



# Rapid Flood Damage and Needs Assessment

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Vietnam 2016



THE SOCIALIST REPUBLIC OF VIETNAM



## Acknowledgments

This Rapid Flood Damage and Needs Assessment (RFDNA) report was prepared by the Government of Vietnam (GoV) with technical contributions from the World Bank task team and support from the Global Facility for Disaster Reduction and Recovery (GFDRR). This report has benefitted from the guidance, coordination, and logistical and technical input provided by officials in Binh Dinh, Ha Tinh, Ninh Thuan, Phu Yen, and Quang Ngai provinces and other stakeholders and many central government ministries, including the Ministry of Planning and Investment (MPI), the National Disaster Management Office (NDMO) under the Ministry of Agriculture and Rural Development (MARD) and the Ministry of Natural Resources and Environment (MoNRE), the Office of Government (OOG), the State Bank of Vietnam (SBV), the Ministry of Transport (MoT), and the Ministry of Finance (MoF).

The assessment team visited Binh Dinh and Phu Yen provinces on February 12 –15, 2017, to gain a firsthand understanding of the scale of the damage and to develop a recovery and reconstruction plan. The team would like to acknowledge the generous support offered by the provinces and line ministries in assisting the team in the field, as well as in Hanoi during the assessment.

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# FOREWORD

Between mid-October and the end of December 2016, a combination of tropical depressions and the North-Eastern Monsoon produced very heavy rainfall and five consecutive periods of flooding, which significantly affected the people and economies of eighteen provinces in central Vietnam (North Central, South Central Coast, and the Central Highland regions). The preparedness and timely action to the warning of the floods from the central government, affected provinces, and communes resulted in minimum casualties.

This report – Rapid Flood Damage and Needs Assessment, Vietnam 2016 – lays the groundwork for the effective recovery from flood impacts in the five priority provinces of Ha Tinh, Quang Ngai, Binh Dinh, Phu Yen and Ninh Thuan. Both the central government and provinces of Vietnam recognize the necessity to continuously improve on disaster risk reduction and management capabilities and aim to rebuild a more resilient future for its citizens.

Presently, we need to immediately start restoring access to services and infrastructure as quickly as possible, incorporating “build back better” components into the reconstruction efforts. This report provides a detailed breakdown of the key affected sectors, the extent of damages sustained, the reconstruction/recovery needs, and the recovery strategy. We are committed to integrating disaster risk management within every development initiative to minimize future risks in the country.

Representative. People’s Committee of Binh Dinh Province

Chairman

The image shows a red circular official seal of the Binh Dinh Provincial People's Committee. The seal features a central five-pointed star and is surrounded by the text "BAN NHAN DAN TINH BINH DINH" and "LY BAN NHAN DAN TINH BINH DINH". Overlaid on the seal is a blue ink signature.

HO QUOC DUNG

## ABBREVIATIONS AND ACRONYMS

<b>CCFSC</b>	Central Committee for Flood and Storm Control
<b>DANA</b>	Damage Assessment and Needs Assessment methodology
<b>DDMFSC</b>	Department of Dike Management and Flood and Storm Control
<b>DMC</b>	Disaster Management Centre
<b>DRM</b>	Disaster risk management
<b>DRR</b>	Disaster risk reduction
<b>GDP</b>	Gross domestic product
<b>GoV</b>	Government of Vietnam
<b>MARD</b>	Ministry of Agriculture and Rural Development
<b>MoC</b>	Ministry of Construction
<b>MoF</b>	Ministry of Finance
<b>MPI</b>	Ministry of Planning and Investment
<b>MoT</b>	Ministry of Transport
<b>OOG</b>	Office of Government
<b>ODA</b>	Overseas Development Assistance
<b>PCC</b>	People's Central Committee
<b>SBV</b>	State Bank of Vietnam
<b>NCC region</b>	North Central Coast region
<b>SCC region</b>	South Central Coast region
<b>UNDP</b>	United Nations Development Programme

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### CURRENCY EXCHANGE RATE

One US dollar (US\$) =  
22,680 Vietnamese dong (VND).

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# EXECUTIVE SUMMARY

## BRIEF DESCRIPTION OF THE EVENT

From the middle of October until the end of December of 2016, very heavy rainfall caused by a combination of tropical depressions and the North-Eastern monsoon produced five consecutive periods of flooding in eighteen provinces in central Vietnam (North Central, South Central Coast, and the Central Highland regions), significantly affecting their people and economies.

The total rainfall on average over a two-month period reached up to 2,000 millimeters, with peaks in Quang Nam (2,611 millimeters), Quang Ngai (2,729 millimeters), and Binh Dinh (2,417 millimeters). The 2016 floods were rare events; while rainfall-induced flooding occurs annually in these regions, they are seldom so frequent and so late in the year. During the two months, new floods would occur in the low-lying areas of the South Central Coast regions while the regions were still feeling effects from the previous ones, thus exacerbating their impacts. As irrigation and hydropower reservoirs in all affected regions reached their maximum capacities, a series of controlled water discharges further intensified the effects.



**FIVE CONSECUTIVE PERIODS OF FLOODING:  
October-December 2016**

**RAINFALL ON AVERAGE OVER A TWO-MONTH PERIOD:  
Up to 2,000 millimeters**

# Damage and Losses

## OVERVIEW

**The six provinces most affected by the floods were Binh Dinh, Quang Ngai Nghe An, Phu Yen, Quang Binh, and Ha Tinh.** The following are all eighteen provinces affected and the dates they were affected:

- Nghe An, Thu Thien Hue, and provinces in between, October 13–18
- Ha Tinh, Phu Yen, and provinces in between and the Central Highland provinces, October 30–November 7
- Thua Thien Hue, Binh Dinh, and provinces in between, November 29–December 4
- South Central and Central Highland provinces (Thua Thien Hue, Ninh Thuan, and provinces in between), December 5–9
- Central and Central Highland provinces (Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, and Gia Lai), December 12–18

Approximately 10 to 30 percent of the people in each province were affected, with over one million temporarily displaced and in need of recovery assistance. On October 15, 2016, the Government of Vietnam (GoV) declared a state of emergency, and in December 2016, the government's Central Committee for Natural Disaster Prevention and Control (CCNDPC) and the United Nations reported the total damage and loss from all five floods in the eighteen provinces:

- Human impact: 134 dead or missing and 151 injured
- Housing: 233,271 houses flooded (with water rising above one meter in 163,682) and 4,093 damaged or collapsed
- Crops: 53,247 hectares of rice damaged and 23,294 hectares of perennial crops and 44,437 hectares of vegetables submerged
- Livestock: 18,371 cattle and 1,218,449 poultry killed
- Infrastructure: 1,782 kilometers of roads damaged or eroded and 585 bridges or culverts and 60 kilometers of dikes damaged
- Estimated economic loss (in Vietnamese dong): VND 10,520 billion (approximately US\$460 million)



## PER PROVINCE

Of the four provinces that came under review for this report, the rapid assessment showed the most severely affected was Binh Dinh, followed by Quang Ngai, Phu Yen, and Ninh Thuan. Table A1.1 summarizes the estimated damage and losses<sup>1</sup> to each province, in Vietnamese dong (VND) and U.S. dollars. The sectors covered under this rapid assessment are Housing, Agriculture, Livestock, Fishery, Irrigation & Flood Control and Road Transportation Sectors.

Subsequently, GoV requested that Ha Tinh province be covered under this project assessment. Because the time to collect information on damage and reconstruction needs for Ha Tinh was extremely short, the report for Ha Tinh province is mainly on the flood protection and irrigation sector, with disaster effects summarized in table A1.2.

**TABLE A1.1. ESTIMATED DISASTER EFFECTS (DAMAGE AND LOSSES) BY PROVINCE**

PROVINCE	Damage		Losses		Total	
	VND millions	USD millions	VND millions	USD millions	VND millions	USD millions
Binh Dinh	1,785,443.5	78.7	183,619	8.0	1,966,883.5	86.7
Quang Ngai	736,754.5	32.5	220,564	10.0	963,554.5	42.5
Phu Yen	358,572.4	15.9	1,081,428	48.0	1,447,212.4	63.9
Ninh Thuan	221,036.0	9.7	369,022	16.0	583,916.0	25.7
<b>TOTAL</b>	<b>3,101,806.4</b>	<b>136.8</b>	<b>1,854,634</b>	<b>82.0</b>	<b>4,961,566.4</b>	<b>218.8</b>

Source: Estimates by the assessment team, based on official information from the government.

Note: The losses reported are only from the agriculture, livestock, and fishery sector.

**TABLE A1.2. ESTIMATED DISASTER EFFECTS (DAMAGE AND LOSSES) FOR HA TINH**

PROVINCE	Damage		Losses		Total	
	VND millions	USD millions	VND millions	USD millions	VND millions	USD millions
Ha Tinh (for flood protection and irrigation only)	219,380	9.7	n/a	n/a	219,380	9.7

Source: Estimates by the assessment team, based on official information from the government.

<sup>1</sup> "Damage" is defined as total or partial destruction of physical assets. "Losses" are defined as reduction or variation in economic flows due to the event—for example, reduction or variation in production; service delivery; access to goods and services; revenues, salaries, personal income, and employment; imports and exports; financial flows; taxes and other revenues and expenditures; transfers; and/or compensation payments.

## PER SECTOR

Of the four sectors, the most severely affected was transportation, with total damage of US\$70 million (VND 1,588,501 million), followed by flood protection and irrigation infrastructure, US\$33.9 million (VND 769,507.8 million), agriculture, livestock, and fishery, US\$22.6 million (VND 512,142.8 million), and housing, US\$10.2 million (VND 231,655 million).

Table A1.3 shows the breakdown of the estimated damage and reconstruction needs costs by sector. A reconstruction needs estimate is not included for the agriculture, livestock, and fishery sector. The sector with the greatest reconstruction need was flood protection and irrigation infrastructure.

**TABLE A1.3. ESTIMATED DISASTER EFFECTS AND NEEDS BY SECTOR**

SECTOR	DISASTER EFFECTS						RECONSTRUCTION NEEDS	
	Damage		Losses		Total		Total	
	VND millions	USD millions	VND millions	USD millions	VND millions	USD millions	VND millions	USD millions
<b><i>Social Sectors</i></b>								
Housing	231,655	10.2	-	-	231,655	10.2	394,208	17.4
<b><i>Productive Sectors</i></b>								
Agriculture	118,481	5.2	1,516,901	66.8	1,635,382	72		
Livestock	377,574	16.6	35,336	1.6	412,910	18.2		
Fishery	16,088	0.7	302,398	13.3	318,486	14.0		
<b><i>Infrastructure</i></b>								
Irrigation and flood control	973,585	42.9	-	-	973,585	42.9	4,517,901	199.2
Road Transportation	1,588,501	69.9	-	-	1,588,501	69.9	3,241,327	142.9
<b>TOTAL</b>	<b>3,305,884</b>	<b>145.5</b>	<b>1,854,635</b>	<b>81.7</b>	<b>5,160,519</b>	<b>227.2</b>	<b>8,153,436</b>	<b>359.5</b>

Source: Estimates by the assessment team, based on official information from the government.

