

KHANH HOA PROVINCIAL PEOPLES' COMMITTEE

2017 Vietnam Post-Typhoon Damrey Rapid Damage and Needs Assessment



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Foreword

Typhoon Damrey, or Storm No.12, made landfall in Vietnam on early Saturday morning, November 4th, 2017, with winds of up to 135 kilometers per hour impacting fifteen provinces in the South Central and Central Highlands regions. Among those, Khanh Hoa was the most affected province with high number of deaths and missing people, seriously damaged infrastructure, collapsed or damaged houses, and severe losses to agriculture, livestock, fisheries and forestry sectors.

With strong financial support from the government of Vietnam (GoV), international organizations and friendly nations, Khanh Hoa province immediately and effectively implemented the right mitigation and recovery measures. This enabled citizens to quickly recover from the typhoon, and restored access to services and infrastructure.

More importantly, this was an opportunity to recognize the necessity to enhance capacity in disaster risk management, to continuously improve the prevention system, and to build a more resilient future for citizens. The need to start incorporating the value of “build back better” and “resilience” into reconstruction and investment plans, as well as to enhance capacity of local communities to respond to natural disasters, is now critical.

This report provides a detailed breakdown of the key affected sectors and the extent of damage sustained in the aftermath of Typhoon Damrey. It identifies the reconstruction and recovery needs, and recommends a clear recovery strategy. In view of the strong commitment by Khanh Hoa to engage in the disaster risk management program, this report is highly relevant in integrating disaster resilience into all development initiatives in order to minimize future climate risks in the province.



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Acknowledgments

This report on Rapid Damages and Needs Assessment of Typhon Damrey in Khanh Hoa province was prepared by the World Bank assessment team led by Nguyen Huy Dzung (Senior Disaster Risk Management Specialist), and comprising Phan Thi Phuong Huyen (Senior Urban Specialist), Dinh Tuan Viet (Senior Economist), Ahmad Zaki Fahmi (Economist), Stephen Platt (Housing Expert, Consultant), Mateo Albala (Agriculture and Livelihood Expert, Consultant), Sujit Das (Transport Expert, Consultant), Alan Clark (Water Resources/Irrigation/Flood Control Engineering Expert, Consultant), Nguyen Dang Nhat (Disaster Risk Management Expert, Consultant), and Tran Hai Yen (Team Assistant). The report was edited by Mamatha Hanumappa and designed by Lauren Kaley Johnson.

The report was prepared upon the request of Khanh Hoa Provincial Peoples' Committee (PPC), using the just-in-time recovery facility from the Global Facility for Disaster Reduction and Recovery (GFDRR). The assessment team visited Khanh Hoa province from 14 to 21 March, 2018, to obtain the necessary data and information on damages, losses and the needs of reconstruction required to develop a Recovery and Reconstruction Plan. The report has greatly benefited from the guidance, coordination, technical and logistical support kindly provided by the officials of Khanh Hoa province, especially the PPC, Provincial Committee for Disaster Prevention & Control and Search & Rescue (PCDPCSR), Department of Agriculture and Rural Department (DARD), Department of Planning and Investment (DPI), Department of Construction (DOC), Department of Transport (DOT), Department of Industry and Trade (DOIT), Department of Culture and Sports (DCS), Department of Tourism (DoT), District Peoples' Committees of Van Ninh, Khanh Vinh and Ninh Hoa, the Khanh Hoa Project Management Unit (PMU), as well as the Statistical Office based in Khanh Hoa province. The team gratefully acknowledges Khanh Hoa PPC and all above agencies for their valuable support and assistance throughout the assessment and completion stages of the report.

The team also acknowledges the valuable support provided by the Office of the United Nations (UN) Resident Coordinator in Vietnam, United Nations Development Programme (UNDP), Food and Agriculture Organization (FAO), and other stakeholders.

Abbreviations and Acronyms

CC	climate change	IMC	Irrigation Management Company
CBDRM	community-based disaster risk management	km	kilometer(s)
CCDPC	Central Committee for Disaster Prevention and Control	m	meter(s)
DARD	Department of Agriculture and Rural Development	MARD	Ministry of Agriculture and Rural Development
DCS	Department of Culture and Sport	MoC	Ministry of Construction
DPI	Department of Planning and Investment	MOLISA	Ministry of Labor-Invalids and Social Affairs
DOIT	Department of Industry and Trade	NGO	nongovernmental organization
DOC	Department of Construction	O&M	Operations and Maintenance
DoT	Department of Transportation	PACCOM	People's Aid Coordinating Committee
DOT	Department of Tourist	PPC	Provincial Peoples' Committee
DRM	disaster risk management	PMU	Project Management Unit
DRR	disaster risk reduction	PCDPCSR	Provincial Committee for Disaster Prevention & Control and Search & Rescue
GDP	gross domestic product	SEDP	Socio-economic Development Plan
GFDRR	Global Facility for Disaster Reduction and Recovery	VCA	Vulnerability and Capacity Assessment
GoV	government of Vietnam	VDMA	Vietnam Disaster Management Agency
GRDP	Gross Regional Domestic Product	UNDP	United Nations Development Programme
GSO	General Statistics Office	USD	US Dollar
FAO	Food and Agriculture Organization of the UN	Currency:	Vietnamese dong (VND)
ha	hectare(s)		
ICT	Information and communication technology		



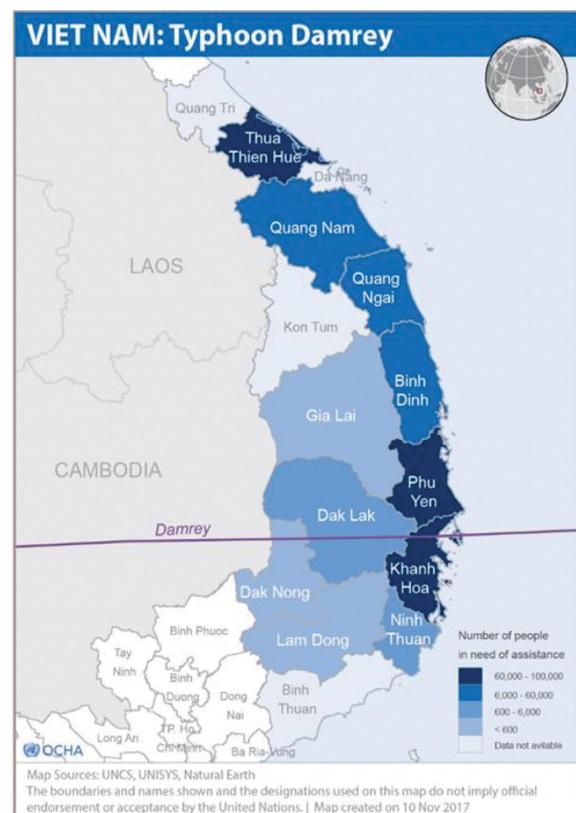
Executive Summary

Brief Description of the Event and its Impacts

Originating from a tropical depression over the South China Sea, the storm strengthened into a deadliest typhoon, named Damrey (known in Vietnam as Storm No.12) on November 2, 2017. Typhoon Damrey made landfall in Vietnam in the early morning of November 4, 2017, impacting 15 provinces in the South Central and Central Highlands regions¹. It directly hit Khanh Hoa province with wind speeds of up to 135 kilometers (km) per hour. Though it rapidly weakened and fully dissipated on the next day, it carried heavy rainfall that caused flooding in 15 provinces. Typhoon Damrey is classified as level 13 in the Vietnam tropical typhoon scale (equivalent to Category 2 of the Saffir-Simpson hurricane wind scale), and the strongest typhoon to strike Vietnam since 2001. Typhoon Damrey's track is shown in figure E.1.

Among the 15 affected provinces, Khanh Hoa province has suffered the most, accounting for approximately 69 percent of the total economic losses of Typhoon

FIGURE E.1: Track of Typhoon Damrey



Source: Vietnam: Typhoon Damrey's Situation Report, Office of the UN Resident Coordinator in Vietnam (as of Nov 2017).

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¹ Quang Tri, Thua Thien Hue, Da Nang, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan, Gia Lai, Dak Lak, Kon Tum, Dak Nong and Lam Dong provinces.

Damrey's impact. Damages and losses were mostly caused by gusty winds, rather than due to floods. The inexperience of Khanh Hoa authorities and communities in responding to the disaster further aggravated the situation. Khanh Hoa has never experienced such a disaster, given the favorable geographical conditions. Table E.1 gives an overview of the damage in Khanh Hoa province compared to the total damage in all 15 affected provinces.

TABLE E.1: Overview of Damage impact of Typhoon Damrey in Khanh Hoa Compared to Total Damage in all Fifteen Affected Provinces

Type of Damage	Unit	Damage in all 15 provinces	Damage in Khanh Hoa province	Percentage
1 Casualties				
Death	person	107	44	41.1%
Missing	person	16	1	6.3%
Wounded	person	315	219	69.5%
2 Housing				
Damaged/collapsed	#	302,783	166,787	55.1%
3 Agriculture, Aquaculture and Forestry				
Crop and vegetable damaged	ha	38,628	33,600	87.0%
Forest broken/fallen	ha	32,494	19,700	60.6%
Aquaculture cages damaged/swept away	cage	38,629	35,785	92.6%
Aquaculture farm damaged/swept away	ha	4,472	1,751	39.2%
Fishing ship damaged/sunk	#	1,809	1,609	88.9%
4 Infrastructures				
River bank/revetment eroded	m	197,278	41,200	20.9%
Irrigation channels damaged/broke	m	258,414	31,200	12.1%
Dams damaged	#	87	2	2.3%
Roads damaged	m	556,030	58,000	10.4%
Communication antennas collapsed	#	527	148	28.1%
Electricity pillars collapsed	#	1,636	800	48.9%
5 Economic loss	million VND	22,680,000	15,500,000	68.3%

Source: Damrey Typhoon's Damage Reports made by the Central and Khanh Hoa Provincial Committees for Disaster Prevention and Control (as of December 2017)
Note: # = number.

15 Affected provinces



Economic loss

VND22

68 trillion

Khanh Hoa

68.3%

Reconstruction and Recovery Needs

The sectors covered under this rapid assessment are housing, agriculture, irrigation and flood control, and transportation. However, agricultural losses were assessed for crop, livestock and fishery and production forest, only. Cross-sectoral issues such as disaster risk management (DRM), climate change (CC) and gender were also included in the rapid assessment, in addition to macro-economic impact in Khanh Hoa province.

Of the four sectors assessed, the most severely affected sector is agriculture including crop production, livestock, fishery and aquaculture, with a total damage of VND 5.4 trillion, followed by housing with a damage worth VND 3.7 trillion, flood protection and irrigation infrastructure at VND 0.4 trillion, and transportation at VND 0.2 trillion.

However, the greatest reconstruction and recovery need is in the housing sector (VND 6.9 trillion), followed by agriculture (VND 2.2 trillion), irrigation & flood control (VND 0.4 trillion) and road reconstruction (VND 0.2 trillion). The box below gives a summary, and table E.2 gives a breakdown of the estimated damage, and reconstruction and recovery needs by sector.

HOUSING

- Khanh Hoa province accounted for 80 percent of all houses destroyed by Typhoon Damrey.
- Being in the direct path of the typhoon, and having a relatively high proportion of semi-permanent houses (about 50 percent), aggravated the impact.
- Within the province, damage was higher in the northern districts of Van Ninh and Ninh Hoa.

AGRICULTURE, LIVESTOCK, FISHERIES AND FORESTRY

- Strong winds and floods following Typhoon Damrey affected the sector activity more than facilities and infrastructure.
- Fisheries and perennial crops subsectors were impacted the most.
- Crop production was the most affected subsector in Dien Khanh City and Cam Lam District.
- Fisheries was the most affected subsector in Cam Ranh City, Nha Trang City, and Van Ninh District, and
- Forestry was the most affected subsector in Khanh Vinh District, Khanh Son District, and Ninh Hoa Town.
- The larger needs are for the crop production and forestry subsectors, followed by aquaculture and by livestock.
- The estimates of the needs reported in this assessment for agricultural support following the Decree No. 02/2017/ND-CP are VND 1,508,482.4 million, below the government estimates of VND 1,756,531 million.

FLOOD CONTROL AND IRRIGATION INFRASTRUCTURE

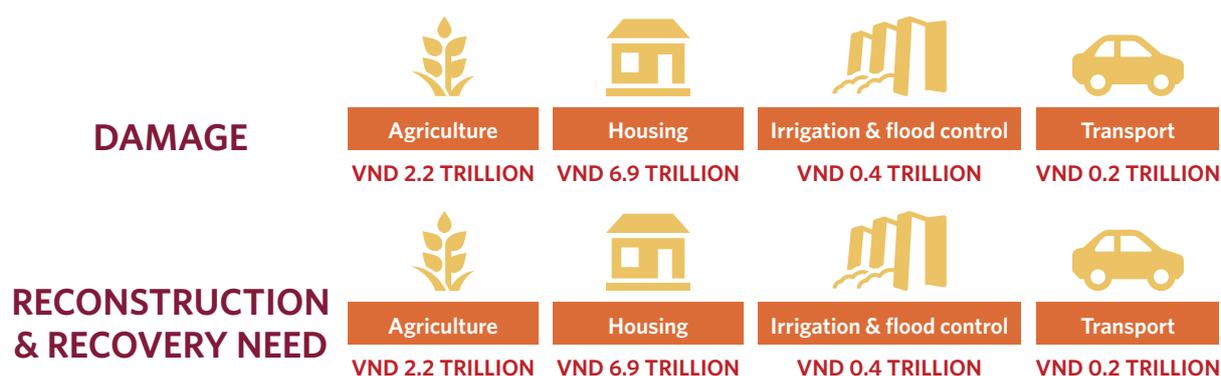
- The largest reconstruction subcomponent is to reinstate failed river bank protection due to flood induced erosion.
- Over half the damage occurred in the northern districts of Van Ninh, Ninh Hoa and Dien Khanh, the districts where irrigation facilities are managed by IMC-North.

TRANSPORTATION

- Damaged infrastructure was restored to the pre-disaster conditions as the extent of damages is relatively small.
- 'Build back better' approach was not adopted

TABLE E.2: Estimated Damage and Loss, and Recovery and Reconstruction Needs by Sector

Sector	Disaster Effect						Reconstruction Needs		Recovery Needs	
	Damage		Loss		Total		Total		Total	
	VND Million	USD Million	VND Million	USD Million	VND Million	USD Million	VND Million	USD Million	VND Million	USD Million
Social	3,680,768	162.15			3,680,768	162.15	6,895,496	303.77		
Housing	3,680,768	162.15			3,680,768	162.15	6,895,496	303.77		
Productive	145,693	6.42	5,200,727	229.11	5,346,420	235.53	211,255	9.31	1,971,892	86.87
Agriculture			1,495,151	65.87	1,495,151	65.87			635,000	27.97
Livestock	62,152	2.74	7,237	0.32	69,389	3.06	90,121	3.97	13,300	0.59
Fishery	83,541	3.68	2,058,294	90.67	2,141,835	94.35	121,134	5.34	730,000	32.16
Forestry			1,640,045	72.25	1,640,045	72.25			593,592	26.15
Infrastructure	570,436	25.13			570,436	25.13	570,436	25.13		
Irrigation and flood control	409,394	18.04			409,394	18.04	409,394	18.04		
Road Transportation	161,042	7.09			161,042	7.09	161,042	7.09		
TOTAL	4,396,897	193.70	5,200,727	229.11	9,597,624	422.81	7,677,187	338.20	1,971,892	86.87



Macro-Economic Impact

Khanh Hoa Provincial Peoples' Committee (PPC) estimated that gross domestic product (GDP) growth in 2018 would decline by 0.9 percent compared to baseline projection. Agriculture sector is expected to contract by 2.6 percent from 2017, while the other two main sectors are expected to continue growing, albeit at a rate lower than the baseline projection. The value of agriculture GDP reduction between 2017 and 2018 is estimated to be about VND 125 billion at 2010 prices or 173 billion at 2018 prices (assuming GDP deflator of 1.38). Impact to GDP growth in the key sectors is shown in Table E.3.

TABLE E.3: Gross Domestic Product (GDP) Estimates for 2017-2018

GDP growth (excluding tax)	2017	2018 (Projection)	
		Baseline	Revision
Total GDP	8.21	7.6	6.7
Agriculture	2.62	2.1	-2.6
Industry and Construction	8.05	8.1	7.4
Services	9.47	8.3	8.1

Source: Khanh Hoa Department of Planning and Investment.

GPD GROWTH REDUCTION:



BASELINE
7.6%

PROJECTION
6.7%

Government Response

The central and provincial governments and the affected communities have been proactive in emergency response. Warnings and operational directives that were disseminated publicly via the media (TV and radio) were successful in guiding the preparedness and response efforts.

As of March 2018, Khanh Hoa province has mobilized a total of VND 733.34 billion to support the emergency repair of key public infrastructures and of houses, for flood prevention, and for the restoration of livelihoods of the affected communities. In addition, 1,500 tons of rice (equivalent to VND 18.5 billion) was distributed to poor households, and tax payment dates were extended for 29 most damaged enterprises in the province.

