price trends, and to ensure the voucher value remains adequate for farmers to be able to afford the required inputs.

360. In addition to the voucher system as an incubator for farmer investment in improved CRA practices and technologies, the project should further increase access to credit by organizing **FFS farmer-level agricultural credit information sessions**. The key Government credit providers, the VBARD, VBSP and the VWU should be invited to participate in the provincial and sub-project CIPs but should also be offered a platform for sharing updated information directly with farmers on credit products accessible by the poor and near-poor. Farmers will thereby receive better information and have an opportunity to inquire for information and discuss barriers to access directly with the credit providers. The project aims to provide credit providers with better information on farmer needs with the aim of having them develop tailored, pro-poor and improved credit products for CRA investments. The project should also seek collaboration with LienVietPostBank and VWU to present their '*Vi Viet'* e-wallet services for improved access to small credit for poor and near-poor women in the target areas (see section 3.1.2).

361. To enable market linkages with input and technology suppliers and buyers for resilient agricultural products and to stimulate farmer-to-farmer and farmer-to-trader learning across scale, the project should organize sub-project CIP level **farmer trade fairs**. The fairs should be organized biennially and by the DARD AEC. Through the fairs, suppliers, traders and buyers should be able to present resilient crop varieties, advances in irrigation or water-efficiency technologies, machinery, post-harvest and food processing techniques etc. In addition, farmers should be able to present the successfully implemented CRA packages and encourage scaling by other farmers or private sector investment.

362. To facilitate documentation, information exchange and scaling of CRA good practice, the project should also support an **online interactive CRA farmer-learning platform**. The platform should be based on the existing online 'Climate Smart Agriculture database', managed by the MARD Institute of Policy and Strategy for Agricultural and Rural Development.[224] The database interface, design and functionality should be further developed to allow the integration of photos, simple videos and documentation showcasing CRA good practice successfully implemented by the project. The photos and videos should be made by farmers participating in the FFS, with technical support by lead farmers and core facilitators. Women and ethnic groups should be adequately represented from a positive and empowering position, for example in terms of number, in different non-conforming farmer roles and responsibilities (various farming functions, extension work, FFS lead farmers, Government decision makers, etc.) and ethnic minority imagery beyond mere cultural representation. The CRA farmer-learning platform should be actively promoted in the CIPs and at other sub-national, national and international workshops and meetings.

[224] http://csa.mard.gov.vn/General/home.aspx

363. In order to address some of the major barriers preventing women and marginalized farmers from adopting or influencing the household and communities' CRA strategies and decision-making, the project should apply the proven **Gender Action Learning Systems (GALS)** tool. The GALS should be integrated into the FFS and facilitated by the VWU, with technical support from an agricultural expert organization or NGO.

6.4 Recommendations on agro-climate information services

364. Meeting a high demand for more localized and actionable agro-climate information so farmers – and agricultural planners – can better identify climate risks and potential impacts, plan their crop calendars and take timely measures to avoid damage and loss from extreme weather events, the project should improve the current GoV forecasting and advisory systems towards a more **farmer needs-driven agro-climate information service**. This should be done by replicating Participatory Scenario Planning, a proven multi-stakeholder approach for enabling access to seasonal climate forecasts, understanding and interpretation of the forecasts and associated uncertainty into locally relevant information that is useful in decision making and planning for CRA and climate resilience (see section 5.4). Official and scientific weather, climate and agricultural planning information should be combined with farmer knowledge and experience to jointly develop user-friendly and farmer-relevant advisories per season and per cropping system.