Vietnam's transportation infrastructure was extensively damaged by the flooding and landslides. As reported, the five floods during October–December 2016 caused heavy damage to the transportation infrastructure, mostly roads and bridges, in the eighteen provinces. After overtopping and/or breaching the riverbanks and dikes, flood flows from various rivers inundated the surrounding areas, including the roads, and in many places washed away portions of road, eroded the road pavement and embankments, and destroyed or damaged many bridges. In hilly terrains, the heavy rainfall caused landslides that blocked and damaged the roads. Heavy surface water flow down the steep slopes caused erosion of road foundations, leading to failure of the pavement. Flooding and landslides had a major impact on road connectivity.

In the four provinces considered to have suffered most from the flooding—Binh Dinh, Ninh Thuan, Phu Yen, and Quang Ngai—the transportation sector alone accounted for about 54 percent of the total damage, which was mainly concentrated in Binh Dinh province; damage to transportation there represented nearly 55 percent of the damage in that sector in the four provinces. The flooding and landslides cut off access to essential services, with destroyed bridges blocking access even to foot traffic—the most basic mode of transportation. Road infrastructure remains vulnerable to further damage and failure until permanent repair works (including the strengthening and raising of riverbanks and dikes) can be completed. The disaster worsened already poor accessibility in the rural areas. The lack of access on the road network restricts the delivery of emergency supplies and will continue to hamper recovery efforts for the most severely affected communities. The rapid assessment estimates total damage in the transportation sector in the selected four provinces at US\$70 million, for which the recovery and reconstruction needs approximate US\$143 million, including the cost of a more resilient standard structure.

The irrigation infrastructure sector (including flood prevention and control) in the affected provinces also experienced great damage. The damages caused to flood embankments and dikes, riverbank erosion protection works, irrigation infrastructure (e.g. canals and canal structures, temporary raised dams, barrage, and access to roads to irrigation headwork, and drainage culverts and sluices), and water supply schemes, with most of the damages occurring to dikes, riverbanks, and irrigation canals wide-spread largely in rural areas where are most vulnerable to natural disasters.. Rural areas suffered major impacts, with damage occurring to dikes and embankments, riverbank protection works, irrigation canals, diversion dams, roads, bridges, culverts, and so on. All damaged schemes and infrastructure identified here are public investments.

The reported damage in this sector in Binh Dinh province exceeded that of the other provinces included in the rapid assessment, as the assessment team observed during the field mission. For the four sectors, the estimated direct damage for Binh Dinh was twice as high as for the other three provinces (see table A1.1).

At the time of the assessment, provincial governments had, with the assistance of the central government, undertaken temporary restoration measures, such as the initial and/or partial closing of breaches, the strengthening of critical bunds and revetments, and so on. Many of these works require immediate attention, with permanent measures taken to lessen the chances of further losses and/or damage in the near future. This is particularly urgent with the approach of the annual monsoon season, when Vietnam is exposed to cyclonic storms and heavy rain. Given the frequency of severe events in Vietnam, completing the repair and strengthening of damaged infrastructure immediately is vital.

The total cost of damage to infrastructure, including dikes and embankments, irrigation canals, and other infrastructure in the five provinces under review in this report is estimated at US\$113 million. The aggregate cost of reconstruction with improved design standards for flood control and irrigation infrastructure in the five provinces that are the focus of the reconstruction project is estimated at US\$200 million, with approximately half that total required by Binh Dinh province.



*\*For Irrigation and Flood Control only*

## **AGGREGATE COST OF RECONSTRUCTION: US\$200 MILLION\***

**With improved design standards for flood control and irrigation infrastructure in the five provinces that are the focus of the reconstruction project is estimated at US\$200 million, with approximately half required by Binh Dinh province.**

# Government's Response

In the face of the 2016 floods in Vietnam, the country's central government acted promptly, according to prearranged response plans. Warnings and operational directives disseminated via the media (TV and radio) guided the preparedness and response efforts.

At the provincial level, the Provincial Committee for Natural Disaster Prevention and Control (PCNDPC) instructed the districts, communes and line provincial departments to implement the pre-agreed response plan. The PCNDPC was on standby every day around the clock, collecting and disseminating information on the flood situations. For the response, the provincial authorities deployed human resources, devices, materials, equipment, water and food, preventive medicines, and other necessities.

Other actions taken by the provincial-, district- and commune-level committees included operating the reservoirs according to the pre-agreed procedures, with the result that no major incidents took place; guiding traffic to avoid areas with collapsed bridges, landslides, and flooded roads, which ensured safety; and promptly evacuating people living in the severely affected areas to safe places. As of the end of December 2016, all evacuated people had returned to their houses or were living with relatives. The media provided constant updates on the situation and disseminated instructions from the Committees for Natural Disaster Prevention and Control for the residents affected by the event.

Each year, the provincial authorities set aside contingency budgets, comprising 3 to 5 percent of their annual budgets, to be used to support relief and emergency operations immediately following a natural disaster. These funds allowed the quick mobilization of relief items, such as food and water, seeds for replanting, livestock, and search and rescue equipment, and they paid for temporary measures, such as sandbags for breached riverbanks and temporary shelters, to be put into place.

Following natural disasters, the provincial authorities in Vietnam also provide extraordinary financial support to social protection beneficiaries—that is, to people affected by the events. In Binh Dinh, for example, the 2016 events prompted the provincial authorities to provide compensation in the following amounts:

- VND 4.5 million per person for loss of life
- VND 1.5 million per seriously injured person
- VND 50 million per destroyed house that could be rebuilt on the same plot
- VND 100 million per house that was washed away and needed to be relocated due to the vulnerability of the original plot to future events, with one alternate land plot granted without a land use fee

The provincial militaries supported the affected households by helping clean up inundated houses and erecting temporary shelters for those who could not go back to their homes. Temporary dikes were also erected, allowing the winter–spring crops to be planted. Contaminated wells were treated, and schools were cleaned up so children could resume their educations. Electricity was restored to most of the affected areas.

## NATURAL DISASTER COMPENSATION, BINH DINH



per person  
loss of life

VND 4.5 MILLION



per seriously  
injured person

VND 1.5 MILLION



per destroyed house  
rebuilt on same plot

VND 50 MILLION



per destroyed house,  
relocated

VND 100 MILLION



# I. INTRODUCTION

## I.1 Vietnam: Brief Overview of Vulnerabilities to Natural Disasters

Of the countries in the East Asia and Pacific region, Vietnam is among those at highest risk from natural disasters, with floods, droughts, severe storms, landslides, and forest fires having substantial economic and human impacts annually. Over the past two decades, natural disasters in Vietnam have caused more than 13,000 deaths and property damage in excess of US\$6.4 billion, valued at an annual average of about 1 percent of gross domestic product (GDP).<sup>2</sup>

While an upward trend in economic impact is probably in part the result of increased exposure associated with economic growth, climate change will also likely exacerbate the impacts from these hazards, as hydro-meteorological events increase in frequency and intensity. Of a total population of 90 million,<sup>3</sup> an estimated 70 percent live in low-lying areas close to Vietnam's coastline, which extends for approximately 3,200 kilometers and is vulnerable to hydro-meteorological disasters, such as floods and storm surges and windstorms generated by tropical cyclones.<sup>4</sup> Vietnam is likely to incur, on average, US\$1.4 billion (VND 30.2 trillion) per year in direct damage due to floods, typhoons, and earthquakes. In the next 50 years, it has a 40 percent chance of experiencing economic loss exceeding VND 141.2 trillion (US\$6.7 billion) and a 20 percent chance of experiencing loss exceeding VND 171.2 trillion (US\$8.1 billion).<sup>5</sup> The poor and extreme poor, including ethnic minorities, are particularly vulnerable to economic shocks, including from disasters, weather extremes, and climate variability.

2 X. Wang, O. Mahul, and C. Stutley, *Weathering the Storm: Options for Disaster Risk Financing in Vietnam* (Washington, DC: World Bank, 2010), 58.

3 Global Facility for Disaster Reduction and Recovery (GFDRR), "Country Profile: Vietnam," 2015, <https://www.gfdrr.org/sites/gfdrr/files/region/VN.pdf>.

4 Ibid.

5 World Bank Disaster Risk Financing and Insurance Program, 2016, Vietnam Sovereign Disaster Risk Finance Study, with support from the Swiss State Secretariat of Economic Affairs (SECO)

Vietnam has a tropical climate. The rainy season normally lasts from May to September in the northern regions and from September to early December in the central and southern regions, during which time heavy rain increases the risk of floods. In the past ten years, severe floods have affected the country almost annually, particularly in the central regions. In September 2009, Tropical Cyclone Ketsana and the depression associated with it brought heavy rain to Cambodia, Lao, and Vietnam, affecting millions. Even though the cyclone did not make landfall, the associated rainfall greatly affected the Central Region of Vietnam. Floods resulted in 163 fatalities and an estimated US\$800 million in damage to the infrastructure, production, and social sectors, with an impact on GDP amounting to 2.9 percent. Since then, severe floods have affected the region almost annually, with major impacts observed in 2012 and 2013.

While the Central Region is heavily exposed to storms and floods, some areas are also vulnerable to droughts. Approximately 2 million people living in the Central Region were severely affected by the prolonged drought of 2015–2016 as a result of impact from the global El Niño. The 2015–2016 drought was among the most intense and long-lasting in the past 90 years. It severely affected rural livelihoods, damaging 60–90 percent of planted crops,<sup>6</sup> affecting assets, and disrupting basic services.

During the last three months of 2016, heavy rain caused five consecutive flooding events, affecting eighteen provinces in the Central Region. The intensity and, particularly, the frequency of floods in this time frame (see table 1.1 for the list of events) far exceeded what is expected under normal circumstances. The heavy rain and floods continued beyond the end of the rainy season, and irrigation and hydropower dams in affected areas reached maximum capacity, resulting in controlled water discharges that further intensified the flood impact downstream of the reservoirs.

## INSTITUTIONAL ARRANGEMENTS FOR DISASTER RISK MANAGEMENT IN VIETNAM

Approved in 2007, Vietnam's National Strategy for Natural Disaster Prevention, Response and Mitigation Towards 2020 focuses mainly on reducing risk from water-related disasters. The strategy stipulates that national and local socioeconomic and sectoral development master plans must integrate natural disaster risk reduction measures, and it recommends the development of a catastrophe risk financing strategy.