The Ministry of Agriculture and Rural Development (MARD) and several PPCs, including the PPC of Khanh Hoa, are coordinating with associated UN agencies, including FAO, IOM, UNDP and UNICEF through funding support of the UN Central Emergency Response Fund (CERF), for the implementation of projects amounting to a total of USD 4.2 million (equivalent to VND 96 billion). The joint UN approach provided humanitarian aid through the distribution of cash grants and vouchers, technical equipment and non-food items in the sectors of food security and the restoration of livelihoods, shelter and WASH to more than 150,000 affected people, a substantive amount of which were beneficiaries in Khanh Hoa.

In addition, UNDP is working in close cooperation with the Government of the Republic of Korea through a funding umbrella of USD 1.0 million to support the reconstruction and repair of more than 3,520 houses.

Principles and Strategy of Reconstruction and Recovery

Only 7.6 percent of the needs for all sectors can be covered under current budget for reconstruction and recovery.

The loss of GDP following disaster occurrences can be mitigated by speedy relief, reconstruction, and recovery activities. For example, if the total reconstruction needs for housing, transport, and irrigation and flood control sectors as estimated in this assessment which amount to VND 7.5 trillion can be fulfilled, this would result in value addition to the construction sector in the amount of about VND 1.4 trillion or in adding 3.2 percent to the post disaster growth estimate². Unfortunately, the budget available for reconstruction and recovery only meets 7.6 percent of the needs for all sectors. According to Provincial Committee for Disaster Prevention & Control and Search & Rescue (PCDPCSR), about 90 percent of households were able to reconstruct their houses with or without support from external stakeholders. Furthermore, the available public funds of approximately VND 259.9 billion meet about 45.6 percent of the needed reconstruction costs in transport, and irrigation and flood control sectors.

In the short term, restoration of key services and infrastructure, including reconstruction or repair of houses, is recommended as first priority.

Reconstruction of irrigation and flood prevention, and transport sectors will deliver additional growth of about 2.9 percent. In addition to financial support, strengthening livelihood recovery by distribution of seeds, seedlings, fertilizers, pesticides, animal feed, vaccinations, fingerlings, etc. should also be undertaken. Such approaches will enable the affected population to resume normal life, which in turn will allow recovery to take place efficiently. Integration of disaster risk reduction (DRR) measures into recovery and reconstruction plans helps in “building back better” by increasing the overall resilience of the local community.

For medium- to long-term recovery and reconstruction, the recovery process should become an opportunity to strengthen the governing bodies, particularly at the local level.

Designation of an agency to take the lead role in coordinating and planning the recovery process, as well as in overseeing the monitoring and evaluation (M&E) of the recovery progress, will enable proper planning and implementation at the local level. Sectoral plans, especially land-use and spatial plans should be reviewed periodically, considering the disaster risks that influence development and investment. It is equally important to have a mechanism in place for effective fund tracking to enable efficient utilization of the funds, and for productive coordination among various funding sources—for example, government funds, international aid, private sector financing, and community contribution—that are involved in recovery and reconstruction.

Particular attention should be paid to the vital role that women play as community members and leaders during the assessment, planning and program implementation stages.

The special problems they face, such as property rights matters and additional responsibilities as heads of households in particularly difficult circumstances, should be addressed and accounted for. This will lead to the identification of adequate, gender sensitive programming in the recovery, reconstruction and ensuing development plans, which will in turn help communities recover faster from climate disasters.

² This estimation has not included any forward, backward linkages, and multiplier effect from the final demand.



1. Introduction



1.1 Overview of Vulnerabilities to Natural Disasters

Vietnam is one of the most hazard-prone countries in the East Asia and Pacific region. The 3,260 kilometers coastline is regularly exposed to typhoons, floods, drought, coastal erosion and landslides. A recent climate risk index found that Vietnam is in the top ten countries globally that are most affected by extreme weather events over the past 20 years.³ With climate change, the frequency and intensity of such events are expected to increase even further. A recent World Bank study of 84 coastal countries ranks Vietnam, unfortunately, in the top tier countries that are most at risk of sea level rise in terms of impact on population, GDP, urban extent and wetland area.⁴ In 2007, a report by the World Bank indicated that Vietnam is one of five countries in the world to be most impacted by climate change.

In recent years, Vietnam has experienced an upsurge in intensity of these natural disasters. The country has suffered heavy human, economic, and infrastructure losses from the onslaught of floods, typhoons, and droughts, among other natural disasters. The total estimated loss from damages caused by disasters in two recent years of 2016 and 2017 is VND 40,000 billion and VND 60,000 billion, respectively.⁵ Each year, climate disasters result in a loss of about 1 percent of Vietnam's GDP.⁶

An estimated USD 1.3 trillion worth of assets are at risk, but only about 5 percent of assets in the country are covered by insurance, according to a risk assessment carried out by the GoV with technical support from the World Bank in 2017.⁶ Despite significant investment in better planning, the government continues to face a funding gap after disasters. The current financing capacity of Vietnam meets only about 21 percent of the estimated need for emergency reconstruction and recovery alone. Vietnam could see losses of over 4 percent

³ <https://germanwatch.org/fr/download/16411.pdf>

⁴ Dasgupta, Susmita, Benoit Laplante, Craig Meisner, David Wheeler, and Jianping Yan. 2007. "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis." Policy Research Working Paper 4136, World Bank, Washington, DC. February.

⁵ Source: Central Steering Committee for Natural Disaster Prevention and Control (CSCNDPC)

⁶ Vietnam Catastrophe Risk Assessment and Modeling, Country Risk Profile, The World Bank, 2017

of GDP in the case of a major disaster. In the next 50 years, Vietnam has a 40 percent chance of experiencing an event with economic losses exceeding USD 6.7 billion, and affecting over 39 million people.

1.2 Institutional Arrangements and Strategy for DRM in Vietnam

The Central Committee for Disaster Prevention and Control (CCDPC), coordinates the DRM activities across ministries at the national level. Established in 1990, the CCDPC is chaired by the MARD minister, with a standing office in the MARD Department of Disaster Prevention and Control, and involves the GoV's line ministries and mass organizations. At the same level, a National Committee for Search and Rescue (NCSR), which is led by the Ministry of Defense and comprises line ministries, has also been established to be responsible for search, rescue and emergency relief during, and immediately after, disasters.

Similar arrangement is in place at the provincial and district levels. The local committees in charge of disaster management provide both vertical and horizontal reporting to CCDPC and administrative authorities. However, both the disaster management, and search and rescue functions are combined at these levels. The standing office is aligned with the Department of Agriculture and Rural (DARD).

These committees are tasked with making decisions on disaster response and short-term prevention measures such as early warning, evacuation, etc. The CCDPC has the task of interdisciplinary coordination and providing support to the prime minister by organizing and directing natural disaster prevention and response nationwide.

In recent years, the GoV has formulated and adopted a set of policies and legal frameworks for DRM, such as the Law on Natural Disaster Prevention and Control, the National Strategy for Natural Disaster Prevention, Response and Mitigation, and the National Climate Change Strategy and action plans, as well as Community-Based DRM Program. Action plans for implementation of the strategies are adopted in all 63 provinces and in the cities of Vietnam.

However, the GoV faces significant institutional and legal challenges in addressing climate risks. Many critical functions for managing drought and other natural hazards fall across different institutions responsible for managing forests, agriculture, and water and land use. The Ministry of Natural Resources and Environment (MoNRE) is responsible for hydro-meteorological monitoring and forecasting and water resource management more broadly, including quantity and quality of water, and land-use planning. On the other hand, MARD leads on disaster prevention and control and on water and land-use plans for agriculture and rural development. This fragmentation and overlapping in the institutional setup are duplicated at provincial and city levels. Equally important, overlapping sectoral policies and legal frameworks often lead to confusion in implementation at all levels.⁷

1.3 Khanh Hoa Province in Context

Khanh Hoa is a province located in the South-Central Coast region, and is highly vulnerable to climate change. It has a population of 1,212,877 and spans an area of 5,197 km² with its capital in Nha Trang. The provincial coastline spreads from Dai Lanh commune to the end of Cam Ranh Bay with a total coastline of 385 kilometers featuring numerous creek mouths, lagoons, river mouths, and hundreds of islands and islets. The province also administers large territorial waters. The coastline is indented by several bays, most notably Van Phong Bay, Nha Phu Bay, Nha Trang Bay and Cam Ranh Bay. Of these, Cam Ranh Bay, with an area of around 200 km² encompassed by a mountain range, is regarded as one of the three best natural seaports in the world. Cam Ranh Bay is strategically important and has been used as a naval base by several major powers throughout history.

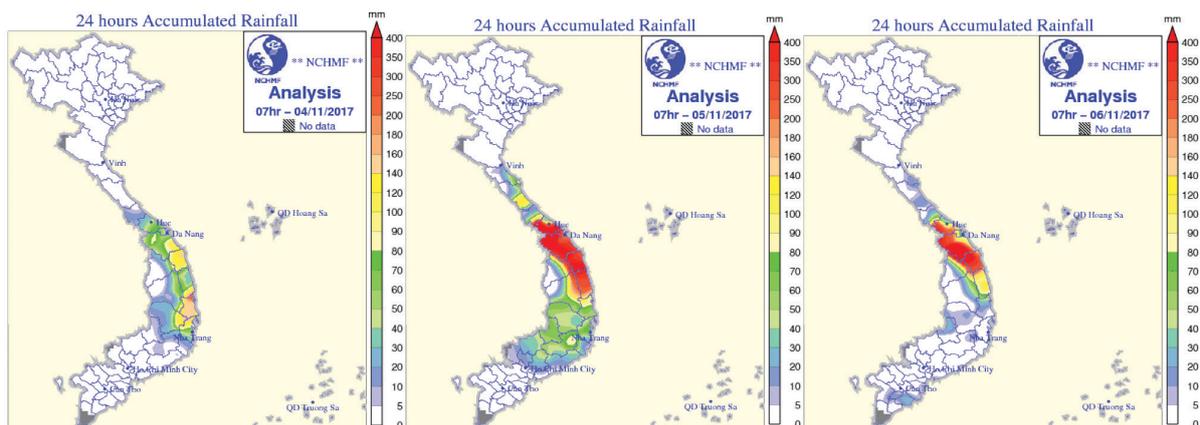
⁷ Toward Integrated Disaster Risk Management in Vietnam - Recommendations Based on the Drought and Saltwater Intrusion Crisis and the Case for Investing in Longer-Term Resilience, The World Bank, 2017

With a **Gross Regional Domestic Product (GRDP) increase of 9.31%** in 2016, Khanh Hoa now ranks fourth in GDP. Growth is particularly strong in the cities and towns. Khanh Hoa's urban population is approximately 45% of its total population, making it the most urbanized province of the South-Central Coast. It ranks fifth in State budget collection, and due to its relatively small agricultural sector, but strong industry and services, its economy is moving rapidly towards industrialization and modernization. The province is endowed with a favorable geographical location, natural conditions, beautiful natural landscapes and beaches, which (together with its Cham heritage) attract a large number of tourists. Khanh Hoa has a vision to turn into a centrally-governed urban entity by 2030, making it an economic, cultural, tourism, and science and technology hub with a high-quality workforce. It aims to be a key defense-security area for the South-Central region, the Central Highlands region, and the country as a whole. In order to fulfil such goals, the province aims to (i) develop industry, agriculture and aquaculture, (ii) improve health care services, education and human resources training, (iii) generate jobs and reduce poverty, and (iv) protect the ecological environment.

1.4 Typhoon Damrey and its Impacts

Typhoon Damrey is the strongest typhoon to strike Vietnam since 2001, having first originated as a tropical depression over the Philippines on October 31st, 2017. Emerging in the South China Sea few days later, the tropical depression developed into the second deadliest and twenty-third named storm of the 2017 Pacific typhoon season, and twelve named storm in the East Sea. In the early morning of November 4th, 2017, Typhoon Damrey made landfall in Vietnam and directly hit Khanh Hoa province with winds of up to 135 km/hour. Typhoon Damrey is classified as level 13 in the Vietnam tropical typhoon scale (equivalent to Category 2 of the Saffir-Simpson scale). The typhoon impacted a total of fifteen provinces in Central Vietnam. Over two days (November 4th and 5th) the torrential rains reached 500-700mm on average, with peak in Quang Nam (1036mm), Thua Thien Hue (969mm) and Quang Ngai (776mm). Khanh Hoa province experienced a smaller amount of rainfall at 150-200mm, and storm surge at 0.5-1.0m. Water level reached to 10.6m (at Yellow level, above alert level II) in Cai Nha Trang river, and at 6.19m (Red level, above alert level III) in Dinh Ninh Hoa river. Figure 1.1 shows the accumulative rainfall measured on November 4th and 5th, 2017.

FIGURE 1.1: Accumulative Rainfall on November 4th and 5th, 2017



Source: Central Hydro-Meteorological Forecast Center, National Hydro-Meteorological Services.

According to CCDPC, the estimated economic loss due to Typhoon Damrey is VND 22,680 billion (approximately US\$994 million). A breakdown of the total damages in the 15 affected provinces is as follows:

1. Human impact: 107 dead or missing and 16 missing;
2. Housing: 3,550 collapsed and 299,233 damaged;

3. Crops: 11,327 hectares (ha) of rice damaged and 27,301 ha of vegetables submerged;
4. Fishery: 4,472 hectares (ha) of aquaculture farm and 38,629 aquaculture cages damaged and swept away, 1,809 fishing vessels sunk or damaged.

Among the fifteen affected provinces, Khanh Hoa province has suffered the most, accounting for approximately 69 percent of the total economic losses resulting from Typhoon Damrey's impact. Despite mild river floods, substantial damages and losses have occurred, mostly caused by widespread and gusty winds. The severity of the damage increased due to the inexperience of Khanh Hoa authorities and communities in responding to the disaster. Khanh Hoa has never before experienced such a disaster, given its favorable geographical conditions.

In summary, the recorded damages and losses caused by Typhoon Damrey in Khanh Hoa province are as follow:

1. Human: 44 dead and 229 injured;
2. Housing: 2,817 collapsed, and 163,970 suffered 30 percent to 70 percent damage;
3. Crop: A total of 33,600 hectares of rice and vegetables affected;
4. Forestry: 19,700 hectares of forest fallen and broken;
5. Livestock: 870,000 cattle and poultry killed/swept away;
6. Aquaculture: 1,751 hectares of aquaculture farms and 35,785 aquaculture cages damaged and swept away, and 1,609 fishing vessels sunk and damaged;
7. Infrastructure: 58 kilometers of road damaged, 41.2 kilometers of river bank/revetment eroded, 31.2 kilometers of irrigation channel and 2 irrigation dams damaged, as well as many other types of public infrastructure such as electricity poles, schools, hospitals and private assets damaged.

Estimated economic losses amount to VND 15,500 billion (approximately USD 696 million).

1.5 Government Response

The Central and provincial governments and affected communities were proactive in emergency response. Warnings and operational directives disseminated publicly via the media (TV and radio) guided the preparedness and response efforts. For example, a total of 6,084 locals were immediately evacuated to safe places. 182 fishing boats with 878 fishermen anchored safely in the safe harbours.

As of March 2018, Khanh Hoa province has mobilized a total of VND 733.34 billion to support the emergency repair of key public infrastructures, for flood prevention and for housing as well as for restoration of livelihoods of the affected communities. Specifically, the fund was contributed by the following sources:

1. Central budget allocation: VND 260 billion
2. Provincial budget: VND 395 billion
3. Provincial DRM Fund: VND 17.34 billion
4. Donation from Russian Government: VND 56 billion
5. Donation from VinGroup: VND 5 billion

In addition, 1,500 tons of rice (equivalent to VND 18.5 billion) were distributed to poor households, and tax payment dates were extended for 29 most damaged enterprises in the province.

The Ministry of Agriculture and Rural Development (MARD) and several PPCs, including the PPC of Khanh Hoa, are coordinating with associated UN agencies, including FAO, IOM, UNDP and UNICEF through funding support of the UN Central Emergency Response Fund (CERF), for the implementation of projects amounting

to a total of USD 4.2 million (equivalent to VND 96 billion). The joint UN approach provided humanitarian aid through the distribution of cash grants and vouchers, technical equipment and non-food items in the sectors of food security and the restoration of livelihoods, shelter and WASH to more than 150,000 affected people, a substantive amount of which were beneficiaries in Khanh Hoa.

In addition, UNDP is working in close cooperation with the Government of the Republic of Korea through a funding umbrella of USD 1.0 million to support the reconstruction and repair of more than 3,520 houses.



107
DEATHS
15 provinces

44
DEATHS
Khanh Hoa



VND 22.68
TRILLION
15 provinces

VND 15.5
TRILLION
Khanh Hoa

VND 0.73
TRILLION
Response





2. Rapid Damage and Needs Assessment Methodology

2.1 Assessment Methodology and Scope

This rapid assessment was carried out in Khanh Hoa province following an official request to the World Bank by the Khanh Hoa PPC on November 10, 2017.

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, fishery and forestry. For the agriculture, livestock, fishery and forestry sectors, losses as well as physical damage were assessed. Macro-economic impacts, DRM and gender were also considered in the assessment as cross-cutting issues.