365. While the existing GoV agro-meteorological observation network has its limitations in terms of number and density of stations, use of outdated technology and limited integration of meteorological and crop and soil monitoring observations, the project should not be required to invest in new automated weather stations. Investments in weather stations are still required for Viet Nam, but through other channels, for example via GoV and private sector investments (ie. AgriMedia) that are already in the pipeline.[225]

366. Linked to the sub-project CIP, the project should assemble a technical group in charge of the co-development of seasonal and ten-to-fifteen-day agro-climate advisories, called the Agro-Climate Information Services (ACIS) technical group. The ACIS technical group should be led by the district DARD and be comprised of provincial hydro-meteorological services staff, district agricultural staff, mass organizations and representatives of the FFS lead farmers. DARD should be trained and technically supported by an external research organization or NGO experienced in developing agro-climate advisories through Participatory Scenario Planning processes. Sub-groups should be formed as required to produce tailored advisories for different cropping systems within the sub-project.

367. The **seasonal agro-climate advisories** should be developed through the following steps, with steps five to eight to be repeated through iterative learning and adaptation feedback loops:

i) *Training of provincial hydro-meteorological staff on generating and interpreting downscaled weather forecasts and climate risk information for agricultural planning*, delivered by IMHEN to cover current capacity gaps essential for developing seasonal agro-climate advisories;
ii) *Agro-ecological zoning to support improved downscaling and advisory development*, done by provincial hydro-meteorological staff with technical support from IMHEN*;*
iii) *Formation of ACIS technical group* at the sub-project CIP level, including the establishment of sub-groups per cropping system as needed. This includes orientation sessions on the objectives and process of agro-climate advisories and mapping of information flows required with agreement on roles and responsibilities of different members;
iv) *Training of ACIS technical group members* on participatory scenario planning for development of agro-climate advisories, community facilitation and engagement with women and ethnic minorities. Existing training materials on participatory scenario planning should be adapted for the project;
v) *Co-development of seasonal agro-climate advisories* through Participatory Scenario Planning workshops, organized pre- and post-season, with updates mid-season. A standard Participatory Scenario Planning workshop consists of six sessions: i) review of previous season and analysis of current status; ii) presenting and co-generating a downscaled seasonal climate forecast; iii) based on seasonal forecast probabilities, develop scenarios of hazards, risks, opportunities and impacts;

[225] For further analysis, see the sub-assessment report on climate information.

iv) coordinated planning for action, developing possible measures to address all the scenarios of hazards, risks, opportunities and impacts; v) develop locally relevant and actionable advisories; and vi) develop a communication plan for dissemination, with packaging advisories to suit user needs and preferences in terms of formats and channels;

vi) *Advisory dissemination or communication*, through paper bulletins, village notice boards, radio, television, SMS and the GoV loudspeaker system, depending on user needs and preferences;

vii) *Farmer-to-farmer advisory interpretation and learning sessions*, pre- and post-seasonal and facilitated by the lead farmers with mentoring support from the Farmers' Union and the VWU, to improve farmers' understanding and interpretation of climate risks, probabilities, scenarios, advisories and use for CRA planning;

viii) *Development of ten-to-fifteen days agro-climate advisories,* by DARD and provincial hydro-meteorological staff, with mentoring support from IMHEN;

ix) *Post-seasonal feedback and refinement of agro-advisories*. This step is linked to step five as a feedback and learning loop to evaluate the effectiveness and usability of the previous advisory and provide recommendations for improvement of the next advisory. These systematic feedbacks and learning loops should create an effective process for continuous refinement of advisories, integrating incremental farmer experience;

x) *Documentation of process for upscaling*. Towards the end of the project, the project should consolidate all the evidence, finalize the training package and disseminate the learning and good practices information through the sub-project and provincial CIPs, national and international working groups, workshops, meetings and other channels where suitable for scaling purposes.

368. **Market information** should be accessed from a variety of existing sources such as private sector and government agencies – who are participating in the provincial as well as the sub-project CIPs - and packaged to accompany the agro-climate advisories. In this way, farmers have a complete menu of information available for better informed agricultural planning that is productive, sustainable and resilient to the identified climate risks. This activity should be linked to the CIP vision and plans on resilient value chains and be integrated under the CIP work plans to ensure a systematic exchange of information and support the establishment of long-term partnerships.