The Law on Natural Disaster Prevention and Control, enacted in 2014, defines the institutional arrangements for the disaster-related agencies, including their responsibilities and coordination mechanisms, from the central to the local levels. This legislation covers nineteen disaster types. Along with the National Strategy for Natural Disaster Prevention, Response and Mitigation, Vietnam has also set up a National Action Plan for Climate Change, as well as a national program to support community-based disaster risk management. Responsibility for disaster risk management lies with the Department of Disaster Prevention and Control (DDPC) and the Disaster Management Centre (DMC) under the Directorate of Water Resources of the Ministry of Agriculture and Rural Development (MARD). The Directorate of Water Resources also plays as a Standing Office of the Central Committee for Natural Disaster Prevention and Control (CCNDPC). As an ex-ante risk reduction measure, the government has been strategically relocating households living in vulnerable areas and had, as of 2014, relocated 71,413 households from areas prone to flash floods and landslides.

Following natural disasters, Vietnam has, for thirty years, been measuring damage and losses using a formal methodology called the Damage Assessment and Needs Assessment (DANA).<sup>7</sup> This methodology was updated with technical assistance from the United Nations Development Programme (UNDP) in 2010. The communes provide damage reports that are then aggregated by the provinces according to a predefined list of damage categories. The Provincial People's Committee (PPC) submits to MARD the compiled report, complete with the damage data collected and requests for assistance based on the needs assessment.

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6 United Nations and Government of Vietnam, 2016, Vietnam: Drought and Sanitation Situation Report No.7 as of October 25, 2016.

7 Wang, Mahul, and Stutley, Weathering the Storm.

## I.2 Event Description and Government Response

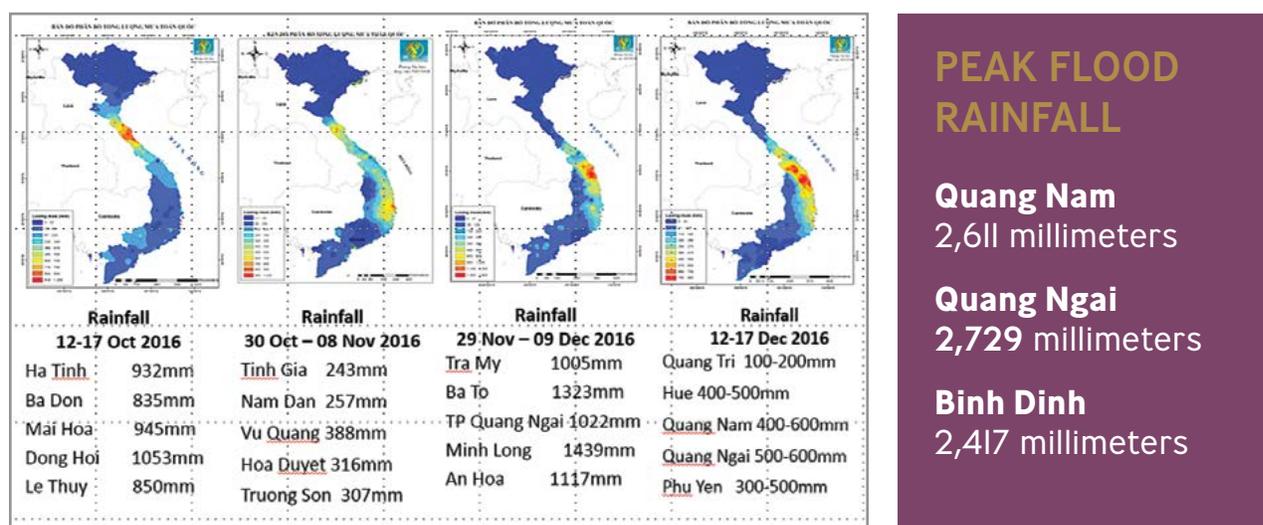
From October to December 2016, heavy rains caused five consecutive floods affecting eighteen provinces<sup>8</sup> in the Central Highland and South Central Coast (SCC) regions of Vietnam. The five cascading events, listed in table 1.1, collectively caused major damage and disruption to people's lives in the regions.

**TABLE I.1. FIVE FLOOD EVENTS AFFECTING THE CENTRAL AND SOUTH CENTRAL COAST REGIONS, OCTOBER–DECEMBER 2016**

Event	Flood period	Main provinces affected
Event 1	Oct. 13–18	Nghe An, Thu Thien Hue, and provinces between
Event 2	Oct. 30–Nov. 11	Ha Tinh, Ninh Thuan, and provinces between and South Central and Central Highland provinces
Event 3	Nov. 29–Dec. 4	Ha Tinh, Phu Yen, and provinces between and Central Highland provinces
Event 4	Dec. 5–9	Thua Thien Hue, Ninh Thuan, and provinces between
Event 5	Dec. 12–18	Central and Central Highland provinces

Figure 1.1 shows the cumulative rainfall measured during the period of the flood events. The total rainfall on average over to months reached 1,500 to 2,000 millimeters, with peaks in Quang Nam (2,611 millimeters), Quang Ngai (2,729 millimeters), and Binh Dinh (2,417 millimeters). The estimated return periods of the rainfall events range between ten and fifty years.

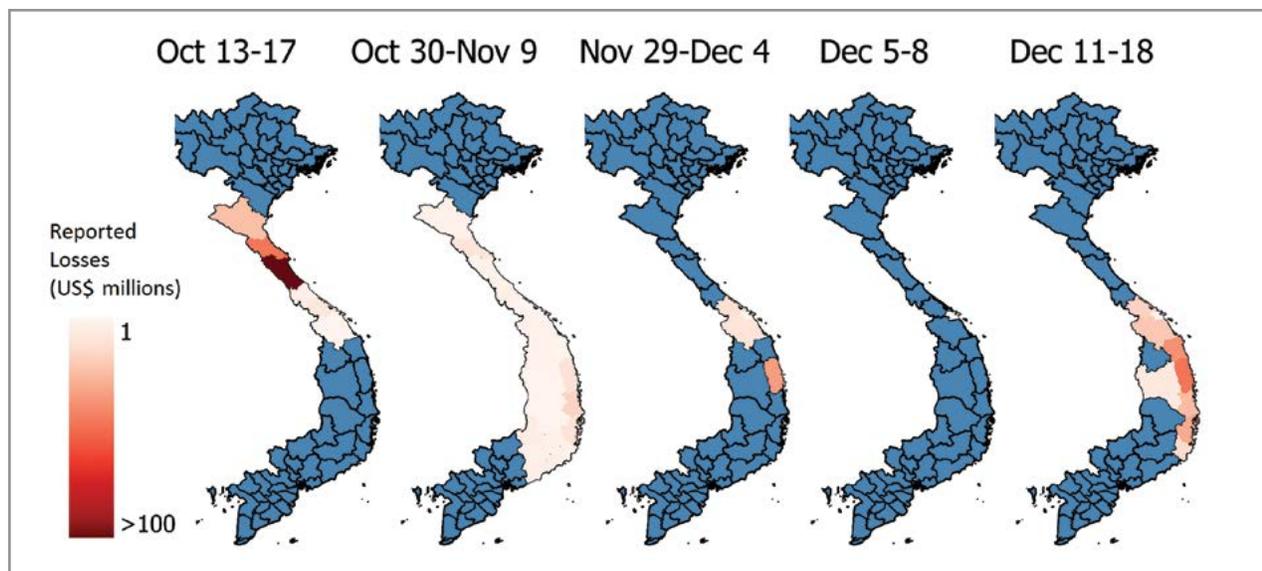
**FIGURE I.1. CUMULATIVE RAINFALL EXPERIENCED IN CENTRAL VIETNAM, OCTOBER 12–DECEMBER 17, 2016**



Source: Vietnam Meteorological Agency, February 2017.

<sup>8</sup> Binh Dinh, Binh Thuan, Dak Lak, Dak Nong, Da Nang, Gia Lai, Ha Tinh, Khanh Hoa, Kon Tum, Lam Dong, Nghe An, Ninh Thuan, Phu Yen, Quang Binh, Quang Nam, Quang Ngai, Quang Tri, and Thua Thien Hue.

FIGURE I.2. VISUALIZATION OF THE REPORTED DAMAGE IN U.S. DOLLARS



Source: SSBN, 2017, Vietnam Flood Event Analytics, 10.  
 Note: Values based on damage numbers reported by the Government of Vietnam.

Figure 1.2 shows the reported damage by province in US dollars by flood event period. During the two months of the disaster, new floods would occur in the low-lying areas of the South Central Coast region while the regions were still feeling effects from the previous ones, thus exacerbating their impacts.

As of early February 2017, 134 people had died and approximately one million had been affected by the floods.<sup>9</sup> Preliminary reports from all eighteen provinces, collated by the United Nations based on GoV data in December 2016, estimated a total of approximately US\$460 million in direct damage and losses. Around 4,000 houses were destroyed, and the torrential rain and resulting floods washed away or eroded the foundations of roads and bridges, causing disruption to people's lives. Irrigation structures and flood control facilities were severely damaged. Erosion of the riverbanks and damage to the embankments allowed flood water to gush over cultivated land and layers of silt to accumulate, affecting the production of cash and subsistence crops. More than one hundred thousand hectares of farmlands were reported as inundated and destroyed, and livestock and poultry were killed. It is understood that none of the public administrative buildings was affected by the floods. The GoV/UN joint report from December 2016 summarized the total effects of the disaster on the eighteen provinces as follows:

- Human impact: 134 dead or missing and 151 injured
- Housing: 233,271 houses flooded (with water rising above one meter in 163,682) and 4,093 damaged or collapsed
- Crops: 53,247 hectares of rice damaged and 23,294 hectares of perennial crops and 44,437 hectares of vegetables submerged
- Livestock: 18,371 cattle and 1,218,449 poultry killed
- Infrastructure: 1,782 kilometers of roads damaged or eroded and 585 bridges or culverts and 60 kilometers of dikes damaged
- Estimated economic loss (in Vietnamese dong): VND 10,520 billion (approximately US\$460 million)

9 United Nations Office of the Resident Coordinator, "Situation Report No. 1, Vietnam: Floods in Central Vietnam," Hanoi, December 31, 2016.

## GOVERNMENT RESPONSE

The central government acted promptly in the wake of the floods, according to the pre-arranged response plans defined in the 2014 Law on Natural Disaster Prevention and Control. Warnings and operational directives disseminated via the media (TV and radio) guided the preparedness and response efforts.

At the provincial level, the Provincial Steering Committee for Natural Disaster Prevention of the Provincial People's Committee (PPC) instructed the local governments, departments, and sectors to implement the pre-agreed response plan. The Steering Committee for Natural Disaster Prevention was on standby every day around the clock, collecting and disseminating information on the flood situations. For the response, the provincial governments deployed human resources, devices, materials, equipment, water and food, preventive medicines, and other necessities.