The baseline data was sourced from the relevant provincial agencies, General Statistics Office (GSO) based in Khanh Hoa province, and all 8 city/districts. Other information such as agriculture country briefings and reports were also collected from United Nations (UN) agencies and other international organizations. In addition, the assessment team collected and analyzed all relevant quantitative secondary data to assess the extent of damage to sectors. The team also collected data on the general geographic, demographic, social and economic characteristics of Khanh Hoa province, as well as data specific to each sector. The secondary data includes the damages and needs reports from local authorities, reports from sectoral ministries, and from the inter-agency relief and joint rapid assessment team. The collected data was compared with baseline data to help contextualize damage and loss. In addition to secondary data collection, face to face interviews with relevant stakeholders and field visits were organized for collection and/or validation of existing data.

The analysis is based on the information collected using disaster damage collecting system regulated by Circular No.43 in which Provincial CNDPC consolidates the information reported at district and commune levels. The data is then presented according to a predefined set of damage categories, in a specified reporting format. The

Ordinance number 02/2017 ND-CP on support for livelihood recovery, and additional provincial decrees on support for recovery, is used as a guide to calculate the recovery needs.

For the calculations of damages and losses, “Damages” refers to the total or partial destruction of infrastructure and physical assets. Its cost is estimated at the replacing or repairing market prices that prevailed just before the disaster. Damages are valued first in physical terms (e.g., number of houses of a specific typology, kilometers of road, number of flood control and irrigation infrastructures, etc.), and then in terms of their monetary value. “Economic losses” refers to changes in economic flows arising from the disaster, the reduction of the flows in the economic activity (e.g., lower or null sales of rice, mango, milk, eggs, shrimps, etc.). These fluctuations continue until the achievement of full economic recovery and reconstruction, in some cases lasting for several years. Losses are expressed as the value of the lost production in current monetary values.

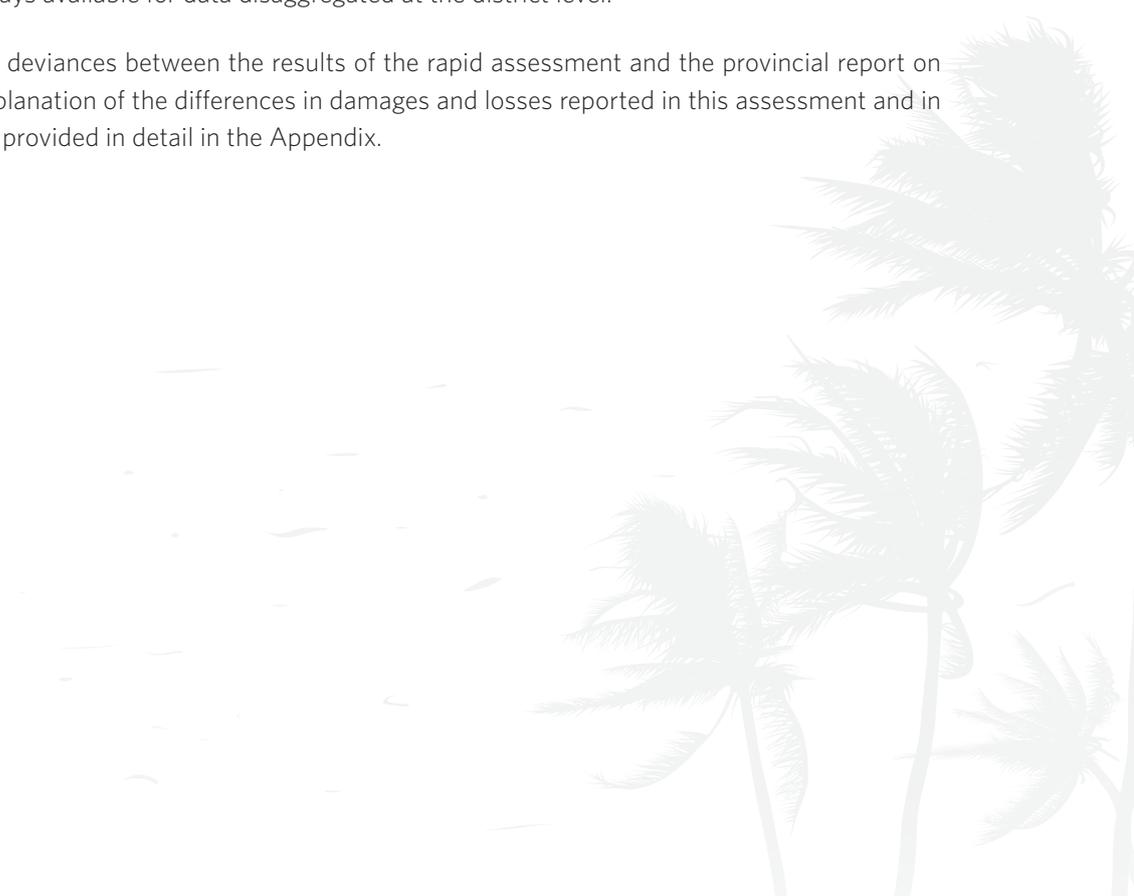
In order to calculate the needs for recovery and reconstruction, the assessment defines recovery as “the restoration, and where appropriate, improvement of facilities, livelihoods, and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors”. “Reconstruction”, however, focuses primarily on the construction or replacement of damaged physical structures, and the restoration of local services and infrastructure.

2.2 Limitations of the Assessment

The assessment was conducted in a short period of secondary data review, and 5 working days at the site to gain first-hand understanding of the impacts. The assessment selected 2 affected coastal and mountainous districts of Ninh Hoa and Khanh Vinh for field visits. Since it was 5 months after the typhoon hit, most of the collapsed houses, aquaculture farms, fish cages and fishing boats were repaired and rebuilt. The assessment, therefore, is mainly dependent on secondary data.

Due to incomplete or inconsistent data provided, in most cases, the district-level data have been used to calculate the share of the damage, and accordingly distribute the damages reported at the province level. The reason to do so is that the data at the province level provided disaggregated damages by different types of crops, animals and aquaculture ponds, allowing the calculation of variation in yields and prices more accurately. Such detailed information was not always available for data disaggregated at the district level.

Therefore, there are few deviances between the results of the rapid assessment and the provincial report on damages and losses. Explanation of the differences in damages and losses reported in this assessment and in the provincial report are provided in detail in the Appendix.





3. Damage and Needs Assessment

This section presents the results of the rapid damage and needs assessment for key sectors in Khanh Hoa province. The assessment utilized the data for damage and recovery needs obtained from government agencies.

3.1 Housing Sector

3.1.1 Housing Stock

About half (49 percent) of Vietnam's housing stock was built after the year 2000 (44 percent in urban and 51 percent in rural areas). Most (93 percent) of the people in Vietnam own their homes. According to 2009 data, more than half (54 percent) of the houses are 60 square meters or more, with about 61 percent in urban and 51 percent in rural areas.⁸

Houses in Vietnam are categorized into four construction types: permanent, semi-permanent, less permanent and temporary. Permanent houses have three main structural elements i.e., columns, roof and walls, built using sturdy material (see table 3.1). Semi-permanent houses have two out of three sturdy elements, less permanent houses have one, and temporary houses have no sturdy element since they are constructed with non-sturdy or flimsy material.

⁸ The 2009 Vietnam population and housing census: major findings. Central Population and Housing Census Steering Committee. Hanoi, June 2010.

TABLE 3.1: Housing Classification Based on Construction Materials

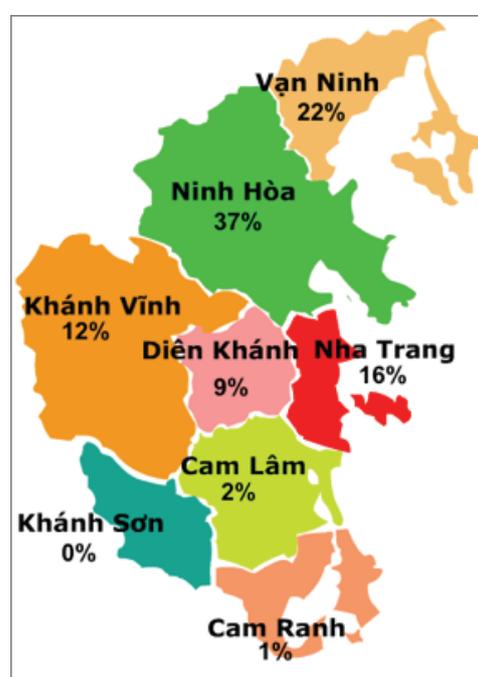
	Supporting columns	Roof	Walls
Sturdy	Steel reinforced concrete	Steel-reinforced concrete	Steel-reinforced concrete
	Brick	Tile (cement/terracotta)	Brick/stone masonry
	Iron/steel/ solid wood		Wood/metal
Flimsy	Scrap wood/bamboo	Sheeting (fibrocement/metal)	Mud/lime/straw
	Other	Leaves/straw/ tar paper	Slabs/bamboo screen/ planks
			Other

Source: The 2009 Vietnam population and housing census, GoV.

3.1.2 Damage to Housing

A total of 118,402 houses⁹ were destroyed and damaged according to the post-Damrey survey report conducted by the provincial authorities and the Vietnam Red Cross in Khanh Hoa province. Damage was higher in the northern districts. Van Ninh had 22 percent of destroyed houses, and Ninh Hoa had 37 percent of destroyed houses (figure 3.1).

According to the GoV criteria on housing damage classification (see table 3.2), 2 percent (2,817 houses) were classified as completely destroyed with more than 70 percent damage; 13% suffered severe damage of 50-70 percent; 38 percent showed heavy damage of 30-50 percent, and 45 percent suffered partial damage of less than 30 percent (see table 3.3).

FIGURE 3.1: Completely Destroyed Houses by District**TABLE 3.2: Classification of Housing Damage**

Damage Category	Damage Impact	Relative Damage	Material Damage
Destroyed	Completely collapsed	More than 70 percent	All collapsed into rubble
Severe	Substantially heavy loss	50-70 percent	Collapsed wall and lifted roof
Heavy	Heavy loss	30-50 percent	Lifted roof
Partial	Partial loss	Less than 30 percent	Slight damage

⁹ Number "166,787" has been used in the provincial damages reports as a result of the quick estimation made right aftermath of the typhoon hit for the immediate humanitarian aid purpose. In the reconstruction and repair phase, a detailed survey on housing damage was conducted in order to make a detailed pay-out plan for supporting the affected households. Furthermore, there number of houses which had less damage were also immediately repaired by the house-owners in the interim period. Therefore, number of houses (118,402) recorded as damaged in the provincial recovery support plan is smaller than the damage reports.

TABLE 3.3: Housing damage in Khanh Hoa Province

Damage	Permanent	Semi-permanent	Other	Total	percent Total
Complete	429	1,974	414	2817	2%
Substantial	20	12,625	2,713	15358	13%
Heavy	16,759	27,152	2,500	46411	39%
Partial	51,301	238	2,277	53816	45%
Total	68,509	49,893	7,904	118,402	100%

Data obtained show that permanent houses resisted the storm better than semi-permanent ones. Of the total damaged houses, fifty eight percent were recorded as permanent or well built (i.e. with sturdy columns, roofs and walls); 42 percent were semi-permanent or less well built (i.e. with one weak structural element; for example, the roof) and less than 1 percent were classified as less permanent or temporary. As seen in table 3.3 above, 29 percent of semi-permanent homes suffered substantial damage or complete collapse. About 1 percent of permanent homes also suffered the same fate, most likely due to their location, being hit by the typhoon in full force. It may also have been due to inadequate construction.

3.1.3 Damage to House Contents

It is understandable that families in damaged houses will suffer damage to their household items, as well. A rough estimate of the cost of replacing these items is provided in table 3.4. The estimate is based on the probability of a family owning an item in a 'basket' of goods, the likelihood of it being irreparably damaged or lost, and the average replacement cost. The calculation does not differentiate between rural and urban homes, and further assumes that many of these items are second-hand.

TABLE 3.4: Damage to House Contents

Damage (million VND)	Permanent	Semi-Permanent	Other	Total
Total	163,200	109,900	200	273,300

3.1.4 Reconstruction Needs

According to Decree No. 136/ND-CP governing the scale of damages, the GoV will provide financial support for demolished and damaged houses owned by poor, near poor and disadvantaged households. The level of support is determined by the GoV and the Ministry of Labour-Invalids and Social Affairs (MoLISA). Under the guidance of Khanh Hoa Peoples Committee, Department of Construction circulated 3 types of house to be reconstructed to communities for selection. Supported by UNDP Vietnam, households have selected Type 2 house of 25.5m² and 3.75m height. The estimated reconstruction cost is 49,556,163 VND (about USD 2,200). Payments to builders are made in two stages, i.e. on completion of the foundation work and on finishing the work. Financial support for repairs is lower; depending on the severity of the damage, typically between VND 2.3 million and VND 15 million (USD 100-700) is paid for repairs, usually after the repairs are completed.

However, existing houses range from 40-100 m² in size, and about 50% of the homes in rural areas are 60 m² or more. Furthermore, actual reconstruction costs will depend on the quality of construction, the scale of damages and the size of house. To estimate reconstruction costs the following assumptions were made:

- The average cost of rebuild or substantial repair is VND 2 million per m².
- Permanent homes are assumed to be 100 m², semi-permanent homes 80 m², and less permanent homes 40 m² in size on average.

The cost of construction based on the above assumptions is given in table 3.5.

TABLE 3.5: Rebuild Cost per House in million VND

Scale of Damage	Standard of Construction			
	Permanent	Semi- Permanent	Less Permanent	Temporary
Complete collapse >70%	200	160	80	30
Substantial heavy damage 50-70%	120	96	48	18
Heavy damage 30-50%	80	64	32	12
Partial damage 15%	30	24	12	5

The total estimated reconstruction cost meeting new safety standards would be VND 6,895,496 million¹⁰, applying the cost shown in table 3.5 to the total number of houses damaged in each district and town. Of which, the total cost of reconstruction for completely destroyed houses would be VND 478,830 million, and the total repair cost for damaged houses would be VND 6,416,646 million. Details of the total damage, reconstruction needs and allocation¹¹ by district are showed in table 3.6.

TABLE 3.6: Reconstruction Needs by District (million VND)

District	Total Damage	Total Reconstruction Needs	Current allocation	Priority
Van Ninh	1,401,950	1,413,280	13,826	1,399,454
Ninh Hoa	916,160	2,191,064	15,237	2,175,827
Nha Trang	898,950	1,419,960	6,076	1,413,884
Cam Lam	36,250	151,780	3,372	148,408
Cam Ranh	4,898	7,820	634	7,186
Dien Khanh	234,040	1,065,152	3,292	1,061,860
Khanh Vinh	188,520	633,840	14,107	619,733
Khanh Son	3,500	12,600	1,136	11,464
TOTAL	3,680,768	6,895,496	57,680	6,837,816



Damage

VND 3.7 TRILLION



Reconstruction Need

VND 6.9 TRILLION



Current Allocation

VND 0.6 TRILLION

3.1.5 Progress in Reconstruction

The available financial resources are insufficient to provide support to all families with damaged homes. The GoV has therefore targeted support to those most in need. Accordingly, those households whose houses suffered only partial damage did not receive this financial support. A total budget of VND 57,680 million was allocated from central funds as shown in table 3.7. An additional VND 40,000 million is available from the Fatherland Front.

¹⁰ The Sub-department of Disaster Prevention and Control has calculated the total damages to be 3,680,768 VND million.

¹¹ The current fund allocation does not include an additional VND 40,000 million available from the Fatherland Fund.

TABLE 3.7: Budget Allocated for Housing Reconstruction (million VND)

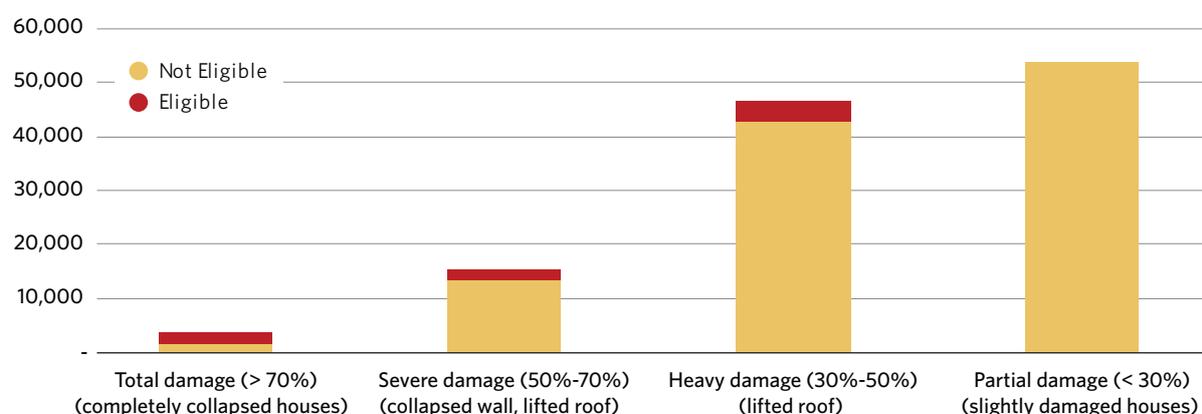
District/Town	Complete Collapse >70%	Substantial heavy damage 50-70%	Heavy damage 30-50%	Total
Van Ninh	7063	3465	3298	13826
Ninh Hoa	8326	3700	3211	15237
Nha Trang	2825	432	2819	6076
Cam Lam	902	1205	1265	3372
Cam Ranh	518	36	80	634
Dien Khanh	2399	230	663	3292
Khanh Vinh	1327	2657	10123	14107
Khánh Sơn	200	56	880	1136
TOTAL	23,560	11,781	22,339	57,680

Table 3.8 gives a breakdown of district- or town-wise payments made to poor, near poor or disadvantaged households to rebuild or repair their house.