6.5 Recommendations on gender and inclusion

369. To address key gender and ethnic minority barriers and constraints as identified under section 4.6, the project should implement the following suite of measures (see the Gender and Inclusion Action plan in annex for more details):

- Capacity building on gender equality and ethnic minority inclusion for local authorities, focused on awareness raising, training activities and experiential learning on gender and climate change, gender and inclusion analysis, mainstreaming, and gender-sensitive and inclusive project planning, implementation and M&E;
- Promote equal representation, participation, leadership and decision-making of men and women, and ethnic groups in project implementation structures, innovation platforms, farmer groups, household decision making on CRA, technical working groups, project consultations and project activities;
- Promote equal access to information, with both women and men and ethnic group representatives in active roles as information providers, trainers, communicators, community facilitators, and information end users. Training events, consultation sessions, communication and training materials should be designed and disseminated through gender-sensitive and ethnic minority appropriate methods, messages, venues and time.

370. At the start of the project, the project implementation team, with partners, will further refine and agree on the project Gender and Inclusion Action Plan, with integration into the project monitoring and evaluation system, and regular monitoring, progress tracking and reporting.

6.6 Environmental and social safeguards

371. A detailed environmental and social safeguards assessment was carried out for this proposal, resulting in two documents annexed to the Full Proposal: the UNDP Environmental and Social Screening Procedure (Annex VI(a)) and the GCF Environmental and Social Management Framework (Annex VI(b)). The following describes in general the conclusions of the two assessments:

372. To achieve its objective, this project will invest in enabling poor/near-poor smallholders to adapt to increasing climate-driven rainfall variability and drought through implementation of two inter-linked Outputs:

Output 1 - Enhanced water security for agricultural production for vulnerable smallholder farmers in the face of climate-induced rainfall variability and droughts
Output 2 - Increased resilience of smallholder farmer livelihoods through climate-resilient agriculture and access to climate information, finance, and markets.

373. While the project will target ethnic minority, women and other poor/near poor farmers, it will build the capacities of all farmers in climate vulnerable areas; as such the project will reach 222,410 direct beneficiaries in the five provinces of Dak Lak, Dak,Nong, Binh Thuan, Ninh Thuan and Khanh Hoa.

374. The project will enable the Government of Vietnam to adopt a paradigm shift in the way smallholder agricultural development is envisioned and supported through an integrated approach to agricultural resilience starting with planning for climate risk based on identification and analysis of agroecosystem vulnerabilities; enhancing water security and guaranteeing access; scaled up adoption and application of climate-resilient agricultural practices and cropping systems; and creating partnerships among value chain stakeholders to ensure access to market and credit.

375. This project will also produce important environmental, social and economic co-benefits. With increasing adoption of agroforestry and other multi-cropping systems, including resilience-enhancing soil, water and biomass management practices, the land degradation processes currently underway will be slowed. The project will empower women and ethnic minorities with the skills and confidence to participate more widely in community and organizational affairs, as well as to establish formal business partnerships and access the market for climate-resilient agricultural products.

376. The project has been screened against UNDP's Social and Environmental Screening Procedure. The Social and Environmental Screening Template was prepared and the project deemed to be a moderate risk (Category B) project. This ESMF has been prepared based on the risks identified through screening of activities. The risks are considered to be acceptable and manageable through the application of mitigation measures.

377. The ESMF provides an outline of the types of mitigation measures that are likely to be required when implementing the project. Where appropriate, site specific environmental and social management plans (ESMPs) or site work instructions may be prepared to deal with specific issues.