Other actions taken by the provincial district- and commune-level committees included operating the reservoirs according to the pre-agreed procedures, with the result that no major incidents took place; guiding traffic to avoid areas with collapsed bridges, landslides, and flooded roads, which ensured safety; and promptly evacuating people living in the severely affected areas to safe places. As of the end of December 2016, all evacuated people had returned to their houses or were living with relatives. The media provided constant updates on the situation and disseminated instructions from the Committee for Natural Disaster Prevention for the residents affected by the event.

Each year, the provincial governments set aside contingency budgets, comprising 5 to 10 percent of their annual budgets, to be used to support relief operations immediately following a natural disaster. These funds allowed the quick mobilization of relief items, such as food and water, seeds for replanting, livestock, and search and rescue equipment, and they paid for temporary measures, such as sandbags for breached riverbanks and temporary shelters, to be put into place.

Following natural disasters, the provincial governments in Vietnam also provide extraordinary financial support to social protection beneficiaries—that is, to people affected by the events. In Binh Dinh, for example, the 2016 events prompted the provincial government to provide compensation in the following amounts:<sup>10</sup>

- VND 4.5 million per person for loss of life
- VND 1.5 million per seriously injured person
- VND 50 million per destroyed house that could be rebuilt on the same plot
- VND 100 million per house that was washed away and needed to be relocated due to the vulnerability of the original plot to future events, with one alternate land plot granted without a land use fee

The provincial w supported the affected households by helping clean up inundated houses and erecting temporary shelters for those who could not go back to their homes. Temporary dikes were also erected, allowing the winter-spring crops to be planted. Contaminated wells were treated, and schools were cleaned up so children could resume their educations. Electricity was restored to most of the affected areas.

### NATURAL DISASTER COMPENSATION, BINH DINH



<sup>10</sup> Binh Dinh People's Committee, Socialist Republic of Vietnam, "Report in Response to Rain and Flood in Binh Dinh Province from 30/10/2016 until 15/12/2016," December 27, 2016, in Vietnamese.



## 2. RAPID DAMAGE AND NEEDS ASSESSMENT METHODOLOGY

### 2.1 Assessment Methodology and Scope

Because the time available was limited and the recovery and reconstruction needs urgent, the rapid assessment focused solely on estimating the direct physical damage to the following sectors: housing, transportation, flood protection and irrigation infrastructure, and agriculture, livestock, and fishery. For the agriculture, livestock, and fishery sector, losses<sup>11</sup> were assessed as well as physical damage. Although not part of the analysis presented in this report, a short section on livelihoods is also included, providing an overview of employment and related concerns in the affected areas.

The analysis is based on information collected using the Damage Assessment and Needs Assessment (DANA) methodology adopted by the Government of Vietnam in 2010.<sup>12</sup> GoV mandates that the provincial authorities consolidate information reported by district and commune levels, and requires the data to be presented according to a predefined set of damage categories, in a specified reporting format.

In terms of geographical scope, the assessments initially focused on all eighteen provinces that were affected by at least one of the five flood events between October and December 2016. Subsequently, following the preliminary assessments carried out by the provinces, the central government (MPI) prioritized four provinces in the South Central Coast region: Binh Dinh, Ninh Thuan, Phu Yen, Quang Ngai, and Ninh Thuan, which are among the most severely affected provinces and had relatively limited access to Government or donor funding compared to other flood-affected provinces. Subsequently, GoV requested the inclusion of a fifth province, Ha Tinh, selected from one of the most affected provinces by the 2016 floods. As the time to collect information on damage and reconstruction needs for Ha Tinh was extremely short, the assessment for that province is mainly on the flood protection and

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<sup>11</sup> “Damage” is defined as total or partial destruction of physical assets. “Losses” are defined as reduction or variation in economic flows due to the event—for example, reduction or variation in production; service delivery; access to goods and services; revenues, salaries, personal income, and employment; imports and exports; financial flows; taxes and other revenues and expenditures; transfers; and/or compensation payments.

irrigation sector. These were deemed most in need of reconstruction and recovery support based on a government-led review of the estimated overall damage and affected population, combined with an analysis of ongoing Overseas Development Assistance (ODA) investments in the eighteen provinces.

## 2.2 Limitations of the Assessment

The main aim of the rapid damage assessment was to quantify the direct physical damage (losses were assessed only for the agricultural sector) from the 2016 floods and to provide a first-order assessment of the immediate and long-term recovery and reconstruction needs. The analysis presented in this report is based on the damage, loss, and reconstruction needs data provided by provincial governments, using the DANA methodology, in discussion with the

FIGURE 2.I. THE FIVE PROVINCES UNDER REVIEW FOR THE RAPID DAMAGE AND LOSS ASSESSMENT





### 3. DAMAGE AND NEEDS ASSESSMENT

World Bank task team. The damage and reconstruction data are those available at the time of writing.

In mid-February 2016, the rapid assessment team made a two-day field visit to the most affected areas in Binh Dinh and Phu Yen provinces to gain a firsthand understanding of the impacts of the floods. The analysis in this report reflects observations the team made in the field during these visits.

Chapter 3 presents the results of the rapid damage and needs assessment for the provinces and the key sectors under review in this report. The assessments use the reported damage and reconstruction needs costs obtained from the government. For the infrastructure-related sectors, damage reported in this section pertains to assets managed by provincial governments. Thus, damage to national assets (such as national highways) is not included. Disaggregation of the damage and reconstruction needs into private and public assets was not attempted, as information was insufficient. It can be said, however, that most of the infrastructure assets reported on in this section fall under public assets.



**The government is expected to seek to ensure that inequalities based on housing will not be exacerbated as a result of the 2016 flooding**

# 3.1 Housing

## HOUSING SECTOR CONTEXT

The housing stock in the four provinces under review is, on average, of relatively good quality. Nationally, approximately 49 percent of the housing stock was built after 2000. In the urban areas, around 44 percent was built during this period and in the rural areas 51 percent. Data suggest most people in Vietnam live in dwellings owned by their families, with the proportion of owned housing at 93 percent of all households with dwellings.

In terms of size, the data indicate that, of all households with dwellings, the housing area of more than half (54.3 percent) is 60 square meters or more. In urban areas, this share is 60.9 percent, 9.5 percentage points higher than in rural areas. In 2009, 96.1 percent of households overall used electricity from the national network for lighting, an 18 percent increase from 1999. Based on the analysis developed by the Population and Housing Census and presented in table 3.1, the houses in Vietnam are categorized into four types: permanent, semi-permanent, temporary, and simple.

**TABLE 3.1. HOUSING CLASSIFICATION BASED ON CONSTRUCTION MATERIALS IN THE 2009 POPULATION HOUSING CENSUS**

Classification	Main Material of Supporting Columns	Main Material of Roof	Main Provinces Affected
Sturdy	<ul style="list-style-type: none"> <li>• Steel-reinforced concrete</li> <li>• Brick/stone</li> <li>• Iron/steel/solid wood</li> </ul>	<ul style="list-style-type: none"> <li>• Steel-reinforced concrete</li> <li>• Tile (cement/terra-cotta)</li> </ul>	<ul style="list-style-type: none"> <li>• Steel-reinforced concrete</li> <li>• Brick/stone masonry</li> <li>• Wood/metal</li> </ul>
Flimsy	<ul style="list-style-type: none"> <li>• Scrap wood/bamboo</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Sheeting (fibrocement/metal)</li> <li>• Leaves/straw/tar paper</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Mud/lime/straw</li> <li>• Slabs/bamboo screen/planks</li> <li>• Other</li> </ul>

Source: Central Population and Housing Census Steering Committee, Socialist Republic of Vietnam, The 2009 Vietnam Population and Housing Census Major Findings, 2009, table 9.2, 122.

For the rapid assessment, only the first three categories were used. Permanent houses were defined as dwellings for which the three main structural elements—supporting columns, roof, and walls—all fell into the “sturdy” category. Semi-permanent houses were defined as having two out of the three in the sturdy category, while temporary structures had only one of the three categorized as sturdy.

## DAMAGE TO HOUSING

Table 3.2 shows the findings of the damage assessment for the housing sector in the four provinces prioritized for review.

**TABLE 3.2. DAMAGE TO HOUSING STOCK IN FOUR PROVINCES UNDER REVIEW**

Province	Typology	Number of units		
		Fully destroyed	Partially damaged	Total affected
Binh Dinh	Permanent houses	454	409	863
	Semi-permanent houses	272		272
	Temporary houses	182		182
	<b>Total</b>	<b>908</b>	<b>409</b>	<b>1,317</b>
Ninh Thuan	Permanent houses			
	Semi-permanent houses			
	Temporary houses			
	<b>Total</b>	<b>51</b>	<b>239</b>	<b>290</b>
Phu Yen	Permanent houses	8	3	11
	Semi-permanent houses	56	24	80
	Temporary houses	95	41	136
	<b>Total</b>	<b>159</b>	<b>68</b>	<b>227</b>
Quang Ngai	Permanent houses	2	4	6
	Semi-permanent houses	15	20	35
	Temporary houses	29	15	44
	<b>Total</b>	<b>46</b>	<b>39</b>	<b>85</b>
<b>TOTAL</b>		<b>1,164</b>	<b>755</b>	<b>1,919</b>

Source: Estimates by the assessment team, based on official information from the government.

It should be noted that, of the affected dwellings, as many as 70 percent in Phu Yen, 69 percent in Bin Dinh, 54 percent in Quang Nai, and 18 percent in Ninh Thin were totally destroyed. Such destruction may be attributed to the strength of the floodwaters.

As shown in table 3.3 in the next section, the overall estimated cost of damage, which included both the household structures and a minimum basket of household goods affected by the floods, amounted to VND 231,655 million, or US\$10 million.

## RECONSTRUCTION NEEDS

The government has aimed to increase Vietnam's housing area per capita from 16.7 square meters in 2015 to 25 square meters by 2020 through a residential housing development strategy.<sup>12</sup> The Vietnam Population and Housing Census reports that in the ten years since 1999 the proportion of households living in dwellings with housing area above 60 square meters has more than doubled, from 24.2 percent to 54.3 percent. This is viewed as a success in terms of the government's effort to increase the average housing area per capita.

Nevertheless, the proportion of households living in cramped living quarters (below 15 square meters) has not declined substantially. Overall, the decline has been only 0.3 percentage points and in urban areas only 0.8 percentage points. The census report notes that such low decline indicates growing disparities between the rich and the poor in terms of housing in both urban and rural areas.<sup>13</sup>

The government is expected to seek to ensure that inequalities based on housing will not be exacerbated as a result of the 2016 flooding and to direct its reconstruction efforts accordingly. The estimated reconstruction costs, including building back better components for those houses that were completely destroyed and strengthening components with mitigation for those with partial damage, are presented in table 3.3. Reconstruction is estimated with the assumption that the government will support reconstruction of permanent houses with a standard size of no less than 60 square meters. As land is owned by the government, land acquisition costs and costs for relocation will be kept to a minimum by relocating households within communities where services are already established.