TABLE 3.8: Houses Eligible for Compensation

District/Town	Complete Collapse >70%	Substantial heavy damage 50-70%	Heavy damage 30-50%	Total
Van Ninh	505	615	713	1833
Ninh Hoa	620	628	698	1946
Nha Trang	217	102	299	618
Cam Lam	52	131	178	361
Cam Ranh	19	5	12	36
Dien Khanh	164	28	96	288
Khanh Vinh	68	321	1570	1959
Khanh Son	10	6	114	130
TOTAL	1,655	1,836	3,680	7,171

Initially, 1,655 (59 percent) of totally collapsed houses were eligible for financial support, and the number was recently increased to 1,730 (61 percent). Only 12 percent of homes with severe (50-70 percent) damage and 8 percent of homes with heavy (30-50 percent) damage were eligible for financial support (figure 3.2).

FIGURE 3.2: Number of Houses Eligible for Financial Support

Great emphasis was placed on getting vulnerable families back into their home by the New Year, only three months after the typhoon. The majority of houses eligible for support have now been rebuilt or repaired. About

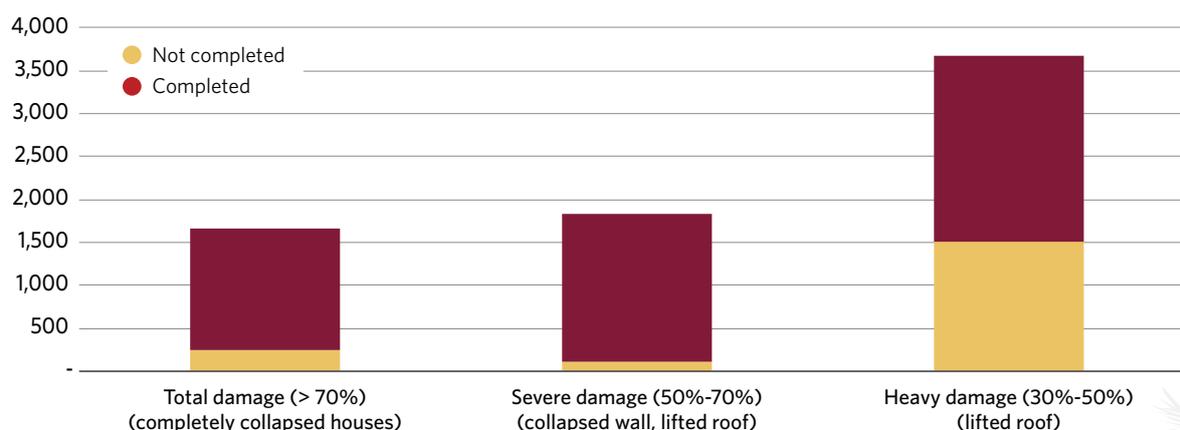
85 percent of completely damaged houses had been repaired or rebuilt by February 15, 2018, just over three months after the event (see table 3.9).

TABLE 3.9: Houses Rebuilt or Repaired by February 15, 2018

District/Town	>70%	50-70%	30-50%	Total
Van Ninh	505	615	713	1833
Ninh Hoa	620	628	698	1946
Nha Trang	0	0	0	0
Cam Lam	52	131	178	361
Cam Ranh	19	5	12	36
Dien Khanh	134	28	96	258
Khanh Vinh	68	321	365	754
Khanh Son	10	6	114	130
TOTAL	1,408	1,734	2,176	5,318
PERCENTAGE	85%	94%	59%	74%

By March 15, 2018, about 4 months after the typhoon, almost 90 percent of eligible, completely damaged houses had been rebuilt and 84 percent of substantially or heavily damaged houses eligible for support had been repaired (figure 3.3).

FIGURE 3.3: Progress in Housing Reconstruction by March 15, 2018



3.2 Transportation Infrastructure (Roads and Bridges)

3.2.1 Sector Background

Road network in Khanh Hoa province comprises about 4,275 kilometers excluding the national roads. There are about 489.81 kilometers of provincial roads, 435.1 kilometers of district roads and 2,768.41 kilometers of commune roads.

Frequent incidents of flooding highlight the prevalence of risks and vulnerability of the transportation network in the province. 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 these areas are bound to yield significant economic benefits by maximizing the integrity of the network while minimizing the negative economic and social impacts—including loss of human lives—from disastrous events.

Being a coastal province, Khanh Hoa is more susceptible to typhoons. Provincial and local authorities broadcast advance information about the likely natural disasters and remain prepared with equipment and other resources prior to the typhoon season, generally from October to January. This helps in mitigating the impact of typhoons and other natural disasters, specifically in reducing the loss of human lives. Road connectivity is usually restored within a day, except in exceptional cases, where it may extend up to a week.

Some communes in low-lying areas get totally flooded and get marooned following heavy rains. It may take several days for the water to drain and for the commune to recover. It is also common for roads and bridges to be washed away or partially eroded due to floods, and to be disconnected due to landslides and erosion of hill-slopes.

3.2.2 Damages to Transportation Infrastructure

The extent of damages in the transportation infrastructure in the province following Typhoon Damrey is relatively small. Most of the damages in transportation infrastructure were caused by water flows and floods from the rainfall following the typhoon. It is understood that the amount and intensity of rainfall following Typhoon Damrey was less than that of the rainfall following earlier, lower-intensity typhoons.

As reported, all damages in the transportation sector in the province were in roads and bridges, except for two vessels (ferry/boat/ship) that were damaged in Cam Ranh, which falls under the sub-sector of inland waterways.

Heavy winds accompanying the typhoon caused trees collapsed that damaged road surfaces, and vertical structures like traffic signs and signal lights. Communication and transport were disrupted at places by trees that fell on overhead wires and on roads, and due to traffic signs and signal lights felled by the typhoon.

Water flows and floods in the wake of the typhoon damaged existing bridges; Irish crossings; culverts, protection work around abutments of bridges and culverts; embankments and road structure in the immediate approach to the bridges, Irish crossings and culverts; and road shoulders. The impact washed out parts of roads, in addition to eroding and deteriorating road surfaces and pavement structures including embankments, embankment slopes, hill-slopes and protection works. It also caused landslides that damaged and/or blocked the roads. The water flow changed its course at some places, breaching or washing away parts of the roads.

Road connections were disrupted at places because of roads being fully or partially washed away, or being blocked by felled trees, traffic signs or traffic signal lights, as well as collapse of part of the bridge and damage to Irish crossings. The PPC and the respective sector management agencies, including the provincial departments of transportation, district divisions and communes, took immediate action to restore the road connectivity by using contingency funds.

The estimated value of damages in transportation infrastructure in the province is approximately VND 160 billion. This amounts to about 1% of total estimated damages and losses of approximately VND 15 trillion. Table 3.10 shows estimated damages (count and monetary value) to the transportation infrastructure in the province caused by the typhoon and the floods that followed in November 2017. These estimates are based on the data provided by the provincial authorities. The assessment includes only the transportation infrastructure managed by the province, and excludes all nationally maintained transportation infrastructures.

TABLE 3.10: Damages to Transportation Infrastructure

District/City	Damaged Roads and Eroded Slopes (meters)	Damaged Bridges (Nos.)	Damaged Culverts (No.)	Damaged Traffic Signs and Signal Lights (Nos.)	Damaged Ferry/Boat/Ship (Nos.)	Value of Damages (million VND)
Van Ninh	9,330	2	22			13,466
Ninh Hoa	23,187	1				34,981
Dien Khanh	30					300
Cam Lam	15,455	1	5			45,850
Khanh Vinh		16	1			1,030
Khanh Son						
Nha Trang	10,245	2		1,501		36,171
Cam Ranh	160				2	240
Total	58,407	22	28	1,501	2	161,310

Source: Khanh Hoa provincial government.

3.2.3 Reconstruction Needs

In order to enhance the capacity to withstand future natural disasters, the affected transportation infrastructure should have been restored to a standard that makes it resilient. However, the sector itself suffered low level of damage which had even less impact on the transportation infrastructure. Therefore, the province decided to rehabilitate the damaged infrastructure to the pre-disaster conditions and finalized the plan accordingly. As a result, the province has not adopted the 'build back better' approach, as it does not add much value to the rehabilitation efforts under current circumstances. For example, there have been small damages to transportation infrastructures at 140 locations scattered throughout Ninh Hoa District. Repairing these small damages to a higher standard does not add any significant capacity to withstand future disasters.

The total funded estimated for rehabilitation of the damaged transportation infrastructure would be VND 160,042 million. Table 3.11 shows the rehabilitation cost presently being implemented with a target of completion by the end of 2018. The table also shows the funds already identified for rehabilitation, and the funding gap as of the time of this assessment in March, 2018.

TABLE 3.11: Transportation Infrastructure Needs

District/City	Rehabilitation Needs (million VND)	Current Allocation (million VND)	Funding Gap (million VND)
Van Ninh	22,719	—	—
Ninh Hoa	47,605	—	—
Dien Khanh	10,324	—	—
Cam Lam	44,793	—	—
Khanh Vinh	14,795	—	—
Khanh Son	14,000	—	—
Nha Trang	294	—	—
Cam Ranh	2,739	—	—
Economic Zone Management Board	2,850	—	—
Total	160,042	76,980	83,062

Source: Khanh Hoa provincial government.
Note: — = not reported.



Reconstruction Need

VND 0.2 TRILLION

3.3 Flood Control and Irrigation Infrastructure

3.3.1 Sector Context

Crop production in Khanh Hoa mainly depends on irrigation. Having adequate irrigation, flood control and drainage infrastructure plays an important role in the social and economic development of a region. Likewise, it is important for the agriculture sector of Khanh Hoa province, where crop production mainly depends on irrigation. The common irrigation system includes diverting water from rivers, utilizing water released from reservoirs, and trapping water coming down mountainous areas.

Agriculture is vulnerable to changing seasonal weather patterns, rising temperatures, increasing frequency and intensity of extreme weather events and rising sea level. Damages are caused by flooding, high winds and droughts. Competition for scarce dry season water resources is increasing due to rapid urbanization, and the development of commercial/ industrial zones.

Water storage reservoirs are built to meet water requirements not only for irrigated agriculture, but also for urban water supply and industry. To date, about 30 reservoirs have been built, of which 18 are managed by water management companies (IMCs). Out of these 30 reservoirs, 24 serve the main purpose of providing dry season irrigation for a total of about 23,330 ha of crop land. Two reservoirs are hydropower developments, while 5 reservoirs were built to meet the urban and industrial sector demands. However, many of the 24 reservoirs built to provide irrigation also supply water for urban use.

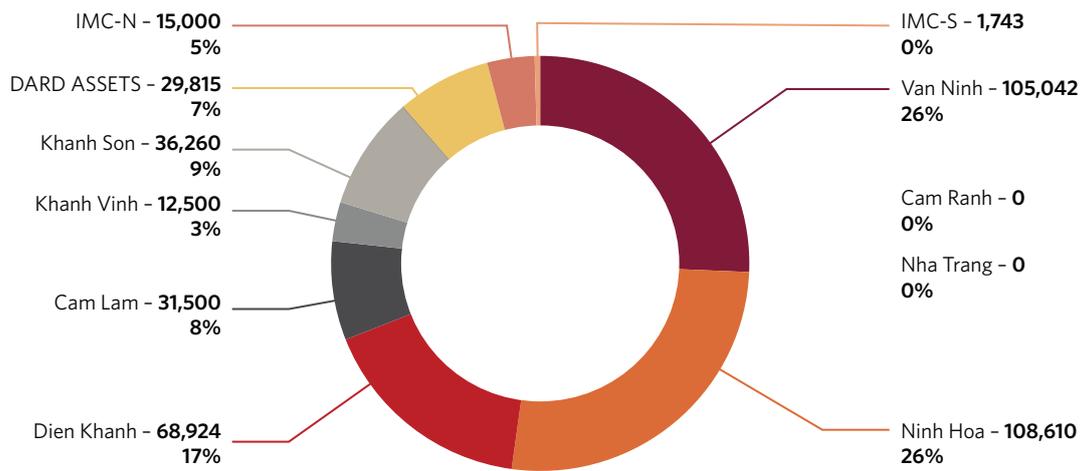
The irrigation systems comprise canal systems serving mostly rice cropped areas in the northern districts, and a mix of crops in the southern districts, including perennial tree crops. For rice, the level of service appears adequate, with priority given to irrigating head-end areas in times of drought. For non-rice crops, farmers tend to pump water from canals in simple pump-pipe systems. There is significant scope to increase the level of service and modernize irrigated agriculture, particularly in non-rice areas.

The flood protection system primarily consists of flood embankments built along rivers with “hard” erosion protection usually comprising rock, gabions, stone masonry or concrete with toe cut-offs and/or aprons. Rivers within urban areas have priority, and these are largely fully embanked. The protection appears to have been set within widened rivers (i.e. set back protection) to provide a high standard of protection.

3.3.2 Damage and Reconstruction Needs of Flood Control and Irrigation Infrastructure Sector

The assessment of damages, and specifically the estimated cost to repair, rehabilitate or replace failed engineering works is about VND 409.4 billion (see table 3.12). Over half the damage occurred in the northern districts of Van Ninh (25.7%) and Ninh Hoa (26.5%), followed by Dien Khanh (16.8%). These are the districts where irrigation facilities are managed by IMC-North. Figure 3.4 shows damages and reconstruction needs by district.

FIGURE 3.4: Damages and Needs by District.



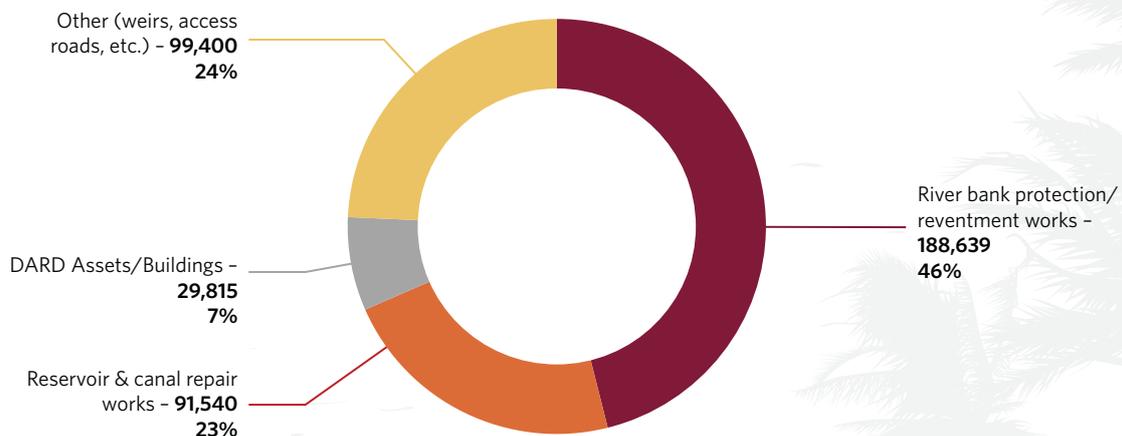
The largest reconstruction subcomponent is to reinstate failed river bank protection. The failed protection was usually of poor standards. Unlike the well-constructed, continuous bank protection found in urban areas, these were shorter lengths of protection placed on outer bends of rivers, and near to cross drainage structures which had been overtopped. Significant damage occurred at about 30 locations. Canals were damaged at about 90 locations, with localized failure of the bank and lining due to flooding.

Flood induced erosion was the major cause of damage and failure of river bank protection works, of canal lining and structures. However, damage was also incurred in two reservoirs by a combination of high water levels and waves caused by the very high winds, which damaged stone/masonry protection to the reservoir face. Reports indicate no major threat to the integrity and safety of the reservoirs themselves, but high winds damaged buildings, particularly roofs. A small land slide caused the structural failure of the IMC-North office/accommodation building at Da Ban reservoir in Ninh Hoa district.

Damages and reconstruction needs are broken down by subsector as follows:

- River bank protection/ revetment works: VND 188.64 billion (USD 8.28 million); 46.1%.
- Reservoir & canal repair works: VND 91.54 billion (USD 4.02 million); 22.4%.
- DARD Assets/ Buildings: VND 29.82 billion (USD 1.31 million); 7.3%.
- Other works (inspection roads, canal structures, etc.): VND 99.40 billion (USD 4.37 million); 24.3%.

FIGURE 3.5: Damages and Needs by Subsector



This reconstruction requirement represents about 9% of the book value of the engineering investments of about VND 4,800 billion¹² managed by the IMCs and others. It is overwhelmingly higher than the annual maintenance budget for these assets, which totals to about VND 22 billion.