6.7 Cost-effectiveness

378. The project provides last mile connectivity for farmers close to irrigation systems and bio-engineered water storage system (rehabilitation and provision of new ponds) for farmers that only have access to rainfall agriculture. This is combined with climate resilient agriculture (CRA) and market access interventions to improve income of already vulnerable groups. Accordingly, the project rehabilitates current ponds rather than building new ones as the best alternative to new ones in the same locations. This is the most cost-effective options for those locations. The FFS approach is also a cost-effective way of increasing adoption of CRA and reaching farmers on effective adaptation strategies. Alternative options for the CRA packages were considered but the CRA packages have been presented to communities (men and women groups, ethnic minorities, poor, near-poor and non-poor smallholders) and local authorities, and discussed and refined. A full economic analysis of this project has been undertaken and the discussion and results can be found in the Economic Analysis Annexes to the Full Proposal (Annexes VII(a) and VII(b)).

6.8 Exit strategy

379. To ensure sustainability of the project, a comprehensive exit strategy should be developed from the project inception stage, integrating the below components. This plan should be monitored and updated regularly by all project partners involved.

380. The project should guarantee full participation of the most vulnerable farmers and relevant local authorities in the assessment, design, development and implementation of the project promoting climate resilient water-efficiency and agricultural technologies and practices, the FFS program, the agro-climate advisories, the CIPs, farmer-learning activities such as the videos and farmer fairs, and other activities. While participatory processes require more time and resources than top-down processes, they have proven to result in higher levels of ownership, O&M and investment after the project has concluded. In terms of community group engagement and social capital, the project should also utilize existing - women-only, men-only or mixed - community groups such as cooperatives, farmer interest groups, credit groups, women's groups, water user groups et al. that have proven to be already self-sustaining. Establishing and sustaining new community groups requires considerable investments and are not required for the selected project sites. The consultations conducted at this feasibility stage have already confirmed that community groups exist in the large majority of the selected communes.

381. The project should ensure that project financial support to farmers is gradually phased-out towards the end of the project and substituted by other options for farmers. For example, the monetary value of the vouchers provided as part of the FFS for the promotion of CRA should gradually reduce, while the farmer's contribution should increase, without losing the incentivizing or performance-based function of the voucher program. Towards the end of the project, the project should shift its focus to support farmers to develop business plans and promote different available public and private credit options for investment in CRA, so that farmers can transition from project support to better and more informed access to these credit systems, in line with their business plans. A crucial condition for promoting a certain CRA package to poor and near poor should also be the prospect of immediate and continuing increase in income or financial viability, so farmers can build up more financial reserves to keep investing in CRA and better cope with risk. Other socio-economic co-benefits of the CRA should also be appealing enough for farmers to ensure their continuing investment.

382. The proposed provincial and sub-project CIPs should be integrated into the Government structures and mandates and build on good practice in public-private value chain platforms where they are existing, for example with coffee in the Central Highlands and dragon fruit in the South-Central Coast. The objectives, functions and meeting frequency of the provincial CIPs should be minimal and focused, in response to the existing workloads of local authorities. Sub-project CIPs should be more active, but also take into account other roles and responsibilities of the actors involved. Towards the end of the project, specific meetings

should be organized to discuss the CIP structure's sustainability and what is required to sustain the platforms or how its functions can be integrated within the existing institutional set-up. The CIPs should remain flexible to cater to local needs.

383. To build long-term institutional capacity, the project should implement a multi-level training program for Government officials, covering technical topics on climate resilience, community facilitation, gender and inclusion as well as organizational and project management functions. The project should identify, train and utilize core or 'master trainers' from the local authorities so they can be engaged or lead in project activities but also be mobilized by other stakeholders implementing climate resilient programs and investments in the target provinces. These stakeholders will be informed and updated on training program progress and results through the CIP structures. Existing Government training materials should be adapted or new materials developed that are tailored to Government end-users.

384. To encourage further uptake, replication and scaling, the project should invest considerably in promoting project learning and good practice at multiple levels, mainly through the CIP meetings, the FFS program and the instrumental role of the lead farmers, the farmer fairs, the farmer online video platform, the development of knowledge and advocacy products, and the dissemination in regional, national and international workshops and events.

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