**TABLE 3.3. DAMAGE AND RECONSTRUCTION COSTS FOR THE HOUSING SECTOR**

Province	Total damage cost (VND, millions, unless stated otherwise)	Total reconstruction cost (VND, millions, unless stated otherwise)
Binh Dinh	133,613	243,645
Ninh Thuan	68,253	81,613
Phu Yen	7,922	46,575
Quang Ngai	21,868	22,375
<b>TOTAL</b>	<b>231,655</b>	<b>394,208</b>
<b>TOTAL (US\$)</b>	<b>US\$10 million</b>	<b>US\$17 million</b>

Source: Estimates by the assessment team, based on official information from the government.

<sup>12</sup> Ministry of Construction of the Socialist Republic of Vietnam, "Vietnam Construction Industry Shows Potential," February 10, 2017, <http://www.xaydung.gov.vn/en/news-detail/-/tin-chi-tiet/F4aS/140920/345780/vietnam-construction-industry-shows-potential.html>.

<sup>13</sup> Central Population and Housing Census Steering Committee, Socialist Republic of Vietnam, *The 2009 Vietnam Population and Housing Census Major Findings*, 2009.

## 3.2 Transportation Infrastructure (Roads and Bridges)

### TRANSPORTATION SECTOR CONTEXT

Vietnam's local road and bridge network comprises about 253,000 kilometers, or about 85 percent, of the total 295,000-kilometer network. It serves around 80 percent of the entire population and 90 percent of the nation's poor, who mainly live in rural areas. Research conducted in Vietnam and neighboring countries since 2000 has shown investments in local roads and bridges have significantly alleviated poverty and increased social participation, school attendance, and health services. Many communes lack roads in good condition, however, and users still face high mobility costs, while for many, bridge connectivity to the cities is limited or nonexistent. Time lost from limited mobility and travel erodes prosperity, while high mobility costs cut the disposable income of poor women and men, who often live in locations without reliable, safe, and affordable transportation.

Vietnam has a long coastline and hilly and mountainous terrains, the steepest of which are concentrated in the Northern Mountain and Central Region provinces. The many inland water bodies make the country prone to various climate and disaster risks, while the combination of steep terrains, variable geology, and increased deforestation and climate impact can lead to a high incidence of flooding. The construction in hilly and mountainous terrain of modern highway networks, which are increasingly expected to conform to vehicle-friendly geometrical designs, involves earthworks that have adversely affected already vulnerable terrain. Combined with significant changes in land use, the variable geotechnical environment, and the impact of climate, this has exposed the provinces in these regions to significant landslide activity. Every year during the rainy season, soil or rock failures affect these highways, sometimes with soil-rock mass up to thousands of cubic meters. Such landslide risks and other climate and disaster risks, including flooding, apply not only to roads but to all modes of transportation.

Recent frequent incidents of flooding highlight the prevalence of these risks and the vulnerability of the transportation network in these provinces. Such risks should be mitigated and managed through a combination of solid, evidence-based planning, design, and engineering solutions, information technology for early detection, forecast, and response, and adequate allocation of financial resources. Efforts in those areas could yield significant economic benefits by maximizing the integrity of the network and minimizing the negative economic and social impacts, as well as the human losses, from disastrous events.

### DAMAGE TO TRANSPORTATION

The five floods between October and December 2016 heavily damaged the transportation infrastructure in seventeen of the eighteen provinces affected. No damage was reported in Da Nang province or for the inland waterway, marine, or airway infrastructures. For railways, five eroded or congested points were reported in Quang Binh province. All damage reported for this sector in the provinces under review here, therefore, relates to the road infrastructure.

The water flow that overtopped and breached the riverbanks and dikes flooded the roadways and breached or washed away parts of the roads, in many cases eroding the pavements and embankments. In hilly terrains, the heavy rainfall caused landslides that damaged and blocked the roads. Heavy surface water running down the steep slopes eroded the road foundations, causing the pavements to fail.

Road networks were also disrupted by stagnant floodwaters, with these conditions lasting for up to a month in some places. The PPC and the respective sector management agencies, including the provincial departments of transportation, district divisions, and communes, took immediate actions to restore the road connectivity. Despite their efforts, the roads remained impassable in some places at the time of assessment.

Table 3.4 shows the estimated damage to the transportation infrastructure caused by the floods of 2016 in the four provinces under review, based on data provided by the provincial governments. The assessment includes the damage and reconstruction needs only for the transportation infrastructure managed by the provinces and excludes all nationally maintained transportation infrastructure. Estimates of the costs of damage, repair, and reconstruction to higher standards were also based on the data provided by the provinces.

The road infrastructure affected by the five floods should be restored to a standard that makes it resilient, thus enhancing its capacity to withstand future natural disaster events. The estimates in table 3.4 are preliminary. For more accurate estimates, site-specific investigation and engineering designs are needed.

**TABLE 3.4 DAMAGE TO TRANSPORTATION SECTOR (PROVINCIAL, DISTRICT, AND COMMUNAL ROADS)**

Province	Damaged road (meters)	Damaged/collapsed bridges	Damaged culverts	Total value of damage	
				(VND, millions)	(US\$, millions)*
Binh Dinh	240,700	57	113	869,744	38.48
Ninh Thuan	434,891	43	20	77,092	3.41
Phu Yen	864,214	113	19	212,365	9.40
Quang Ngai	392,391	40	10	429,300	19.00
<b>TOTAL</b>	<b>1,932,196</b>	<b>253</b>	<b>162</b>	<b>1,588,501</b>	<b>70.29</b>

\*Assumed USD = 22,600 VND. Source: Estimates by the assessment team, based on official information from the government.

## RECONSTRUCTION NEEDS

Reconstruction needs include the reconstruction of roads, pavement structures, culverts, and bridges. Construction of additional cross-drainage structures, including bridges, will also be necessary, replacing causeways, road embankments, and slopes with cohesive materials for higher stability. Slope protection works, the stabilization and improved drainage of hill slopes, and other protection works to strengthen and increase the capacity of the drainage arrangements will be required as well. Table 3.5 shows the breakdown of the needs estimated for the transportation sector.

**TABLE 3.5 TRANSPORTATION SECTOR NEEDS (PROVINCIAL, DISTRICT, AND COMMUNAL ROADS)**

Province	Cost of repair and reconstruction (VND, millions)	Cost of repair and reconstruction (US\$, millions)*
Binh Dinh	945,383	41.83
Ninh Thuan	357,000	15.80
Phu Yen	1,001,944	44.33
Quang Ngai	937,000	41.46
<b>TOTAL</b>	<b>3,241,327</b>	<b>143.42</b>

\*Assumed USD = 22,600 VND. Source: Estimates by the assessment team, based on official information from the government.

## 3.3 Flood Control and Irrigation Infrastructure

### FLOOD CONTROL AND IRRIGATION INFRASTRUCTURE SECTOR CONTEXT

Its irrigation, flood control, and drainage infrastructure plays a pivotal role in Vietnam's economic and social development. The country has developed irrigation infrastructure to serve 4.5 million hectares, which represents 60 percent of the country's arable land area and provides employment to 60 percent of the population.

Crop production in the central regions is predominantly dependent on irrigation, carried out through systems with different forms and capacities. The common irrigation systems include diverting water from local rivers—often by diverting their flow with low-height weirs, by releasing water from reservoirs in the upstream mountainous areas, and, to a lesser extent, by withdrawing groundwater in coastal areas. Overall, irrigation systems in these regions are well developed, but with rather conventional technical specifications, which makes them vulnerable to natural disasters like floods. This vulnerability is coupled with deferred maintenance.

As the Central Region is prone to natural disasters, mainly tropical cyclones and storms, most of the infrastructure needs to be able to cope with annual floods and waterlogging. These extreme events often cause landslides and erosion of riverbanks, threatening the lives of local people. Systems for protecting people, their livelihood activities, and infrastructure are thus essential and worthy investments.

### DAMAGE TO FLOOD PROTECTION AND IRRIGATION INFRASTRUCTURE AND RECONSTRUCTION NEEDS

All damage schemes and infrastructure identified in the assessment of the irrigation and flood control sector are public investments. The 2016 disaster caused damage to flood embankments and dikes, riverbank erosion protection works, irrigation canals and canal structures, temporary and raised dams and drainage culverts and sluices, and water supply schemes. Most of the damage, however, was to dikes, riverbanks, and irrigation canals. Major impacts were seen in rural areas and to rural infrastructure, including dikes and embankments, riverbank protection works, irrigation canals, diversion dams, roads, bridges, culverts, and so on.

The reported damage in this sector in Binh Dinh province exceeded that of the other provinces included in the rapid assessment, as the assessment team observed during the field mission.

At the time of the assessment, provincial governments had, with the assistance of the central government, undertaken temporary restoration measures, such as the initial and/or partial closing of breaches, the strengthening of critical bunds and revetments, and so on. Many of these works require immediate attention, with permanent measures taken to lessen the chances of further losses and/or damage in the near future. This is particularly urgent with the approach of the annual monsoon season, when Vietnam is exposed to cyclonic storms and heavy rain. Given the frequency of severe events in Vietnam during this time, completing the repair and strengthening of damaged infrastructure immediately is vital.

The total estimated cost of damage to this sector, including dikes and embankments, irrigation canals, and other infrastructure in the four provinces under review is VND 595.7 billion (US\$26 million). The aggregate cost of reconstruction with improved design standards for flood control and irrigation infrastructure is estimated at VND 3,295 billion (US\$145.83 million), shown in table 3.6, with the costs broken down by province in table 3.7.

**TABLE 3.6. BREAKDOWN OF DAMAGE AND RECONSTRUCTION COSTS FOR FLOOD PROTECTION AND IRRIGATION**

Classification of works		Details of damage	Damage cost (VND millions)	Reconstruction cost (VND millions)
Dikes	Grade III & spl. gr.	Blown off/cracked/broken	84,556	1,076,600
Riverbank protection/revetments	Gabion crates	Collapsed (length/numbers)	116,035	594,054
	Concrete/stone rip-rap			
Irrigation canals	Main, primary, secondary, tertiary canals	Blown off/washed away/damaged	267,533	1,109,262
Dams	Medium, small, and embankment dams	Broken (small dams)	10,646	58,366
Clean water	Damaged water supply schemes	Damaged pumps, water mains, etc.	631	23,323
Other works	Seawalls/roads		116,306	434,402
<b>TOTAL</b>			<b>595,707</b>	<b>3,272,684</b>

Source: Estimates by the assessment team, based on official information from the government.