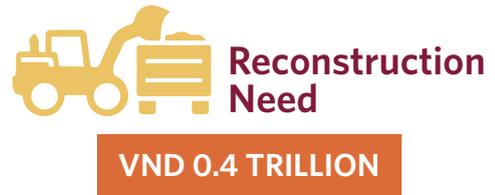


TABLE 3.12: Damages and Repair/ Rehabilitation Costs by District for Irrigation/ Water Resource Assets

No.	Category of Damage/ Repair works	Damages		%	Government Funding			Remarks
		million VND	million USD		Central	Provincial	District	
I	Van Ninh	105,042	4.61	25.7%	94,300	5,000	5,742	Northern most district
	River bank protection/ revetment works	75,850	3.33	72.2%				4 locations: Rivers To Giang, Hien Lurong, Dong Dien
	Reservoir revetment/ protection repair	15,300	0.67	14.6%				On river Goc
	Canal repair works	13,892	0.61	13.2%				17 locations
II	Ninh Hoa	108,610	4.77	26.5%	42,940	42,000	23,670	Northern district
	River bank/ coast protection/ revetment works	59,939	2.63	55.2%				16 locations: Rivers Cai, Lot & Tan Lam
	Canal repair works	36,064	1.58	33.2%				61 locations
	Spill/overflow sections of weirs, etc	1,784	0.08	1.6%				6 locations
	Inspection road repairs	300	0.01	0.3%				2 locations
	Other	10,523	0.46	9.7%				
III	Dien Khanh	68,924	3.03	16.8%	40,000	15,600	13,324	Central district
	River bank protection/ revetment works	18,950	0.83	27.5%				2 locations: Rivers Cho & Cai
	Various works	49,974	2.19	72.5%				9 locations
IV	Cam Lam	31,500	1.38	7.7%	20,500	5,800	5,200	Southern district
	River bank protection/ revetment works	4,000	0.18	12.7%				1 location
	Canal repair works	24,500	1.08	77.8%				10 locations
	Other	3,000	0.13	9.5%				2 locations
V	Khanh Vinh	12,500	0.55	3.1%	12,000	0	500	Central west district in hills
	River bank protection/ revetment works	12,000	0.53	96.0%				2 locations
	Other	500	0.02	4.0%				
VI	Khanh Son	36,260	1.59	8.9%	4,500	21,400	10,360	Southwest district in hill
	River bank protection/ revetment works	17,900	0.79	49.4%				5 locations
	Other	18,360	0.81	50.6%				13 locations
VII	Nha Trang	0	0.00	0.0%	0	0	0	Central coastal district
VIII	Cam Ranh	0	0.00	0.0%	0	0	0	Southern most district
IX	DARD ASSETS	29,815	1.31	7.3%	0	29,404	411	
	Building repairs (roof damage, etc)	20,800	0.91	69.8%				
	Other	9,015	0.40	30.2%				
X	Irrigation Management Company - North	15,000	0.66	3.7%	10,000	5,000	0	
XI	Irrigation Management Company - South	1,743	0.08	0.4%	0	1,330	413	
TOTALS		409,394	17.98	100.0%	224,240	125,534	59,620	
					million USD	9.8	5.5	2.6
						54.8%	30.7%	14.6%

¹² Approximate estimate based on book value of assets reported for IMC-North.

3.4 Agriculture, Livestock, Fisheries and Forestry

3.4.1 Sector Context

In 2017, agriculture represented 10.7 percent of the value added in the economic activity of Khanh Hoa province, where fisheries and forestry are the two major primary activities. In terms of output, crop production in Khanh Hoa is less relevant nationally, and in relative terms to other Vietnamese provinces: in 2016, production of cereals per capita was 201.9 kg, well below the national (526.9 kg) and provincial (395.1 kg) figures. In the low lands, rice is the main crop in the cropping system, though other crops (e.g., garlic and onions) are making headway among the farmers. In the uplands, fruit (mango) and nut (cashew) trees, and annual crops (e.g., cassava and peanut) are the major crops. Rice remains the favoured staple food, and cashew and peanuts are largely grown as cash crops.

The agricultural landscapes differ depending on the geographical location. Crop production and agroforestry systems dominate the agricultural landscape in the middle and southern districts (Khanh Vinh, Dien Hanh, Khanh Son and Cam Ranh). In the upper half of the province (Van Ninh, Ninh Hoa and Nha Trang), fisheries is the most prominent activity, followed by forestry and crop production.

Before Typhoon Damrey, the weather conditions in 2017 were considered favorable, with higher prices for some major crops (e.g., rice, sugarcane, corn), and lower prices for animal feed. Other agricultural products were hit by disease, and were priced lower due to poor quality. This led to domestic products being banned from export to China, and replaced by cheaper US food products. Aquaculture was affected by erratic weather conditions that changed the salinity and acidity conditions of ponds, lowering the health of the farmed species.

3.4.2 Assessment of Disaster Effects

The overall impact on the agriculture sector (see table 3.13) is estimated at VND 5,346,420.3 million, of which VND 1,495,151.4 million correspond to crop production, VND 69,389.2 million to livestock, VND 2,141,834.7 million to fisheries, and VND 1,649,045 million to forestry. The typhoon trajectory crossed through the upper-middle area of the province, affecting the fisheries and perennial crops subsectors the most. The facilities and infrastructures of the agriculture sector were impacted to a lesser extent. As per the damages reported by the provincial government, the main causes of impact are the strong winds and flooding caused by Typhoon Damrey.

TABLE 3.13: Damages and Losses in the Agriculture, Livestock, Fisheries and Forestry Sectors by District (million VND)

District	Subsector				TOTAL
	Agriculture	Livestock	Fisheries	Forestry	
Cam Ranh City	26,136.8	260.6	408,764.4	3,526.6	438,688.4
Dien Khanh District	191,082.0	—	0.0	—	191,082.0
Nha Trang City	111,307.3	42,612.5	1,039,796.9	356,460.8	1,550,177.5
Ninh Hoa Town	300,379.8	15,830.9	92,190.1	560,951.4	969,352.2
Khanh Vinh District	164,372.8	1,093.5	0.0	385,104.1	550,570.4
Cam Lam District	400,977.2	1,230.5	62,472.6	115,703.1	580,383.4
Khanh Son District	49,764.9	6.6	9,114.0	108,269.3	167,154.8
Van Ninh District	251,130.5	8,354.7	529,496.8	110,029.7	899,011.7
Total	1,495,151.4	69,389.2	2,141,834.7	1,640,045.0	5,346,420.3

Note: — = not reported.

FIGURE 3.6: Damages and Losses in the Agriculture, Livestock, Fishery and Forestry Sectors

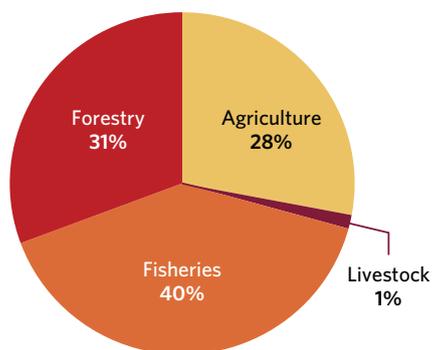
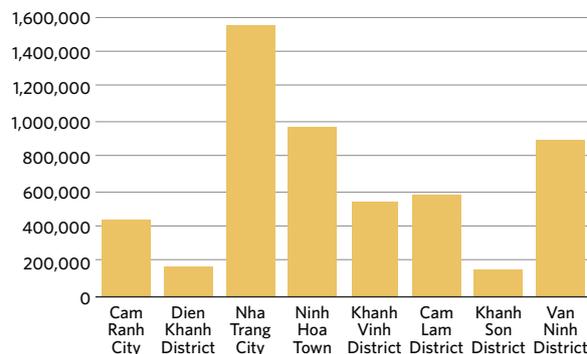


FIGURE 3.7: Damages and Losses in the Agriculture, Livestock, Fishery and Forestry Sectors by District (million VND).



The most affected districts were located in the upper-middle area of the province: Nha Trang City (VND 1,550,177.5 million), followed by Ninh Hoa Town (VND 969,352.2 million) and Van Ninh District (VND 899,011.7 million). Damages and losses by sector and by district are shown in figures 3.6 and 3.7. Affected cities and districts can be clustered into three groups:

- Cluster 1: those districts where the most affected subsector was crop production: Dien Khanh City and Cam Lam District,
- Cluster 2: those districts where the most affected subsector was fisheries: Cam Ranh City, Nha Trang City, and Van Ninh District, and
- Cluster 3: those districts where the most affected subsector was forestry: Khanh Vinh District, Khanh Son District, and Ninh Hoa Town.

3.4.3 Damages and Losses in Agriculture and Forestry

Based on the reports submitted by the provincial government, the total area damaged by the Typhoon Damrey is estimated at 59,392.7 ha (table 3.14). The most affected district was Ninh Hoa town, with over 26,141.5 ha damaged, followed by Khanh Vinh District (10,764.2 ha) and Cam Lam District (7,998.7 ha).

In terms of value of lost production, Ninh Hoa town was the area most hardly hit, with a combined effect of damages and losses of VND 861,331.2 million. Over two thirds of this amount were caused by losses in forestry (VND 560,951.4 million), particularly damages to the acacia plantations. Other districts with high losses are Khanh Vinh District (VND 549,475.9 million), Cam Lam District (VND 516,680.3 million) and Nha Trang City (VND 467,768.1 million).

TABLE 3.14: Agricultural Land Affected and Production Losses

	Land affected (Ha)	Damages and Losses (VND million)			
		Total	Annual crops	Perennial crops	Forestry
Cam Ranh City	648.5	29,663.4	2,752.9	23,384.0	3,526.6
Dien Khanh District	3,881.5	191,082.0	14,929.1	176,152.9	—
Nha Trang City	1,905.9	467,768.1	2,007.4	109,299.9	356,460.8
Ninh Hoa Town	26,141.5	861,331.2	135,334.3	165,045.4	560,951.4
Khanh Vinh District	10,764.2	549,476.9	27,246.2	137,126.6	385,104.1
Cam Lam District	7,998.7	516,680.3	17,234.6	383,742.6	115,703.1
Khanh Son District	2,468.7	158,034.2	1,733.2	48,031.7	108,269.3

	Land affected (Ha)	Damages and Losses (VND million)			
		Total	Annual crops	Perennial crops	Forestry
Van Ninh District	5,583.6	361,160.2	7,584.9	243,545.6	110,029.7
TOTAL	59,392.7	3,135,196.4	208,822.8	1,286,328.7	1,640,045.0

Note: — = not reported.

Going by subsector, the cultivated area with perennial crops, especially fruit trees, was seriously affected. The aggregated impact totals VND 1,286,328.7 million, especially due to the losses in Cam Lam District (VN 383,742.1 million) and Van Ninh District (VND 243,545.6 million). The perennial crops whose cultivated area was more seriously affected were mango (5,078.6 ha), cashew (4,214 ha) and banana (2,322.9 ha). Most of the damages reported in forestry refer to areas with plantations of acacia, with largely immature trees. The most affected districts are Ninh Hoa Town (VND 560,951.4 million), Khanh Vinh District (VND 385,104.1 million) and Nha Trang City (VND 356,460.8 million). The typhoon had a relatively minor impact on the production of annual crops, estimated at VND 208,822.8 million. More than half of that amount (VND 135,334.4 million) is attributed to the combined damages and losses in the annual crops cultivated in Ninh Hoa Town.

Floods are considered to have reduced the 2017 output of the agricultural activity by about 129,110.9 tons (table 3.15). This lower output translates into estimated economic losses in the amount of VND 413,624.7 million, of which VND 208,822.8 million corresponds to annual crops and VND 204,802 million to perennial crops. The bulk in volume and value of the losses for annual crops corresponds to sugarcane, with over 103,160.1 tons lost (valued at VND 101,096.9 million) and to cassava, with 9,421 tons lost (valued at VND 32,246.2 million). These losses are the result of the disaster timing, at the beginning of the winter-spring season after most of the spring-autumn rice crop had been harvested. Farmers had to wait for the water to recede from the flooded crop fields which delayed the planting of winter and winter-spring season.

TABLE 3.15: Losses to Crop Production

Production Loss	Quantity (ton)	Value (million VND)
Annual Crops	123,741.4	208,822.8
Perennial Crops	5,369.6	204,802.0
TOTAL	129,110.9	413,624.7
Perennial Crops (7 years)	28,152.3	1,081,526.7

For perennial crops, about 80 percent of the lost output is accounted for by damaged production of mango (1,490.2 tons), banana (1,055 tons), coconut (885 tons) and cashew nuts (879.7 tons). In value terms, 84 percent of the losses are accounted for by mango alone (VND 71,680.3 million). The damages in these plantations will continue to have an impact over several years, before the trees can bear fruit again, assuming that the necessary rehabilitation and replanting work is carried out. Factoring these figures into a 7-year time frame, the losses are estimated to exceed 28,152.3 tons and VND 1,081,526.7 million, with mango (VND 761,311.6 million) and coconut (VND 168,494.1 million) accounting for about 87 percent of that amount.

3.4.4 Damages and Losses in Livestock

Compared to the other subsectors, livestock has suffered a relatively minor impact. The available pre-flood stock before the typhoon hit (table 3.16) was estimated at 88,284 large animals (cattle, buffalo and horse), 180,852 small animals (goat, sheep and pig) and 2,956,208 heads of poultry (chicken, duck and quail). Following the disaster, the current estimates indicate that 595,971 animals are reported dead, of which 164 are large animals, 4,539 are small animals, and 591,268 are poultry birds. In the pre-flood stock, these numbers represent 0.2 percent of large animals, 2.5 percent of small animals and 20 percent of poultry birds. The total figures correspond to about 18 percent of the existing pre-disaster stock.

TABLE 3.16: Damage and Loss to Livestock

Districts	Large Animals (head)	Small Animals (head)	Poultry (head)	Damages (million VND)	Losses (million VND)
Pre-flood Stock	88,284	180,852	2,956,208	—	—
Dead Livestock	164	4,539	591,268	—	—
Cam Ranh City	1	17	2,228	233.4	27.2
Nha Trang City	113	2,768	360,616	38,167.0	4,445.4
Ninh Hoa Town	22	1,059	137,982	14,181.1	1,649.8
Khanh Vinh District	5	68	8,858	979.2	114.2
Cam Lam District	6	75	9,767	1,101.8	128.6
Khanh Son District	—	—	42	5.9	0.7
Van Ninh District	17	551	71,774	7,483.6	871.1
% of pre-flood stock	0.2%	2.5%	20.0%	—	—
Total				62,152.1	7,237.1

Note: 'Large animals' refers to cattle, buffalo and horse. 'Small animals' refers to goat, sheep and pig.

Totally, 4,539 animals raised for meat production and 11 milk-producing animals were reported dead. The damages total VND 62,152.1 million and the losses to VND 7,237.1 million, mostly in meat production. The combined loss totals to VND 69,389.2 million.

3.4.5 Damages and Losses in Fisheries

Fishing is the most important and primary activity in the province. Fisheries resources reported by GSO comprise aquaculture facilities, and both sea and inland catches. The available 2017 statistics (table 3.17) show that out of 4,766 ha used for aquaculture farming in the province, almost half (2,136 ha) was used for shrimp farming, over one third was used for farming other products (e.g., mollusk, clam, snail) and the remaining 816.7 ha was used for fish farming. The combined total for aquaculture production and fishing was above 87,774.8 tons¹³, of which 12,577.9 tons were from aquaculture farming and 75,196.9 tons came from sea and inland catches. The value of this production amounts to VND 7,280,560.5 million, with 62 percent coming from sea catches (VND 4,523,428.9 millions) and 25 percent coming from aquaculture production of shrimps (VND 1,796,248.4 millions). By type of vessel, 46,226.9 tons and VND 2,780,757 million are estimated to be generated by boats with over 90 Cheval Vapeur (CV).

TABLE 3.17: Fishery and Aquaculture Production and Value in 2017

	Area (ha), Boats (unit)	Output (tons)	Output Value (million VND)
Total Aquaculture and Catches		87,774.8	7,280,560.5
Aquaculture Production	4,766.0	12,577.9	2,757,131.5
... of which	fish	816.7	272,523.3
	shrimp	2,136.0	1,796,248.4
	other	1,813.3	688,359.8
Catches & boats	5,965	75,196.9	4,523,428.9
... of which	Sea catches	75,048.9	4,509,041.8
	Inland fishing	148.0	1,251,857.9

¹³ In the estimates of damages and losses for fisheries, the damage to cages and the relevant losses are excluded. In the catches, products without price provided are not included in the calculations. Additional clarifications can be found in the methodological note.

		Area (ha), Boats (unit)	Output (tons)	Output Value (million VND)
... of which	< 20 CV	3,308	10,418.7	626,730.7
	20-90 CV	1,877	18,551.3	1,115,941.1
	> 90 CV	780	46,226.9	2,780,757.2

Source: Calculated from GSO data.

Note: Annual reports by GSO span the beginning of September to the end of October of the following year.

Damages reported by the provincial government and the districts amount to a total of 2,747.6 ha lost and 1,609 boats and vessels damaged (table 3.18). Out of the damaged area in aquaculture ponds, 255.5 ha corresponds to fish ponds, 1,475 ha to shrimp ponds, and 1,071.1 ha to ponds farming other products such as mollusc and clam. Of the 1,609 damaged boats, 1,124 boats were of less than 20CV, 450 boats of 20-90 CV, and 26 ships of over 90 CV. Going by severity of damage, 1,003 units were completely damaged and irreparable, 356 were very heavily damaged, and 249 were heavily damaged.