**TABLE 3.7. BREAKDOWN OF DAMAGE AND RECONSTRUCTION COSTS FOR THE FLOOD CONTROL SECTOR**

Province	Estimated damages		Estimated reconstruction costs	
	VND, millions	US\$, millions	VND, millions	US\$, millions
Binh Dinh	178,283	7.889	2,411,623	106.71
Phu Yen	121,029	5.355	372,454	16.48
Quang Ngai	242,256	10.719	358,389	15.86
Ninh Thuan	47,527	2.103	153,369	6.79
<b>TOTAL</b>	<b>589,095</b>	<b>26.066</b>	<b>3,295,835</b>	<b>145.83</b>

Source: Estimates by the assessment team, based on official information from the government.

## 3.4 Agriculture, Livestock, and Fisheries

### AGRICULTURE CONTEXT

The four prioritized provinces belong to the South-Central Coast (SCC) agroecological zone of Vietnam, a region strongly dependent on agriculture. Around 50 to 70 percent of the population derives most of its income from agriculture. Rice is the main crop in the cropping system, especially in the flood plains. In the uplands, the deep sandy soils are widely used to produce fruit and nut trees (mangoes, cashew nuts) and annual crops (cassava, peanuts). Rice remains the favored staple food, while cashews and peanuts are largely grown as cash crops. Other grain legumes (soybeans, mungbeans, black beans) are widely grown in Binh Dinh, Ninh Thuan, and Phu Yen. Other crops with large cultivated areas in the four provinces are mango, sesame in Binh Dinh and Phu Yen, and garlic in Ninh Thuan.

### DAMAGE TO AGRICULTURE

Based on the reports submitted by the provincial governments, the total area affected by the floods in the four provinces is estimated at 81,312 hectares (see table 3.8), of which over 65,000 hectares are considered fully lost. This damage is estimated to have caused economic losses of VND 4,760.2 billion (US\$210.6 million), with Binh Dinh suffering the largest loss of VND 2,209.3 billion (US\$97.8 million).

**TABLE 3.8. AGRICULTURAL LAND AFFECTED**

Provinces	Affected area (ha)	Production losses (VND, billions)	Production losses (VND, millions)
Quang Ngai	6,139.2	619.2	27.4
Binh Dinh	26,344.0	2,209.3	97.8
Phu Yen	33,173.6	987.0	43.7
Ninh Thuan	15,655.2	944.7	41.8
<b>TOTAL</b>	<b>81,312.0</b>	<b>4,760.2</b>	<b>210.6</b>

Source: Estimates by the assessment team, based on official information from the government.

Note: Forestry and fruit trees are included.

With regard specifically to crop production (table 3.9), the floods reduced the 2016 output for the four provinces by around 368,643.1 tonnes, which translates into an estimated economic loss of VND 3,076.7 billion (US\$136.1 million). The losses were high due to timing, as the floods arrived at the end of the winter season and the beginning of the winter–spring season, when the fields were growing paddy and peanuts.<sup>14</sup>

Of the four provinces, Binh Dinh was the most affected, with a reduction of 153,121.2 tonnes in crop production, followed by Phu Yen (103,654.3 tonnes). The largest economic loss was in Binh Dinh, at VND 1,559.3 billion (US\$69 million), followed by Ninh Thuan (VND 798 billion, US\$35.3 million), and Quang Ngai (VND 505.6 billion, US\$22.4 million).

<sup>14</sup> The main peanut crop is the winter–spring crop (from December to March), when the yield is highest.

**TABLE 3.9. LOSSES TO CROP PRODUCTION**

Provinces	Output losses (tonnes)	Output value losses (VND, billions)	Output value losses (US\$, millions)
Quang Ngai	38,198.5	505.6	<b>22.4</b>
Binh Dinh	153,121.2	1,559.3	<b>69.0</b>
Phu Yen	103,654.3	213.8	<b>9.5</b>
Ninh Thuan	73,669.1	798.0	<b>35.3</b>
<b>TOTAL</b>	<b>368,643.1</b>	<b>3,076.7</b>	<b>136.1</b>

Source: Estimates by the assessment team, based on official information from the government.

Note: Forestry and fruit trees are excluded.

## AGRICULTURE RECONSTRUCTION AND RECOVERY NEEDS

Based on their reports, the total of damage and losses in the four provinces is estimated at VND 4,916.4 billion (US\$217.5 million), of which VND 4,760.2 billion is losses (table 3.10). Binh Dinh was the hardest hit, with damage and losses combined estimated at more than VND 2,346.4 billion (US\$103.8 million). The estimated funding needs for reconstruction and recovery are, respectively, VND 226.4 billion (US\$10 million) and VND 2,142.1 billion (US\$94.8 million). Reconstruction is expected to rehabilitate the damaged agriculture infrastructure, while recovery covers the distribution of seeds and other planting materials, fertilizers, and pesticides for off-season replanting in the affected areas. These interventions are expected to build on efforts delivered in response to requests from the provincial governments in the aftermath of the disaster, mainly to carry out the 2016–17 winter–spring cropping. This included the provision of planting material and crop seeds, particularly for rice (1,400 tonnes), corn (57 tonnes), vegetables and beans (41 tonnes), cassava (8,000 tonnes) and sugar cane saplings (10,000 tonnes). In total, financial support amounted to VND 74.5 billion (over US\$3.3 million).

**TABLE 3.10. ESTIMATED IMPACT ON CROP PRODUCTION AND NEEDS**

Provinces	Damage (VND, billions)	Losses (VND, billions)	TOTAL (VND, billions)	TOTAL (US\$, millions)
Quang Ngai	16.7	619.2	<b>635.9</b>	<b>28.1</b>
Binh Dinh	137.1	2,209.3	<b>2,346.4</b>	<b>103.8</b>
Phu Yen	2.3	987.0	<b>989.3</b>	<b>43.8</b>
Ninh Thuan	-	944.7	<b>944.7</b>	<b>41.8</b>
<b>TOTAL (VND, billions)</b>	156.2	4,760.2	<b>4,916.4</b>	<b>217.5</b>
<b>Reconstruction needs</b>			<b>226.4</b>	<b>10.0</b>
<b>Recovery needs</b>			<b>2,142.1</b>	<b>94.8</b>

Source: Estimates by the assessment team, based on official information from the government.

## LIVESTOCK CONTEXT

Livestock production is very important to the farming systems of the SCC region. As demand for meat is increasing in Vietnam, the raising of livestock is seen as an opportunity to help alleviate poverty. Available data suggest that over 20 percent of Vietnam's cattle are found in the SCC region, principally in Binh Dinh, Phu Yen, and Quang Ngai. For the poor households, animal husbandry diversifies income sources, generates available capital for investments, improves cash flow, and makes effective use of crop byproducts. Available estimates suggest income from beef cattle husbandry accounts for 22 to 26 percent of total family income for these households. Provincial governments have prioritized the raising of beef cattle, and the cattle population has increased in recent years at an annual rate of 5 to 11 percent, depending on the province.

## DAMAGE TO LIVESTOCK

As shown in table 3.11, early estimates suggest over 333,000 animals died as a result of the floods, of which 12,832 were large animals (cows, buffalo), 38,174 small animals (goats, sheep), and 282,001 poultry (chickens, ducks). The total figure corresponds to about 1.8 percent of the existing stock before the floods. Binh Dinh was the province most affected, with a total of 232,800 dead animals, including 10,980 large animals, 25,620 small animals, and 196,200 poultry. Some 114,684 animals raised for meat were killed.

**TABLE 3.II. NUMBER OF LIVESTOCK DEAD**

Provinces	Pre-flood stock of livestock (head)			Dead livestock (head)			Share over pre-flood stock, % (percent)
	Large	Small	Poultry	Large	Small	Poultry	
Quang Ngai	338,424	446,539	4,260,145	570	1,620	44,665	0.9
Binh Dinh	292,384	798,302	6,974,181	10,980	25,620	196,200	2.9
Phu Yen	188,063	110,046	3,537,900	117	250	29,556	0.8
Ninh Thuan	93,266	294,007	1,305,070	1,165	10,684	11,580	1.4
<b>TOTAL</b>	<b>912,137.0</b>	<b>1,648,894.0</b>	<b>16,077,296.0</b>	<b>12,832</b>	<b>38,174</b>	<b>282,001</b>	<b>1.8</b>
<b>Percent over stock, %</b>				<b>1.4</b>	<b>2.3</b>	<b>1.8</b>	

Source: Estimates by the assessment team, based on official information from the government.

## LIVESTOCK RECONSTRUCTION AND RECOVERY NEEDS

Livestock damage and losses in the four provinces total, respectively, VND 323.3 billion (US\$14.3 million) and VND 81.1 billion (US\$3.6 million) (table 3.12). In the aggregate, the overall economic impact is estimated at VND 404.3 billion (US\$17.9 million). The losses on meat production are estimated at VND 74,673.5 billion (US\$3.3 million). With damage and losses totaling VND 275.1 billion (US\$12.2 million), Binh Dinh suffered the greatest overall impact in the livestock subsector. The funding needs for reconstruction and recovery are estimated, respectively, at VND 468.7 billion (US\$20.7 million) and VND 36.5 billion (US\$1.6 million). Reconstruction aims to restock animal herds and rehabilitate and rebuild infrastructure. The recovery activities the provincial governments have requested from the central government include the delivery of vaccines and medicines to prevent disease in cattle and poultry and of animal breeds to restore production, at a cost amounting to over VND 7,680 billion (around US\$340 million).

**TABLE 3.I2. ESTIMATED IMPACT ON ANIMAL HUSBANDRY AND NEEDS**

Provinces	Damage (VND, billions)	Losses (VND, billions)	TOTAL (VND, billions)	TOTAL (US\$, millions)
Quang Ngai	17.2	30.4	<b>47.6</b>	<b>2.1</b>
Binh Dinh	243.7	31.4	<b>275.1</b>	<b>12.2</b>
Phu Yen	5.5	14.3	<b>19.9</b>	<b>0.9</b>
Ninh Thuan	56.8	4.9	<b>61.7</b>	<b>2.7</b>
<b>TOTAL</b>	<b>323.3</b>	<b>81.1</b>	<b>404.3</b>	<b>17.9</b>
<b>Reconstruction needs</b>			<b>468.7</b>	<b>20.7</b>
<b>Recovery needs</b>			<b>36.5</b>	<b>1.6</b>

Source: Estimates by the assessment team, based on official information from the government.

## FISHERY CONTEXT

Fishery resources in the SCC region of Vietnam reported by the General Statistics Office comprise aquaculture facilities and catches, both at sea and inland. Fishery and aquaculture production for 2015 in the four provinces under review was an estimated 523,914 tonnes, of which 35,275 tonnes comprised aquaculture production (68 percent shrimp and 18 percent fish) and 488,639 tonnes catches.