TABLE 3.18: Damages and Losses to Fisheries

		Damaged Area (ha), Boats (units)	Lost output (ton)	Value of lost output (VND million)
Aquaculture	2,747.6	7,308.4	1,650,867.8	
... of which	fish	255.5	2,235.6	144,001.6
	shrimp	1,475.0	2,949.0	1,094,724.9
	other	1,071.1	2,123.7	412,141.3
Catches & Boats	1,609	6,773.0	407,426.3	
... of which	< 20 CV	1,124	3,207.5	192,945.2
	20-90 CV	459	2,818.8	169,561.2
	> 90 CV	26	746.7	44,919.9
TOTAL	14,081.4	2,058,294.1		

The losses are estimated at 14,081 tons of product, of which 7,308.4 tons are due to damages in the aquaculture ponds and 6,773 tons are due to damages to boats. In terms of value, the losses in aquaculture farming were estimated at VND 1,650,867.8 million, almost four times higher than the losses in sea captures and inland fishing (VND 407,426.3 million). The ponds with highest losses were those farming shrimp and lobsters, with an estimated production loss of 2,949.0 tons, valued at VND 1,094,724.9 million.

By district (table 3.19), the largest affected areas of aquaculture are in Nha Trang City (1,338.8 ha, of which 1,099.4 ha are shrimp farms), Cam Ranh City (868.3 ha, used almost exclusively to farm other products, such as mollusk, clam and snail), and Van Ninh District (352.2 ha, used for shrimp farms). In terms of value, the major losses are to the facilities, in shrimp farms (VND 1,094,724.9 million). Most of these heavily damaged facilities are in shrimp farms in Nha Trang City (VND 816,027.1 million), the mollusk farms in Cam Ranh City (VND 351,229.2 million) and the fish farms in Van Ninh District (VND 261,367.3 million).

TABLE 3.19: Damages and Losses in Aquaculture Farming by District

Districts	Affected Area (Ha)			Losses (VND million)			
	Total	Fish	Shrimp	Total	Fish	Shrimp	Other
Cam Ranh City	868.3		1.5	352,343.8		1,114.6	351,229.2
Nha Trang City	1,338.8	239.3	1,099.5	950,914.6	134,887.6	816,027.1	
Ninh Hoa Town	43.7			17,700.0			17,700.0
Cam Lam District	128.5		21.8	59,428.0		16,215.9	43,212.2
Khanh Son District	16.2	16.2		9,114.0	9,114.0		
Van Ninh District	352.2		352.2	261,367.3		261,367.3	
TOTAL	2,747.6	255.4	1,475.0	1,650,867.8	144,001.6	1,094,724.9	412,141.3

DAMAGES AND LOSSES



3.4.6 Recovery needs

Following the criteria set out in Decree No. 02/2017/ND-CP, the provincial government estimated that the total needs to be covered in the agriculture sector are VND 1,756,531 million, of which VND 305,781 million can be allocated to beneficiaries eligible under the above mentioned decree (table 3.20). The available funding (VND 263,395 million) is fully allocated to cover the needs of those eligible beneficiaries. The resulting funding gap is about VND 1,493,136 million, of which VND 42,386 million corresponds to the gap in funding to support eligible beneficiaries.

TABLE 3.20: Needs and Funding Gaps for Typhoon Damrey Recovery

	Needs	Available funding	Funding gap
Agricultural support following Decree No. 02/2017/ND-CP	1,756,531	263,395	1,493,136
- for beneficiaries eligible under the Decree	305,781	263,395	42,386
- for beneficiaries ineligible under the Decree (including VND 40 billion support for ship owners)	1,450,750		1,450,750

In total, our own estimates of the needs for agricultural support following Decree No. 02/2017/ND-CP are VND 1,508,482.4 million, below the government estimates of VND 1,756,531 million. Disaggregated by district, the available funding is distributed as shown in table 3.21. Our own calculations of the needs for the sectors, following the criteria defined by the Decree 02/2017/ND-CP, are shown in the last row at the bottom of the table. The larger needs are for the crop production and forestry subsectors, followed by aquaculture and by livestock. Following the same criteria, our own estimates of the additional needs associated to aquaculture, sea farming (cages), and fishing boats are VND 1,243,785.5 million.

TABLE 3.21: Needs and Funding Gaps for Typhoon Damrey Recovery by District

District	Crop production, Forestry and Salt production	Animal Husbandry	Aquaculture (excluded fishing boats)	Total by District
Nha Trang	4,400	1,799	73,037	79,276
Cam Ranh	755	23	5,532	6,310
Ninh Hoa	71,583	13,266		84,989
Van Ninh	23,850	4,291	19,644	47,785
Dien Khanh	31,693	11,481		43,173
Cam Lam	20,513	266	2,768	23,547
Khanh Vinh	15,524	447		15,971
Khanh Son	4,853	15	2	4,870
Total by Subsector (by the government)	173,171	31,588	100,983	305,921
Total by Subsector (own calculations)	160,260	26,854	77,582	264,697

Fisheries remained largely unattended despite the efforts by the Khanh Hoa PPC. Further analysis on the items eligible to be funded (table 3.22) shows that most of the damages on crops, forestry and livestock are eligible for support. Yet the support allocated to fisheries only covers 4 percent of the needs to support small ponds and 6 percent to support off-shore cages, representing about one third of the total estimate of VND 305,742 million.

TABLE 3.22: Sector Needs Eligible and Non-eligible for Support

	Eligible for Support & Estimated Needs			Non-Eligible for Support		Total (units)
	(units)	Share (%)	(VND million)	(units)	Share (%)	
Crops (ha)	40,804.1	93	173,171	3,044.5	7	43,848.6
Forestry (ha)	19,028.7	74		6,760.2	26	25,788.9
Livestock (head)	596,029	57	31,588	451,013	43	1,047,042.0
Fisheries (ha)	425,623		100,983	6,199,868.7		6,625,491.6
Small ponds (ha)	122.9	4		2,624.7	96	2,747.6
Off-shore cages (m³)	425,500.0	6		6,197,244.0	94	6,622,744.0
TOTAL			305,742			

RECOVERY NEEDS



Agriculture

VND 1.0 TRILLION



Fisheries/aquaculture

VND 1.2 TRILLION



Livestock

VND 0.3 TRILLION





4. Economic Impacts

4.1 Regional Economic Development before Typhoon Damrey

In 2016, Khanh Hoa's GDP, or the total value added from production activities in the province, was equal to VND 54.3 trillion¹⁴. The amount is equal to VND 41.4 trillion if it is valued at 2010 prices. Khanh Hoa's GDP is roughly equivalent to 1.4 percent of Vietnam's GDP. Therefore, the impact on Khanh Hoa's GDP will not affect the overall economic growth of Vietnam.

Service sector is the largest contributor to GDP. The sector includes the following subsectors: wholesale and retail trade, transportation, hotel and restaurant, information and communication technology (ICT), financial and professional services, and government services. These contribute to about 55 percent of the total GDP. Industry and construction contribute to about 34 percent of GDP, while agriculture, forestry, livestock and fishery sectors contribute to about 11 percent of GDP.

The economy of Khanh Hoa province was growing steadily during the pre-Typhoon Damrey period. GDP grew by 8.5 percent in 2016, higher than overall GDP growth in Vietnam, which grew by 6.2 percent in 2016. For 2017, the Khanh Hoa province GSO estimated the GDP growth at about 8.2 percent, slightly lower than 2016 growth (figure 4.1), but still higher than Vietnam's estimated GDP at 6.8 percent. This estimate for 2017 has not been adjusted for the impact of Typhoon Damrey that happened in the last two months of 2017.

Slower growth in 2017 is mainly due to slower growth in agriculture, industry, and construction sectors, while growth in the services sector remained strong at 9.5 percent. The contribution of agriculture, industry and construction sectors to GDP growth declined slightly. Contribution of agriculture declined from 4 percent to 3.5 percent, while contribution of industry and construction declined from 35 percent to 33 percent. The contribution of services sector increased from 61 percent to 63 percent.

¹⁴ If net product taxes (taxes on products minus subsidies on production) is included, total GDP in current price would amount to 62.35 trillion VND.

Prior to Typhoon Damrey, the Department of Planning and Investment (DPI) projected that economic growth in 2018 would slow down. Growth was projected to reach 7.6 percent, slower than what was achieved in 2016 and 2017 (8.5 and 8.2 percent, respectively). This slow-down was particularly expected in agriculture and services sector. Agriculture growth was projected to decline from 2.6 percent in 2017 to 2.1 percent in 2018, and growth in the services sector was projected at 8.3 percent, significantly lower than 2016 growth of 9.5 percent. Only construction and industry sector's growth projection was slightly increased from 8 to 8.1 percent. This lower growth projection for 2018 might be due to the notion of GDP growth as "target" to be achieved by the provincial government, resulting in a tendency to set the projected rate of growth more conservatively.

GDP growth in 2018 was projected to decline sharply, from 7.9 percent in 2017 to 1.3 percent in 2018, if net tax on production is included. This was due to the expected losses in import tax on petroleum that would no longer be collected in Khanh Hoa once the Nghi Son refinery began operation in Thanh Hoa province. However, since tax on petroleum import is centrally collected, the revenue losses will not be borne by the Khanh Hoa provincial government.

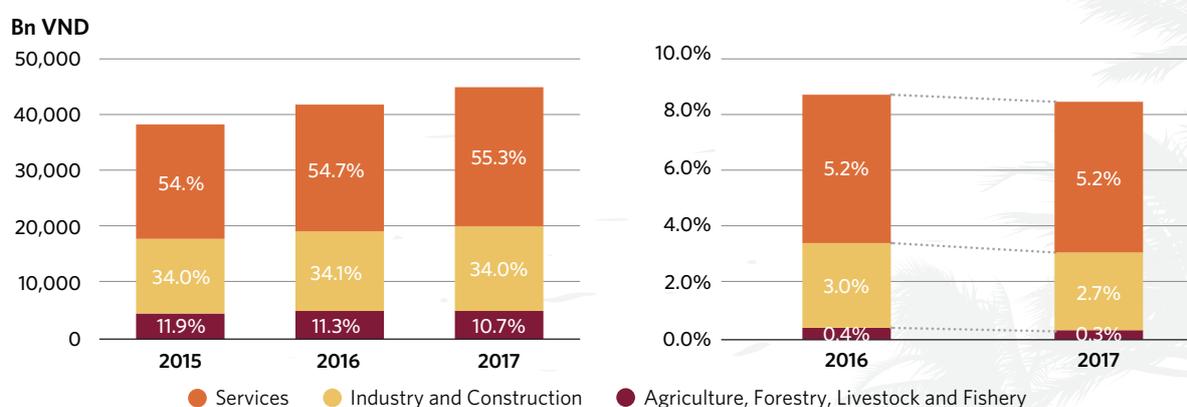
4.2 Damage and Losses due to Typhoon Damrey

The impact of the typhoon was felt in damage to physical assets such as buildings, land, and equipment, and losses in production flows. Total damages reduced capital stock which may affect future flow of GDP, while total losses reduced GDP in the years when it happened. The comparison between total damage and losses and GDP (table 4.1) reflect the magnitude of the disaster impact, which may also be useful for comparison with other cases of disaster.

Due to data availability constraints, this rapid damage and needs assessment is mainly focused on estimating the value of damage and recovery needs. It only estimates losses in agriculture (including livestock, fishery, and forestry) sector. It assesses damages in the housing, irrigation/flood control, and agriculture sectors. The coverage of the current assessment is similar to that of the rapid flood damage and needs assessment, done after heavy floods affected five provinces in Vietnam in 2016¹⁵. Therefore, comparison of the impacts of these two disasters is plausible.

Typhoon Damrey's disaster impact in Khanh Hoa province in 2017 is nearly double the combined impact of the 2016 floods in the 5 provinces. The damage and losses when measured in constant 2010 prices are 80 percent higher than the 2016 disaster, and the ratio to total GDP of Vietnam is 68 percent higher. As a proportion to Khanh Hoa provincial GDP, the total disaster impact constitutes to about 15.8 percent of Khanh Hoa GDP for 2017.

FIGURE 4.1: Sectoral Contribution to GDP and GDP Growth



¹⁵ World Bank conducted a post-2016 flood's rapid assessment of damages and needs in the five Central Region provinces of Ha Tinh, Quang Ngai, Binh Dinh, Phu Yen and Ninh Thuan. The report is available at https://www.gfdr.org/sites/default/files/publication/Vietnam%20Rapid%20Damage_FinalWebv3.pdf

TABLE 4.1: Damage and Losses: Post-Damrey in Khanh Hoa vs. Post-2016 Floods in Five Provinces

	Damrey	2016 floods
Total Damage (VND billion)	4,397	3,306
Total Agriculture Losses (VND billion)	5,201	1,855
Total Damage and Agriculture Losses in Current Prices (VND billion)	9,598	5,161
Total Damage and Agriculture Losses in 2010 Prices	7,065	3,939
Total D&L to Vietnam GDP of the disaster year (%)	0.22	0.13
Total D&L to the provincial GDP of the disaster year (%)	15.8	—

Note: D&L= Damage and Losses; — = not available.

Source: Rapid Damage and Needs Assessment.

4.3 Impact of Disaster to Provincial GDP

The provincial GDP estimates from Khanh Hoa government (produced jointly by the GSO and DPI for 2017) **have not been adjusted to the disaster impact**. The general view is that the impact to 2017 GDP is likely to be small because the disaster happened when the spring-autumn crop had been harvested. However, information from several government departments that supervise productive sectors such as tourism, trade and industry, suggests that temporary revenue losses may have occurred in the days following the typhoon due to damage to facilities such as hotels, restaurants, and agro-processing industries. However, these revenue losses are difficult to estimate due to unavailability of data from affected private enterprises.

The Khanh Hoa provincial government estimated that GDP growth in 2018 would decline by 0.9 percent compared to baseline projection (see tables 4.2 and 4.3, and figure 4.2 below). Furthermore, agriculture sector (agriculture, livestock, fishery and forestry) is expected to contract by 2.6 percent from 2017, while the other two main sectors are expected to continue growing, albeit at a lower rate than the baseline projection. The value of agriculture GDP reduction between 2017 and 2018 is estimated to be about VND 125 billion in 2010 prices or VND 173 billion in 2018 prices (assuming GDP deflator of 1.38).

TABLE 4.2: 2017-2018 GDP Estimates for Khanh Hoa Province

	2017	2018 (Projection)	
		Baseline	Revision
GDP growth (excluding tax)			
Total GDP	8.21	7.6	6.7
Agriculture	2.62	2.1	-2.6
Industry and Construction	8.05	8.1	7.4
Services	9.47	8.3	8.1

Source: Khanh Hoa DPI.

The assessment of losses—required for estimating the disaster impact to GDP—in the post-Damrey damage and needs assessment in Khanh Hoa was limited to the agriculture sectors (including livestock, fishery and forestry). Therefore, this section on macroeconomic impact of the disaster will mainly discuss the impact to the agriculture GDP. The total agricultural production loss (measured in 2018 prices) post-Damrey was estimated to be VND 5.35 trillion. The total 2018 production losses are estimated to be about VND 4.56 trillion. By multiplying the losses with the value-added coefficient from the Input-Output table¹⁶, the estimate of production losses was transformed into agriculture GDP losses. As shown in table 4.3, the estimated reduction in agriculture GDP is VND 1.77 trillion, about 10 times more than the government's projection of VND 173 billion.

¹⁶ Monthly Statistical Reports in 2017 and 2018, Statistic Office based in Khanh Hoa province.

TABLE 4.3: Impact of the Disaster to Agriculture Sector GDP in 2018*

	Production Losses**	Value Added Coefficient	Losses in Value Added/GDP**
	(VND billion) 2018		(VND billion)
Annual Crops	208.82	0.45	93.97
Perennial Crops	648.92	0.45	292.01
Forestry	1,640.05	0.45	738.02
Livestock	7.24	0.45	3.26
Fishery	2,058.29	0.31	638.07
Total	4,563.32		1,765.33

Note: * Including livestock, fishery and forestry; ** In 2018 Prices

The assessment also estimated losses of about VND 204.8 billion in perennial crop production in 2017. This translated to about VND 67.8 billion reduction in real agriculture GDP of Khanh Hoa province during 2017. As a result, taking into account the impact of the disaster, the 2017 agriculture GDP shrank by 1.2 percent (compared to 2.6 percent per government estimate). As a result, Khanh Hoa GDP grew to 8.0 percent in 2017, down from the official estimate of 8.2 percent. The reason for this gap is that the government estimate did not take the disaster impact into account. In 2018, the rapid damage and needs assessment estimated that agriculture GDP will contract by 27.1 percent, resulting in 2018 GDP growth of only 4.1 percent, down from the official estimate of 6.7 percent (see figure 4.2).

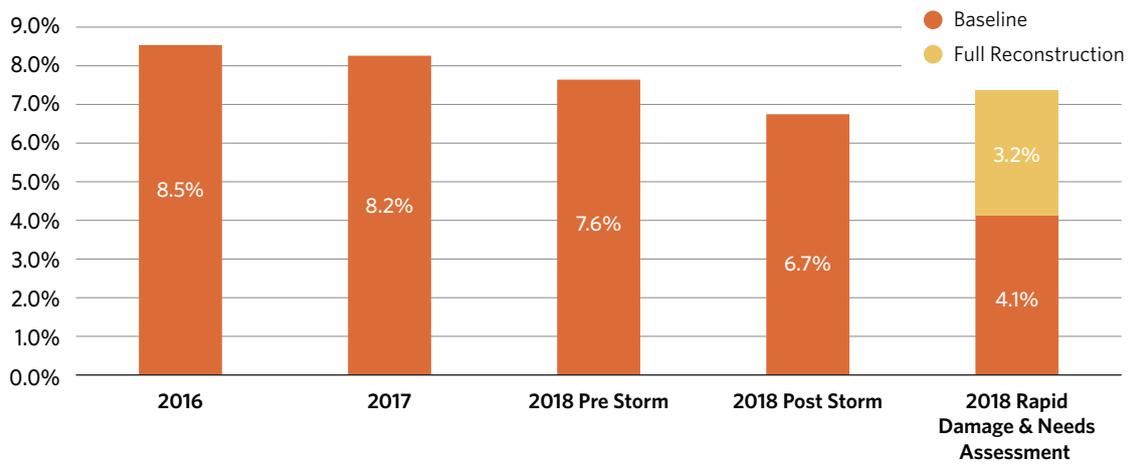
GPD GROWTH REDUCTION:



4.4 Accounting for Reconstruction and Recovery Impact

The impact of Typhoon Damrey to GDP losses reflect the decline in the sectoral value added in Khanh Hoa province. It is these added sectoral values that will be distributed as incomes that are then invested in labor and capital. Hence in general, GDP losses will lead to lower economic welfare. Following disasters, loss in GDP can be mitigated by speedy relief, reconstruction, and recovery activities. For example, if the total reconstruction needs for housing, transport, and irrigation/flood control sectors as estimated in this assessment which amount to VND 7.5 trillion can be fulfilled, this would result in the creation of value added in the construction sector of about VND 1.4 trillion. This will elevate the post disaster growth estimate by 3.2 percent. This estimation has not included any forward or backward linkages, or multiplier effects from the final demand.

However, funding gap (needs minus available funds) for reconstruction is quite large. As discussed previously, available public funding for reconstruction in the three sectors (housing, transport, and irrigation/flood control) are only VND 259.9 billion, about 45 percent of the funding needed. If we assume that 90 percent of households will be able to meet their own housing reconstruction needs (including government support), the current available public funding for reconstruction of irrigation and transport sectors will deliver additional growth of about 2.9 percent (see figure 4.2).

FIGURE 4.2: Khanh Hoa Province GDP Growth, Disaster and Reconstruction Impact*

Source: Khanh Hoa DPI 2016-2018 government projection.

Note: * GDP by Economic Sector (excluding net product taxes).



5. Recovery, Reconstruction and Disaster Risk Reduction

5.1 Recovery and Reconstruction Principles and Strategy

The section provides essential information to assist all relevant stakeholders in formulating a framework and principle for the immediate, and medium- to long-term post-disaster recovery. This framework will help in defining the recovery strategy which includes prioritizing actions and providing guidance on financing, implementing, and monitoring the recovery.

Additionally, by developing a framework, the authorities will be able to better address longer term disaster vulnerability through coherent programs that bridge the current gap between recovery and development. Such programs include addressing disaster-resistant housing, building code enforcement, safety nets, green growth, and climate change resilience. As a result of developing its recovery framework, a government would be able to prioritize disaster risk reduction and resilience measures within both its short- and long-term development goals.

Another important initial step in setting up a recovery framework is the articulation of the recovery guiding principles. They enable the government to convey its recovery priorities to the public and to stakeholders. Outlining guiding principles for recovery is important to ensure effective transition from the immediate humanitarian response to the medium- to long-term recovery.

5.1.1 Immediate or Short Term Recovery and Reconstruction

“Building back better” with the integration of DRR measures into recovery and reconstruction should be taken into account in the immediate term to ensure that all construction work, housing, crops, etc. are resilient to future natural disasters. In this phase, the restoration of access to basic services and infrastructure is given priority to enable affected communities to resume normal life.

Housing is always a post-disaster priority, and is well supported by the Khanh Hoa provincial government, given the fact that funds for house repair and rebuild are promptly disbursed to eligible households. However, there are large numbers of households that are not eligible for such support. In the immediate term, regulations should be in place to provide financial support not only to households that fall under eligible category, but also to those households that fall under ineligible category but are still in need of support.

Needed support for livelihood recovery through distribution of seeds, seedlings, fertilizers, pesticides, animal feed, vaccinations, fingerlings, etc. should also be included under support for immediate or short term recovery plans. Financial support for livelihood recovery should also be given priority in the short term.

5.1.2 Medium to Long Term Recovery and Reconstruction

“Building back better” in this phase succeeds through a cross-sectoral approach to address institutional, social and financial aspects of recovery and reconstruction, as discussed below.

Institutional arrangements: The arrangement aims to have an entity for core functions of planning and oversight to meet recovery objectives. Within the DRM institutional arrangement, Khanh Hoa CNDPC should also be designated as an agency to take the lead role in planning and coordinating recovery. To ensure effective political and technical leadership, the PPC should hold consultations with relevant agencies to come up with a clear mandate for a lead agency. The lead agency would oversee the development of the recovery framework and would play a critical role in its implementation. It may also play a central role in the coordination, oversight, and monitoring and evaluation (M&E) of the recovery process.

Capacity building: The recovery process should become an opportunity to strengthen the governance structures, particularly at the local level. The lead agency and other related agencies of Khanh Hoa province should initiate the recovery process in cooperation with other technical agencies such as the UN and INGOs to provide needed capacity building support in recovery planning, financing, procurement, etc.. The capacity building component should be implemented in parallel with the development of a “Manual on Standard Operating Procedures in Disaster Recovery”. Providing detailed guidance for the recovery of common sectors such as housing and agriculture which will help district and commune level staff to:

1. Reconfirm information on damages more accurately;
2. Collect and calculate data on losses; and
3. Collect information on needs and priorities.

Enhancing the participatory approaches and decentralized planning and programming: For a successful and sustainable recovery and reconstruction process, it is very important that the affected communities have ownership, and be included in decision-making. The lowest administration level is in charge of planning, programming and decision-making under such participatory and decentralized approaches, which should be strongly promoted throughout the whole process of recovery and reconstruction.

Gender sensitivity: Particular attention should be paid, in the assessment, planning and programming stages for recovery, to the vital role that women play as community members and leaders, and the special problems they may face, such as property rights issues, and additional responsibilities they bear as heads of households in particularly difficult circumstances. This will lead to the identification of adequate, gender sensitive programming in the recovery, reconstruction and ensuing development plans, which will in turn help communities recover faster from climate disasters.

Financing mechanism: Mobilization of funds and coordination mechanisms that channel funds to the implementation entities in a timely manner are critically important for recovery from disasters. Recovery may be funded through

government funds, international aid, private sector financing, and community contribution. To manage recovery in a holistic manner, it is recommended that the government have an effective fund tracking mechanism for both on-budget and off-budget funds. A good fund tracking mechanism along with a strong public financial management system enhance donor confidence and help in mobilizing additional funds for recovery. It is important to implement a system of budget mobilization and monitoring prior to the recovery and reconstruction phase.

Contributing to the economic revitalization of the affected communities: Recovery activities should contribute to the revitalization of the economy of the affected communities through the revival of production (agriculture, industry), trade and service sectors, and through the creation of income-generating employment opportunities.

Integrate the resilient infrastructure design in all sectors: Linking hazard mapping with land use/urban plans will integrate and strengthen resilience across sectors. An integrated data management system, including standard-compliant spatial data infrastructure and risk information platforms, is essential for spatial planning, infrastructure development, and operations and maintenance. Such a system would visualize the potential risks and alternatives for safeguarding socioeconomic development, and help immensely in recovery and reconstruction efforts after a disaster strikes.

Monitoring, evaluating and learning: Recovery programs and plans must include appropriate, participatory monitoring and evaluation mechanisms that allow timely implementation of corrective measures, capturing the experience and the voices of the target population. Having a good monitoring and evaluation process in place will promote overall guidance and improve coordination among stakeholders.

Mainstreaming DRR in the recovery and reconstruction process: DRR can be integrated into the recovery and reconstruction process by:

1. Ensuring that all recovery proposals are supported by multi-hazard risk assessments and that appropriate measures to manage and reduce risks are included;
2. Ensuring that appropriate information about disaster risk is available and is taken into consideration in the decision making process;
3. Establishing criteria on acceptable levels of risk and
4. Reinforcing disaster management capacities at local, provincial and national level.

5.2 Recovery and Reconstruction Framework for Key Sectors

5.2.1 Housing

The Provincial DoC, as part of its program of providing design guidance, provided plans and costs for two recommended housing types. Both types are simple, with a single storey and mono-pitch roofs, with dimensions and cost estimates as shown below:

Type 1 House:	Area: 21m ² ; Plan 7m x 3m with enclosed area of 18m ² Estimated Cost: 42.3 million VND
Type 2 House:	Area: 25.5m ² ; Plan 8.5 x 3m with enclosed area of 22.5m ² Estimated Cost: 49.5million VND

Owners had the option to follow these designs or to change them, for example, by making them larger. All plans and construction needed approval and payments were made in two installments. The local government rebuilt homes in ethnic minority areas.

The DoC provided construction advice to local builders engaged in the post-typhoon reconstruction. Development Workshop France (DWF) also worked

with local builders and householders in the affected districts, providing technical assistance to improve storm resilience of foundations and roofs, in particular.

The MoC produces an atlas of recommended housing designs. These designs all have a ground plan of 4m wide by 8-9 m long, with a home area of about 32-36m². Typically, these homes are 50 percent larger than recommended designs for post-typhoon reconstruction.

The Department also provided advice about temporary storm protection 2-3 days before the typhoon, having been advised of severe weather by the Meteorological Office. This consisted of various solutions for tying down flimsy roofs and for boarding up windows and cross- bracing walls.

For the short to medium term, improvements of the regulatory frameworks and policies for housing construction should be prioritized. This will support the long-term risk reduction, which requires safe land-use and construction practices to be institutionalized as a normal part of the building culture. The requirements for improvement are outlined below:

- Designation of responsibility and authority for land-use management based on hazard mapping.
- Building control standards are based on engineering principles of building safety, consistent with local cultural values and economic feasibility.
- Building control standards should also take into account amenities and comfort, and seek to progressively improve the design standards of modest housing.
- These standards should become the basis for training building professionals, the building industry and local builders.
- Compliance with these standards is checked, confirmed and enforced.

For the longer term, building insurance mechanism and schemes for housing reconstruction/repair is essential to share the burden with the public budget. Currently there is an ‘insurance gap’ in that few, if any, households have building insurance. Housing insurance is highly desirable as it would help drive improvements in housing construction and safety. The GoV should consider working with international insurance agencies to develop a home insurance program.

5.2.2 Transportation Infrastructure (Roads and Bridges)

As mentioned before, the province considered the extent of damages in the transportation infrastructure following Typhoon Damrey and subsequent rainfall to be very small. In view of this, the province decided to rehabilitate the damaged transportation infrastructure to the pre-disaster conditions, and has finalized the plan accordingly. Therefore, there are no further post-Damrey reconstruction needs to repair the damaged transportation infrastructure.

However, considering the frequent natural disasters, specifically the floods that impact the province, there is a need for comprehensive measures to improve the resilience of roads and bridges. This will enhance the capacity to withstand future impacts. Therefore, there is a need to review the current design standards in Vietnam so that they are applicable for various terrain and climatic conditions, keeping in mind the current and future prevalence and intensity of various natural disasters. Following the review, an engineering study of the existing transportation infrastructure in the province is necessary to identify the short-falls and needs to match the design standards.

The following recommendations are offered with the aim of ensuring that the road subsector in the province is more resilient to future natural disasters:

- Review the design standards at the national level, to ensure that standards are widely applicable for various terrain and climatic conditions, and promote resilient enhancing capacity to withstand various types of natural disasters. If the review cannot be done at the national level, it is in the interest of the provincial government to review it, considering the province's high susceptibility to natural disasters.
- Impose strict conditions in development plans to prevent disruption and obstruction in natural water courses, include satisfactory land drainage regulations, and avoid development in low-lying areas.
- Upgrade roads, and improve road connectivity to help efficient evacuation during disasters.
- Gradually upgrade gravel-surfaced and dirt roads to asphalt-surfaced and/or concrete roads. Concrete roads should be provided in water-logged and flood-prone areas.
- Control deforestation and manage vegetation in hill-slopes.
- Adopt good practices for protection, stabilization and improved drainage of hill-slopes.
- Allow for provision of adequate waterways across the roads, thinking ahead to a 50 year flood cycle.
- Gradually convert from Irish crossing (or causeway) to bridge to ease high flow of water.
- Strengthen protection to the abutments of the waterways, and to the embankment at immediate approaches to the waterways.
- Ensure provision of adequate surface drainage arrangement along the side of the roads, and proper maintenance thereof.
- Encourage use of stable and cohesive materials at embankment side-slopes, and implement slope protection as required to avoid erosion in stretches susceptible to high-velocity water flow.
- Allocate funding for routine and periodic maintenance of the road network at required level.
- Recognize the need for timely improvement in the quality of design and construction.

Capacity building within the province and knowledge exchange with other countries can be undertaken in the review of design standards. A similar review, capacity building and knowledge exchange process in financing and management of the transportation sector to address design and construction standards, techniques, procedures, etc., will go a long way in increasing resilience to natural disasters.

5.2.3 Flood Control and Irrigation Infrastructure (Hydraulic Structure)

For hydraulic structures, recovery, reconstruction and disaster risk reduction focuses primarily on “building back better” with engineering work that will be more resilient to natural disasters, floods/typhoons and droughts. Simultaneously, it recognizes the need for:

1. Improved water use efficiencies in the face of scarce water resources, and
2. Improved level of service, particularly to the agriculture sector, as measured by flexible and affordable irrigation supply.

These activities require investment in better management systems and tools, and staff competencies.

There are a number of engineering and management alternatives such as achieving the right balance between new reservoir construction and improved efficiency of irrigation delivery systems. There are also various options to stimulate investment in the private sector, particularly for on-farm irrigation systems such as drip and sprinkler.

Immediately after Typhoon Damrey, the IMCs carried out essential repairs needed to safeguard their assets. For example, within one week of the typhoon, IMC-North carried out temporary repairs to the Da Ban reservoir embankment, engaging a contractor to dump and place rock fill. The embankment had been damaged by waves which had dislodged protection and caused scour holes. Also, the annual maintenance budget was used to

repair erosion damage along the canals, the access roads to reservoirs, and at structures. District Agriculture and Rural Development Division staff have similarly completed the more urgent river bank protection work.

Nonetheless, the bulk of the required repair and reconstruction work remains to be completed, and will only be initiated after funds are made available. The total damage recovery requirement has been estimated at VND 2,657.7 billion, while available funds for reconstruction total just VND 790.8 million, which is only 29.8% of requirement¹⁷. The bulk of recovery funds are from central and provincial governments. Of the total reconstruction funds available, VND 123.3 billion (15.6%) are for irrigation and water resources infrastructure, sufficient to address about 30% of the reconstruction requirement.

Annual maintenance budgets for the IMCs are low, being only 0.40% to 0.53% of the book value of assets, and equivalent to about VND 0.73 million/ha. For modern canal systems, maintenance requirements are typically about 1-1.5%, or VND 2.27 million/ha¹⁸.

The shortfall in funding for maintenance and disaster recovery is made up by periodic reinvestment in water resources infrastructure. The Khanh Hoa provincial government has approved investments in water resources/irrigation infrastructure totalling VND 7.610 billion for 2016-2020. Of this amount, VND 1.07 billion (14.0%) is for the rehabilitation and modernization of 11 irrigation systems, while VND 5.29 billion (69.6%) is for four new storage reservoirs and canal irrigation systems. The remaining amount is for flood/river bank protection work (16.2%) and for drainage channels (0.2%).

Non-budgeted investment plans include:

1. VND 3,740.0 billion for other work proposed for 2016-2020, including 10 more new reservoirs and 6 irrigation systems which make up 71.4% of this amount, and
2. VND 4,725 billion proposed for 2021-2025, including 8 more new reservoirs and 4 irrigation systems which make up 71.7% of this amount.

The investment plans indicate a need and desire by the provincial government to invest in reservoir storage and irrigation schemes, with these comprising about 70% of planned investments to 2025, with 30% of investment to rehabilitate and upgrade existing schemes and for flood/river bank protection.

In identifying risk reduction measures to be considered while formulating investment plans in the water resources and irrigation sector, the following should be taken into account:

- Climate change with increasing incidence of severe typhoons, heavy rainfall and droughts¹⁹.
- On-going rapid growth in urban populations, as well as expansion in commercial activities and industrial zones. These place increasing pressure on dry season water resources.
- Government policies and plans to improve water productivity²⁰, and particularly the 2017 Law for Hydraulic Structures²¹ which includes increasing water resources (Article 4), conservation and improved efficiency in water use (Article 5), adoption of advanced technology (Article 6), formulation and approval of master plans (Article 14), private-public sector investment (Article 15), plans for natural disasters (Articles 18, 19, 20), operations (Articles 24,25,26,27), and water service charging (Articles 34. 35), and dam safety (Article 45).

¹⁷ Source: Department of Planning & Investment, Khanh Hoa Province.

¹⁸ Based on experience of authors and through participation in various irrigation projects and studies.