**TABLE 3.I3. FISHERY AND AQUACULTURE PRODUCTION IN THE FOUR PROVINCES, 2015 (TONNES)**

Provinces	Total aquaculture and catches	Aquaculture production				Catches
		Total	Fish	Shrimp	Other	
Quang Ngai	164,735.0	6,038.0	1,683.0	4,209.0	146.0	158,697.0
Binh Dinh	210,101.0	9,731.0	3,510.0	5,911.0	310.0	200,370.0
Phu Yen	63,392.0	9,392.0	807.0	6,845.0	1,740.0	54,000.0
Ninh Thuan	85,686.0	10,114.0	415.0	7,093.0	2,606.0	75,572.0
<b>TOTAL</b>	<b>523,914.0</b>	<b>35,275.0</b>	<b>6,415.0</b>	<b>24,058.0</b>	<b>4,802.0</b>	<b>488,639.0</b>

Source: Estimates by the assessment team, based on official information from the government.

Note: Preliminary figures.

## DAMAGE TO FISHERY

Damage reports from the provincial governments indicate the largest impact of the floods was on the aquaculture ponds. Available estimates indicate full or partial damage to 968 hectares of aquaculture facilities, 458 hectares of fishery ponds, 47 boats, and 745 aquaculture cages for lobster production in the four provinces. The most severe damage was in Phu Yen, with 397 hectares of aquaculture facilities and 425 hectares of fishery ponds affected.

**TABLE 3.14. DAMAGES TO FISHERIES**

Provinces	Affected area (ha)		Assets, equipment		
	Aquaculture facilities	Fishery ponds	Boats	Cages	Equipment sets
Quang Ngai	25	33	7	---	2
Binh Dinh	338	---	25	---	---
Phu Yen	397	425	10	745	---
Ninh Thuan	208	---	5	---	2
<b>TOTAL</b>	<b>968</b>	<b>458</b>	<b>47</b>	<b>745</b>	<b>4</b>

Source: Estimates by the assessment team, based on official information from the government.

In terms of output, 3,374 tonnes of aquaculture production were estimated lost. This represents a loss of around 9.2 percent relative to the estimated production for 2016.<sup>15</sup> Again, Phu Yen had the largest losses in aquaculture production of the four provinces (1,529 tonnes)—over 16 percent of the 2016 production estimates—followed by Ninh Thuan (924.8 tonnes), around 9 percent. In terms of value, the total losses of aquaculture production have been estimated at VND 642 billion (US\$28.4 million), over 11 percent of the estimated production value for 2016. In Phu Yen, almost one-third of the production value in aquaculture for 2016 was lost.

**TABLE 3.15. LOSSES TO AQUACULTURE**

Provinces	Output losses		Output value losses		Output value losses (US\$, millions)
	(tonnes)	Share over 2016 output estimate (percent)	(VND, billions)	Share over 2016 output estimate (percent)	
Quang Ngai	170.8	2.7	6.6	1.1	0.3
Binh Dinh	685.2	6.8	41.0	4.1	1.8
Phu Yen	1,592.9	16.3	549.1	30.1	24.3
Ninh Thuan	924.8	8.8	45.2	1.9	2.0
<b>TOTAL</b>	<b>3,373.8</b>	<b>9.2</b>	<b>641.9</b>	<b>11.1</b>	<b>28.4</b>

Source: Estimates by the assessment team, based on official information from the government.

## FISHERY RECONSTRUCTION AND RECOVERY NEEDS

The damage to boats, nets, and ponds in the four provinces have been estimated at VND 58.2 billion (US\$2.57 million) and the losses due to disrupted production at VND 655.2 billion (US\$29 million). The overall impact totals VND 713.4 billion (US\$31.6 million). The funding needs for reconstruction and recovery have been estimated, respectively, at VND 84.4 billion (US\$3.7 million) and VND 294.9 billion (US\$13 million). Reconstruction is expected to rehabilitate aquaculture facilities and ponds and other facilities, as well as restore fishing gear, equipment, and boats. Recovery aims to provide seeds, fingerlings, and medicines for the aquaculture ponds and fisheries. Requests for support from the provincial governments target mostly fishermen with damaged equipment and boats, amounting to VND 4,884 billion (US\$216.1 million), chemicals to treat fishery ponds, and extension of loan due dates for fishermen.

<sup>15</sup> Estimates for 2016 based on preliminary output data for 2015 by the General Statistics Office. [http://www.gso.gov.vn/default\\_en.aspx?tabid=778](http://www.gso.gov.vn/default_en.aspx?tabid=778).

**TABLE 3.16. ESTIMATED IMPACT ON FISHERIES AND NEEDS**

Provinces	Damage (VND, billions)	Losses (VND, billions)	TOTAL (VND, billions)	TOTAL (US\$, millions)
Quang Ngai	10.6	6.6	<b>17.2</b>	<b>0.8</b>
Binh Dinh	37.5	41.0	<b>78.5</b>	<b>3.5</b>
Phu Yen	9.8	562.4	<b>572.3</b>	<b>25.3</b>
Ninh Thuan	0.3	45.2	<b>45.5</b>	<b>2.0</b>
<b>TOTAL (VND, billions)</b>	58.2	655.2	<b>713.5</b>	<b>31.6</b>
<b>Reconstruction needs</b>			<b>84.4</b>	<b>3.7</b>
<b>Recovery needs</b>			<b>294.9</b>	<b>13.0</b>

Source: Estimates by the assessment team, based on official information from the government.

## 3.5 Population and Livelihoods

The floods of October to December 2016 in the four provinces under review disrupted normal livelihoods for at least three months for significant proportions of the population, most of whom were engaged in agricultural activities.

For the flood-affected region three (the South Central Coast region), the 2009 Population and Housing Census reported the labor force numbering 10,548,048, of whom 5,147,169 were female. Female labor in Vietnam was almost on balance with male labor, accounting for 48.8 percent of the employed population. Unemployment in 2016 was low, at 3.7 percent of the labor force, as presented in table 3.17. In 2014, Vietnam also had a low Gini Coefficient of 37.6, suggesting a fairly equal society.

**TABLE 3.17. ESTIMATED IMPACT ON CROP PRODUCTION AND NEEDS**

Indicator	Rate
Population below \$1.90 (PPP) per day	3.1% (2014 est.)
Population below \$3.10 (PPP) a per day	12.0% (2014)
Gini coefficient	37.6 (2014)
Labor force	54.93 million (2016 est.)
Labor force participation rate	80.6% male; 67.1% female
Labor force by occupation	Agriculture: 48.7%; Industry: 21.7%; Services: 29.6%
Unemployed	3.7% (2016)

Source: Poverty data from Asian Development Bank, “Key Indicators for Asia and the Pacific,” 47th ed., 2016, <https://www.adb.org/sites/default/files/publication/204091/ki2016.pdf>, last accessed April 11, 2017.

GINI Coefficient from <http://data.worldbank.org/indicator/SI.POV.GINI>.

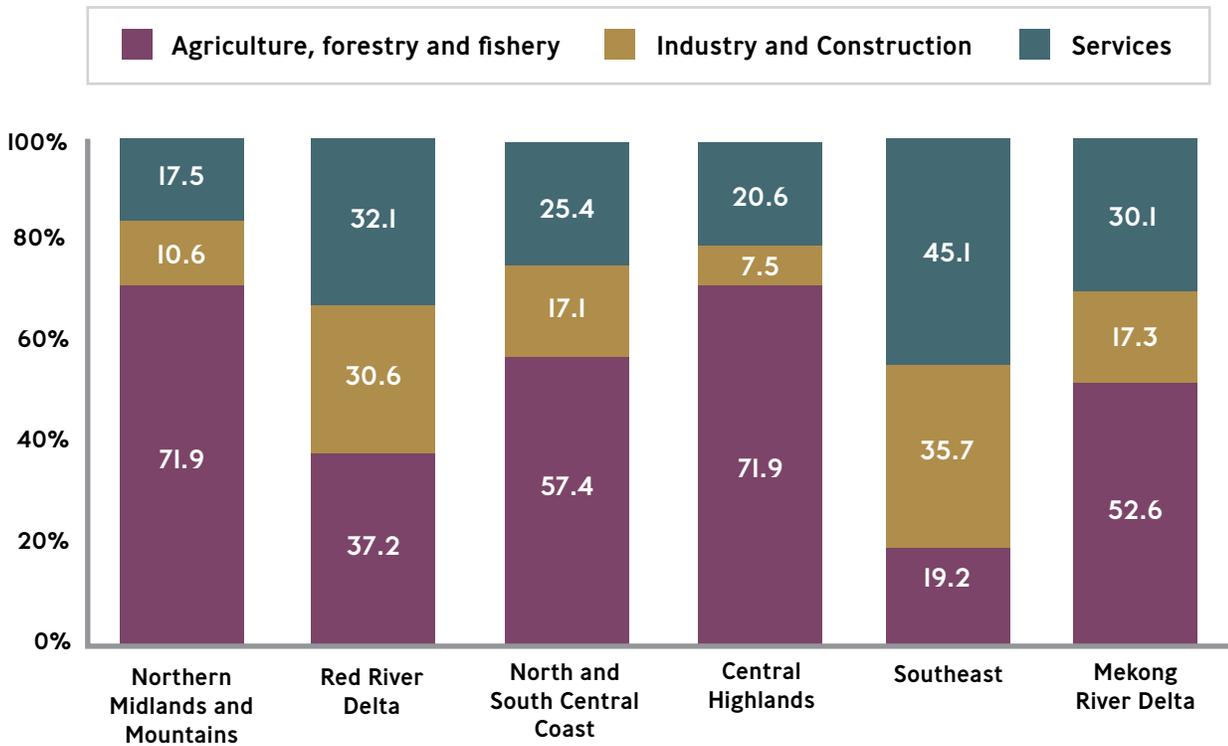
Labor force data from Ministry of Labor, Vietnam Population and Housing Census, 2009.

Unemployed labor force data from Central Intelligence Agency, The World Factbook, <https://www.cia.gov/library/publications/the-world-factbook/fields/2129.html>.

The Labor Force Survey, as illustrated in figure 3.1, indicated the proportion of the labor force engaged in agriculture, forestry, and fishery at 71.9 percent in the Northern Midlands and Mountains and Central Highlands and 57.4 percent in the North and South Central Coast regions.<sup>16</sup>

16 General Statistical Office (GSO), Ministry of Planning and Investment of the Socialist Republic of Vietnam, “Vietnam—Labour and Employment Survey 2010,” listed in IHSN Survey Catalog, International Household Survey Network, reference ID VNM\_2010\_LFS\_v01\_M, 2010, <http://catalog.ihsn.org/index.php/catalog/4126>.

FIGURE 3.I. PROPORTION OF EMPLOYED POPULATION BY INDUSTRY AND SOCIOECONOMIC REGION, 2010



Source: General Statistics Office, Ministry of Planning and Investment, Labour and Employment Survey 2010, Vietnam.

As the remit for this assessment has not included the collection of loss estimates, it is not possible to estimate income loss and impact on livelihoods for the region or period under review. The floods of late 2016 would, however, have taken a toll on the ability of persons working in agriculture, forestry, and fishery to earn their livings, as rivers broke their embankments and rushed into agricultural fields, leaving sand deposits on soil and destroying produce. Furthermore, most workers in the agricultural area fall into the category of self-employed/household enterprise, which accounts for some 78.5 percent of the labor force. This suggests that, unless they are able to engage in economic activity, they will not earn an income, unlike salaried workers who may continue to earn despite losing time at work.



## 4. RECOVERY AND RECONSTRUCTION

This chapter summarizes the recommendations regarding the short-, medium-, and long-term recovery and reconstruction needs for each sector reviewed in the previous sections.

### 4.1 Recovery and Reconstruction Needs

#### Housing

The recovery needs for the housing sector are:

- Ensure inequalities based on housing will not be exacerbated as a result of reconstruction following the 2016 flooding, and that efforts are directed accordingly. At the same time, continue the so far successful implementation of the plan to increase per capita average dwelling size.
- Ensure households moved to safer locations will have access to basic services and will not be disadvantaged as a result of the relocation.

#### Transportation Infrastructure (Roads and Bridges)

The following recommendations pertain to transportation infrastructure needs in the four provinces, where restoring connectivity is essential for people to resume their day-to-day activities:

- Restore rural accessibility by repairing impassable roads and bridges.
- Construct additional cross-drainage structures, including bridges replacing causeways.

- Upgrade key routes to withstand potential hazards.
- Use more stable material at road embankments and at side-slopes, together with slope protection as required.
- Stabilize hill slopes, including improved drainage and protective works as required.
- Improve and strengthen surface drainage arrangements alongside the roads.
- Engage local communities in the reconstruction of the transportation infrastructure, encouraging female workers to participate and using local material where possible. .
- Develop and implement resilient design and construction standards, maintenance routines, and budgets.

## **Flood Control and Irrigation Infrastructure**

Restoring the infrastructure for flood control and irrigation is a high priority to ensure communities are protected against future floods. The following recommendations reflect the recovery and reconstruction needs:

- For the rehabilitation of the flood control and irrigation structures, it is important to choose appropriate material and implement design standards fully, including standards for maintenance during the lifespan of the infrastructure.
- The design of rural infrastructure should be based on detailed analysis of the local conditions. The lack of detailed design in the past may have contributed to the failure of some of the structures.
- Consider improving design principles with greater concern for flexibility and drainage. Detailed hydrological studies will be important to avoid the overtopping of the embankments in the event of floods of similar magnitude.
- The operation manuals for the reservoirs (large and small) are in urgent need of review, as these could bear on the safety of the infrastructure that will be reconstructed downstream in the long term. Improved reservoir operations can reduce the flood peaks in the rivers and, consequently, lower the chances of the overtopping of dikes and unintended flooding.

## **Agriculture, Livestock, and Fisheries**

Restoring agriculture, livestock, and fisheries is key to the swift recovery of the communities, especially in the rural areas, from the effects of the floods. The following recommendations pertain to the agriculture, livestock, and fishery sector:

### **Crops**

- Distribute seeds and other inputs for off-season replanting in affected areas.
- Rebuild affected farmers' stocks of saved seeds and planting material.

### **Livestock**

- Restock animal herds and build capacity, including for animal management and health care and pasture management.
- Provide animal feed, vaccinations, and veterinary services.

### **Fishery**

- Rehabilitate aquaculture facilities and ponds.
- Restore fishing gear, equipment, and boats.
- Provide seeds, fingerlings, and medicines for aquaculture facilities and inland fisheries.

## 4.2 Recovery and Reconstruction Principles

This section recommends recovery and reconstruction principles that can guide and form the basis for recovery planning, describing them according to the immediate-, medium- and long-term time frames to which they apply. As the time frame for the rapid assessment did not allow guiding principles to be developed specifically for this flood event, these are derived from international experience in recovery and reconstruction.

### IMMEDIATE-TERM RECOVERY AND RECONSTRUCTION

**In the immediate phase, build back better and smarter by integrating disaster risk reduction measures into recovery and reconstruction.** It is important to restore access to services and infrastructure as quickly as possible, incorporating “build back better” components into the reconstruction efforts. Restoration of key services and infrastructure will enable the affected population to resume normal life, which in turn will allow recovery to take place efficiently. The infrastructure should be reconstructed in a way that increases the overall resilience of the local community it serves.

For the 2016 floods in Vietnam, the immediate response and recovery plans devised by the central and provincial governments before the events worked well, and emergency measures are already in place, with temporary shelters erected and temporary roads and bridges provided in many locations. Households severely affected by the floods have received financial support.

### MEDIUM- TO LONG-TERM RECOVERY AND RECONSTRUCTION

**Produce better data collection, sharing, and damage estimates.** The damage estimation methodology DANA<sup>17</sup> is well established, and the affected communes and provinces have used it to estimate the impacts from the floods in financial terms. Room remains for improvement, however, with regard to data collection, sharing, and damage estimates. One possible avenue to explore is the construction of a database that is prepopulated with the most current damage and reconstruction unit costs for the categories of items to be included in the assessment based on the DANA methodology. Location information on destroyed and partially damaged infrastructure, complete with photographs, can be linked to the cost data so the estimation of damage and reconstruction needs can be carried out more quickly, with less effort, and consistently across the country.

**Continue raising communities’ awareness of potential risks.** Raising awareness of disaster risk management at the local level is key for increasing the resilience of communities. As residents become aware of the potential risks from natural disasters in their localities, they will be better prepared, and unnecessary suffering and loss may be averted. Vietnam is already conducting community drills regularly, resulting in high awareness of local risks. Providing information on the risks from natural disasters during peacetime, educating children about them, and communicating them through various media can all help raise awareness. The Community-Based Disaster Risk Management (CBDRM) project currently undertaken by DMC will help promote community-level risk awareness.

**Streamline the budget allocation process for emergency reconstruction projects, both at the central and provincial levels, to minimize delays and uncertainties in mobilizing funds for medium-term reconstruction projects.** Although the contingency budget allocated in the annual budget is available for immediate relief and recovery purposes, the mechanism for allocating funds for medium- to long-term reconstruction needs is currently unclear. Considering the frequent occurrence of hydro-meteorological hazard events in Vietnam that require reconstruction efforts on an almost annual basis, having a clear emergency budget allocation mechanism for this purpose would be beneficial. As part of this mechanism, risk financing options could also be considered.

**In the medium term, incorporate better components into the design of the infrastructure to be reconstructed.** Repairs should not just restore infrastructure to the same standards and specifications as before the event. Rather, planners should consider all options, including innovative approaches, such as the use of green infrastructure, so they may come up with the optimal design specifications and solutions. Doing so will ensure resilience in the future, especially in the face of the projected increase in frequency and intensity of hydro-meteorological hazards under climate change scenarios. For the design of resilient infrastructure, an integrated

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<sup>17</sup> Damage Assessment and Needs Assessment methodology; see chapter I.

flood management approach should be applied, taking into account the hydrological, meteorological, and other conditions of entire river basins and surrounding environments.

**Carry out comprehensive hydrological analysis before any reconstruction.** The design of the existing rural infrastructure, including bridges, flood embankments, and diversion structures or weirs, was not based on a comprehensive hydrological analysis, which has led to the structures having inadequate capacity. A full hydrological analysis before designing the specifications of infrastructure to be constructed is recommended so the repairs will be adequate for the locations.

**Allocate budget for maintenance of the infrastructure.** Once constructed, infrastructure should be maintained to ensure it functions to its design standards and lasts its designed lifespan. Not allowing for maintenance work may result in costly replacement, or even unexpected damage and disruption to people's lives. It is recommended to allow adequate budget for the monitoring and maintenance of key infrastructure (dikes, roads, bridges, and canals) that was reconstructed following the 2016 floods, as well as for the existing infrastructure.

**Incorporate disaster risk reduction and climate change adaptation concepts into land use planning.** Informed land use planning can reduce unnecessary risk from natural disasters, as well as from climate change. Vulnerable locations can be identified using scientific analysis and modeling, as well as by taking advantage of local knowledge. Policies and strategies that limit the uses of land in these locations can be developed and implemented to reduce the risk to human lives and assets. Where these plans affect people already living on the land, care must be taken to avoid adversely affecting them. GoV has been actively promoting the planned relocation of residents from vulnerable land since 2007.



## 5. ENHANCING DISASTER RISK MANAGEMENT

The reconstruction phase provides an excellent opportunity to increase resilience against future disaster events by building back better or by strengthening the institutional capacities of the government agencies to respond to disasters. Review of existing disaster risk management mechanisms, both *ex ante* and *ex post*, can identify gaps and areas for improvement. This section recommends areas to highlight throughout the reconstruction phase for improved disaster risk management.

**Make risk information available and build capacity to generate and incorporate it for planning purposes.**

Disaster risk management (DRM) and reduction (DRR) are most effective when mainstreamed into physical, fiscal, and policy decision making at both the national and subnational levels. DRR also requires long-term vision, as risks from disasters and climate change persist over long periods of time. That vision should be informed by scientific analysis and by evidence and knowledge of the potential hazards, the exposed assets and their vulnerability, and the risks associated with the hazards and exposure.

Furthermore, information on the potential hazards and exposed assets and the assets' vulnerability to the hazards and risks should be available for use by decision makers, and the risk quantified at the appropriate scale to respond to the issue at hand. Strengthening the country's capacity to produce risk information is paramount, as is having the means to store and disseminate it and the knowledge to make decisions based on it. The ongoing World Bank-funded VN-Haz project, which covers ten provinces in the Central Region, aims to produce an information system in which the quantified risk information derived from hydrological models is made available for use in planning and other development-related projects. Adoption of such a system should be considered.

**Develop DRM financing instruments to ensure liquidity in the face of natural disasters.** As Vietnam is particularly prone to severe hydro-meteorological hazards almost annually, emergency contingency budget is set aside that allows the central and local governments to mobilize resources quickly for immediate relief and recovery.

Developing a financial instrument that will allow the smooth and efficient transition from immediate recovery into medium-term reconstruction efforts (for example, the rebuilding of infrastructure) may further improve the government's ability to cope with disasters and increase the resilience of the country by reducing disruption to services for the affected population.

**Strengthen disaster risk governance.** Many international donors are currently working with GoV on disaster risk reduction issues. It is noted that donor coordination could be improved so the investments made in the various areas do not become piecemeal and so they adhere to a clear set of principles guided by GoV, reducing redundancies and overlaps in and fragmentation of DRM systems. According to the DRM Law which was adopted in 2014, a dedicated DRM agency should be established and functional at both national and provincial levels as soon as possible. This agency can take a lead role in coordinating the various efforts supported by the international communities to establish a coherent strategy that allows these efforts to scale up across the country in an efficient way and to streamline these activities so they all feed into the common goal of increasing the resilience of Vietnam to natural disasters, like the 2016 floods.