¹⁹ Climate variability has increased the frequency and intensity of extreme weather conditions. The El Nino Southern Oscillation (ENSO) drought of 2014-2016 was particularly bad, making this the driest period in 40 years. The 2015 Southwest Monsoon saw 40%-70% less rainfall than an average year, with a 1% probability of rainfall being any lower during the months of June to September. Dry season river flow levels dropped to between 20%-30% of the average annual flow levels, and water levels in some reservoirs dropped to below 15% of design capacities. Pumps were used to pump reservoirs below minimum (dead) storage levels.

²⁰ The government's Agricultural Restructuring Plan (ARP) of 2013 highlights the need to improve water productivity to raise efficiency and competitiveness of the sector, and place it on an environmentally sustainable footing.

²¹ Law on Hydraulic Works approved June 2017, by the XIVth National Assembly of the Socialist Republic of Vietnam at its 3rd session which aims to introduce irrigation sector reforms including water charges and water allocation rules.

Opportunities and measures for the water resources/irrigation sector may be grouped as:

1. Structural/engineering measures including reservoirs, irrigation schemes and flood/river bank protection with “building back better” part of a drive for modernization including pump-pipe irrigation systems²², and
2. Non-structural measures including improved knowledge base; data-informed reservoir and irrigation scheme operations with improved equipment and communications; improved maintenance; improvement of drought/flood mitigation strategies; and changes to cropping patterns.

5.2.3.1 Structural Measures – “Building back Better”

Increased focus on increasing the efficiency of irrigation as a part of scheme modernization is suggested, though the argument for more reservoirs to increase water resources available to meet demand through the long dry season is strong. This may delay the requirement for additional reservoirs, increase crop productivity, and stimulate involvement of the private sector to invest in drip and trickle irrigation systems for high value crops.

The irrigation schemes in the northern districts are predominantly cropped with rice, in both the monsoon and the dry season. The potential for dry season crop diversification may be explored in these schemes. There is more crop diversification in the southern districts, including perennial tree crops and vegetables. Modernization investments would improve monitoring and control of flows, with balancing storage and simple Supervisory Control and Data Acquisition (SCADA) systems likely to be justified for all schemes. Reservoir monitoring and communication should also be improved, rather than relying totally on fixed line or cellular phone communications which may fail in the event of a typhoon. In non-rice areas, additional investment in pump-pipe distribution with hydrant outlets providing water under pressure may be justified²³, leading eventually to widespread adoption of drip/sprinkler systems, meanwhile supporting hand-hose irrigation which is already quite common.

River bank protection works appear to be soundly designed and constructed, with priority given to protection of densely populated areas. Designs adopt hard concrete/rock protection. The potential for low cost flood/river bank protection using geotextile bags²⁴, and also use of grasses (e.g., vetiver) may be explored.

5.2.3.2 Non-Structural Measures

Knowledge base: An improved knowledge base would enable informed design and decision making. For further improvement of water resources, database to support new reservoir design and construction may also be included.

Data informed operations: Further improvement in operations of hydraulic structures (including reservoirs and irrigation schemes) may be achieved by data informed operations with improved equipment for remote monitoring (and control) of levels, flows, rainfall, soil moisture, crops and so on. However, this would require investment in staff capabilities and in equipped workshops to maintain equipment²⁵.

Maintenance: The key to risk reduction for both droughts and typhoons is having adequate and well maintained infrastructure. Though provincial authorities are abreast in prioritizing needs, they face budgetary constraints so that maintenance backlogs occur and have to be periodically addressed by investment projects. Further study of maintenance requirements, possibly developing improved asset management database systems, and a significant increase in annual maintenance funding is suggested.

²² Pump pipe irrigation systems are expected to be constructed in irrigation systems in Cam Lam under the ADB supported WEIDAP.

²³ This is being piloted under WEIDAP with ADB support in Cam Ranh - Suoi Dau irrigation scheme, Cam Lam District.

²⁴ As successfully adopted along the Jamuna - Padma rivers in Bangladesh.

²⁵ SCADA equipment installed at Da Ban Reservoir/Irrigation Scheme is no longer functional due to inability to manage its maintenance.

Choice of crops: Provincial master plans and investments concerning hydraulic structures depend on the choice of crop as this affects water requirement and the appropriate infrastructure and the level of service. Currently, rice is the major crop in the northern districts of the province, and diversification into non-rice crops in the dry season is recommended as an effective drought mitigation strategy.

Crop insurance: Farmers are risk adverse, and investments in efficient water application systems (drip and sprinkler) and non-rice crops will be constrained without measures to address risk, such as crop insurance. Investments in tree crops are particularly risky, as they are vulnerable to droughts or typhoons—for example, banana, papaya and pomelo are particularly vulnerable to storm damage.

5.2.4 Agriculture, Livestock, Fisheries and Forestry Sector

The estimated cost of recovery and reconstruction for the agriculture, livestock, and fisheries subsectors is VND 2,183,145.6 million. These interventions will build on and continue the efforts of Khanh Hoa PPC to deliver an adequate response and support farmers to recover and restore production and their livelihoods. Particular attention is needed for farmers who carried out these recovery and reconstruction actions by themselves and at their own risk.

5.2.4.1 Short to Medium Term Recovery Actions

In the short-term (first 12 months), the cost to achieve main priorities for each subsector will amount to VND 1,466,268.6 million (table 5.1). Recovery will focus on immediate activities aimed at the restoration of production levels.

TABLE 5.1: Short Term Recovery and Reconstruction Activities in 2018

Subsector	Program of Activity	Value (million VND)	Responsible Agency
Agriculture	Provide seeds, inputs, and financial and management support to replant annual crops	85,000.0	DARD, PPC Khanh Hoa
	Rehabilitation work, provision of seedlings, financial and management support to replant perennial crops and fruit trees (multiyear)	330,000.0	
Livestock	Provision of feed and vaccines (large animals)	7,993.5	DARD, PPC Khanh Hoa
	Provision of feed and vaccines (small animals, poultry)	5,306.0	
	Restocking of large animals (cattle)	20,940.9	
	Restocking of small animals (pigs, goats, poultry)	69,179.6	
Fisheries	Repair and restoration of damaged boats, vessels and equipment	121,134.0	DARD, PPC Khanh Hoa
	Provide seeds, fingerlings, medicines for aquaculture facilities and inland fisheries	550,000.0	
	Provision of equipment and nets	180,000.0	
Forestry	Rehabilitation work, provision of seedlings, financial and management support to replant damaged forests (multiyear)	94,714.6	DARD, PPC Khanh Hoa
TOTAL		1,464,268.6	

The recovery actions are expected to cover:

- **Distribution of seeds and other planting material, fertilizers, pesticides and financial support.** The cost for providing this assistance is estimated at VND 85,000 million. These actions will take into consideration the outcomes of the project by the PPC of Khanh Hoa on large-size paddy farming and crop transformation, through which 961.4 hectares of inefficient rice production were to be transformed into areas growing other annual crops and fruit trees by the end of November 2017. These efforts will also build on the actions led by the PPC to provide appropriate seeds for planting vegetables in the 2017-18 winter-spring season. Similarly,

the recovery actions should streamline those joint activities by the PPC and farmers aimed to actively prevent and control plant diseases. Farmers should be encouraged to use quality seeds, and to avoid varieties with an uncertain origin, which are more likely to be less resilient to diseases.

- **Distribution of animal feed, vaccinations to farmers and cattle raisers**, at a cost of VND 13,299.5 million (VND 7,993.5 million for large animals and VND 5,306.0 million for small animals and poultry) which also includes provision of veterinary services. These recovery actions will build on the actions by the PPC to reinforce the inspection and examination of farms and slaughterhouses, monitor the use of banned substances on livestock, and enforce quarantine periods on animals and animal products across the province.
- **Distribution of seeds, fingerlings, and medicines for aquaculture facilities and inland fisheries ponds**, at a cost of VND 550,000 million.

The reconstruction actions are:

- **Rehabilitation works of the damaged area of perennial crops, and provision of inputs** (e.g., seeds and other replanting material, fertilizers and pesticides) along with financial support in concessional terms (e.g., refinancing and soft-lending) to restart the activity. This support will span three years, which is adequate time for the trees bear fruit again. The cost for the first year is estimated at VND 330,000 million.
- **Restocking animal herds and scaling up capacity building in animal management**, animal health, and pasture management in affected townships, at a cost of VND 90,120.5 million, of which VND 20,940.9 million is for large animals and VND 69,179.5 million is for small animals and poultry.
- **Repair and restoration of damaged vessels and boats**, at a cost of VND 121,134 million. The reconstruction activities need to be consistent with an effective implementation of fisheries support policies under the Decree No. 89/2015/ND-CP and the Decree No. 67/2014/ND-CP to actively assist fishermen in accessing credit and fishing vessel insurance. The reconstruction activities should align with the efforts by the PPC aimed at improving the management of local fisheries, especially encouraging the use of scientific and technical advances by fishermen to improve preservation methods and the quality of fishery products.
- **Provision of equipment, nets and other tools for aquaculture farming**, estimated at VND 180,000 million. The activities are expected to build on the efforts by the PPC to develop and implement aquaculture planning, and to encourage closer linkages with the value chain (trading and processing) of aquatic products. These efforts include the support to farmers in adapting their aquaculture farming practices to the seasonality of each species, and regularly monitoring the ponds to ensure that they adhere to health, safety and environmental standards.
- **Rehabilitation works of the damaged area of forest plantations, and provision of inputs** (e.g., seeds and other replanting material, fertilizers and pesticides), along with financial support in concessional terms (e.g., refinancing and soft-lending) to replant the damaged forests and restart the activity. This support will span up to seven years, once the trees mature to meet the appropriate size and volume, and become marketable. The cost of the first year is estimated at VND 94,714.6 million, and covers the following activities: design, vegetation removal, hole digging, seedlings, fertilizers, planting, tending, protection and fire prevention. These activities will build on the actions to implement the Prime Minister's Directive No. 10/CT-TTg dated March 30, 2016, on measures to prevent and fight forest fires, aiming at a more close cooperation among stakeholders (such as local authorities, land owners, users and government officers) to enforce forest laws and sustain reforestation efforts and forest protection.

5.2.4.2 Longer Term Recovery Actions (2020 and Beyond)

In the long term (2019-2020), the main focus is on the reconstruction of the damaged areas of perennial crops and forests (table 5.2). In 2019-2020, the support to rehabilitate the areas with perennial crops amounts to VND 220,000 million, with continued support to efforts started in 2018. The support to rehabilitate the forest

areas for that period of 2019-2020 are estimated at VND 56,096.6 million. During these 2 years, the activities involved are the purchase and application of fertilizers, tending, and protection and fire prevention.

TABLE 5.2: Long Term Recovery and Reconstruction Activities in 2019-2020

Subsector	Program of Activity	Value (million VND)	Responsible Agency
Agriculture	Rehabilitation work, financial and management support to replant perennial crops and fruit trees (multiyear)	220,000.0	DARD, PPC Khanh Hoa
Forestry	Rehabilitation work, financial and management support to replant damaged forests (multiyear)	56,096.6	DARD, PPC Khanh Hoa
TOTAL		276,096.6	

Beyond 2020, the remaining activities are focused on the rehabilitation and management of forests (table 5.3). The subsequent activities in the following years include protection and fire prevention, brunching, road maintenance, and finally, harvesting.

TABLE 5.3: Long Term Recovery and Reconstruction Activities beyond 2020

Subsector	Program of Activity	Value (million VND)	Responsible Agency
Forestry	Rehabilitation work, financial and management support to replant damaged forests (multiyear)	442,780.4	DARD, PPC Khanh Hoa
TOTAL		442,780.4	



6. Enhancing Disaster Risk Management

6.1 DRM Capacity of Khanh Hoa Province

The damage caused by Typhoon Damrey is not only due to its intensity but also due to the vulnerability and low resilience capacity of affected communities. Some factors such as awareness of local people about disaster risk reduction, housing quality and preparedness measures have had a positive impact on community resilience to natural disasters. As typhoons rarely make landfall in the southern coast, the damages caused by Typhoon Damrey were also due to the psychological barriers of the people in the community. *“Although the militaries forced the local people living in fish cages to evacuate, they tried to come back in the evening to protect their property. This is one big reason of death”²⁶.*

In order to capture the DRM picture in Khanh Hoa province, the team assessed both the capacity and the vulnerability of local authorities and the community by reviewing existing DRM mechanism. Both structural and non- structural measures were evaluated to identify the gaps and areas for improvement. The findings are:

- The Joint Circular No. 43 has been applied at all levels to collect data on damages. The guidelines in the circular are quite complicated for both data collecting and synthesizing. Furthermore, it is insufficient for recovery purposes, lacking the data on losses, needs and priorities for recovery purposes.
- In line with Decision 1002 of the GoV for the roll out of community-based disaster risk management (CBDRM) in Vietnam, Khanh Hoa province used provincial budget to implement the CBDRM program since 2015-2016.

Within 2 years of implementation, in coordination with Khanh Hoa CNDPC, the CBDRM program supported the establishment of the provincial Technical Group (TG) with 22 members from relevant department, sectors and district. PPC then issued the decision to recognize the formal group for further dissemination capacity building under CBDRM program. The TG was equipped with the knowledge on DRM planning, Vulnerability and Capacity Assessment (VCA), and on integrating DRR into the socio-economic development plan (SEDP).

²⁶ Mr.Hung, Khanh Hoa Centre for Hydro - Meteorological Forecasting.

However, Khanh Hoa CBDRM program stopped at the end of 2016 due to lack of budget. In the 2 years of operation, the program was only able to serve at the official level and could not penetrate further to community level. Even so, some gaps are addressed below:

- Some mass organizations and communities are aware that communication is key for community awareness-raising, and to ensure widespread dissemination of the knowledge on disaster preparedness and response to people living in disaster-prone areas. However, the process is carried out as a mere mention or as a very short session, in village meetings or mass organization meetings. Beyond this, there is no follow-up to reinforce and/or update these messages due to lack of funding.
- The program's communication material on DRM is too basic and obsolete. CNDPC has old versions of CBDRM training material which has not been updated since it was provided by the national program.
- Each year, provincial CNDPC coordinated with all sectors and districts to prepare an action plan for natural disaster prevention and control. However, it is not a very practical document as the budget allocation for plan implementation is meagre. The plan has therefore not been fully integrated into the SEDP, sectoral plans or the land use/urban plans.
- With regard to the early warning system, it is quite well-equipped for fishery subsector. Nearly all fishing vessels are equipped with a communication system to connect with the early warning information system of local and regional hydro-meteorological forecasting centers. However, in other areas, the communication system for early warning is inadequate. In some areas, especially in mountainous areas, the commune loudspeakers, hand-speakers, DVD/CD readers, radio waves etc. do not have a broad reach.
- As mentioned earlier, the devastation caused by Typhoon Damrey was underscored by the poor quality of housing. Underprivileged, low income communities usually live in disaster prone areas. Houses in these communities are constructed with poor quality material, without any basic technical design for disaster resistance.
- The Operations and Maintenance (O&M) of infrastructure constructions has not been paid enough attention. Therefore, they are highly vulnerable to disasters.

The new DRM Law has more provisions on long-term prevention, response and risk management. The long-term response refers not only to the repair and restoration of physical infrastructure for preventing disasters, but also to "upgrading", which implies "building back better". Interest in reducing the damage and negative impacts caused by natural disasters in the future by building capacity for a better disaster preparedness and risk mitigation is reflected in almost every consultation meeting. Recovery and reconstruction, therefore, will provide a great opportunity to trigger DRM programs as communities are very keen on adopting disaster risk prevention and mitigation measures.

6.2 Recommendations for Enhancing Disaster Risk Management

"Building back better" with its 3 pillars of institutional, physical and economic resilience, is strongly recommended for recovery and reconstruction. Given below are some recommendations for enhancing DRM in the immediate/short, medium and long term recovery processes in Khanh Hoa province.

1. Strengthening risk information system

- Improve disaster risk related data/information to integrate into feasible DRM plans and SEDP to allocate adequate budget. Appropriate information about disaster risk is available and should be taken into consideration in the decision making process.
- Coordinate with other governments and developmental organizations to improve the Joint Circular 43 in applicable version to collect disaster damages and calculate the recovery needs.
- Create the disaster risk data system by computerizing and transferring the data from commune to provincial level into the system.

2. Developing DRM financing instruments

- Review budget allocation policy and system for DRM funds with clear guidelines.
- A mix of private and public financing should be used to support the recovery process (government investment is only 31% of the estimated value of damage in 2017, which was VND 4.9 billion)
- Reconstruct damaged public infrastructures, while the government facilitates lending for the repair and reconstruction of privately owned infrastructures.
- Enhance the system of budget mobilization and monitoring for recovery and reconstruction phase. The Khanh Hoa CNDPC should continue to work as the coordinating agency for budget mobilization as well as budget allocation.

3. Promoting the CBDRM program

- Restart the 1002 program by reinforcing TG, and further by building capacity of local authorities on planning and implementation of CBDRM.
- Promote community based preparedness and mitigation plans at village and household levels, with a focus on vulnerable groups such as women, children, elders, and people with disability.
- Develop practical disaster response plans with emergency response drills and evacuations, in line with the climate change scenario proposed by MONRE.

4. Strengthening disaster risk governance and mainstreaming

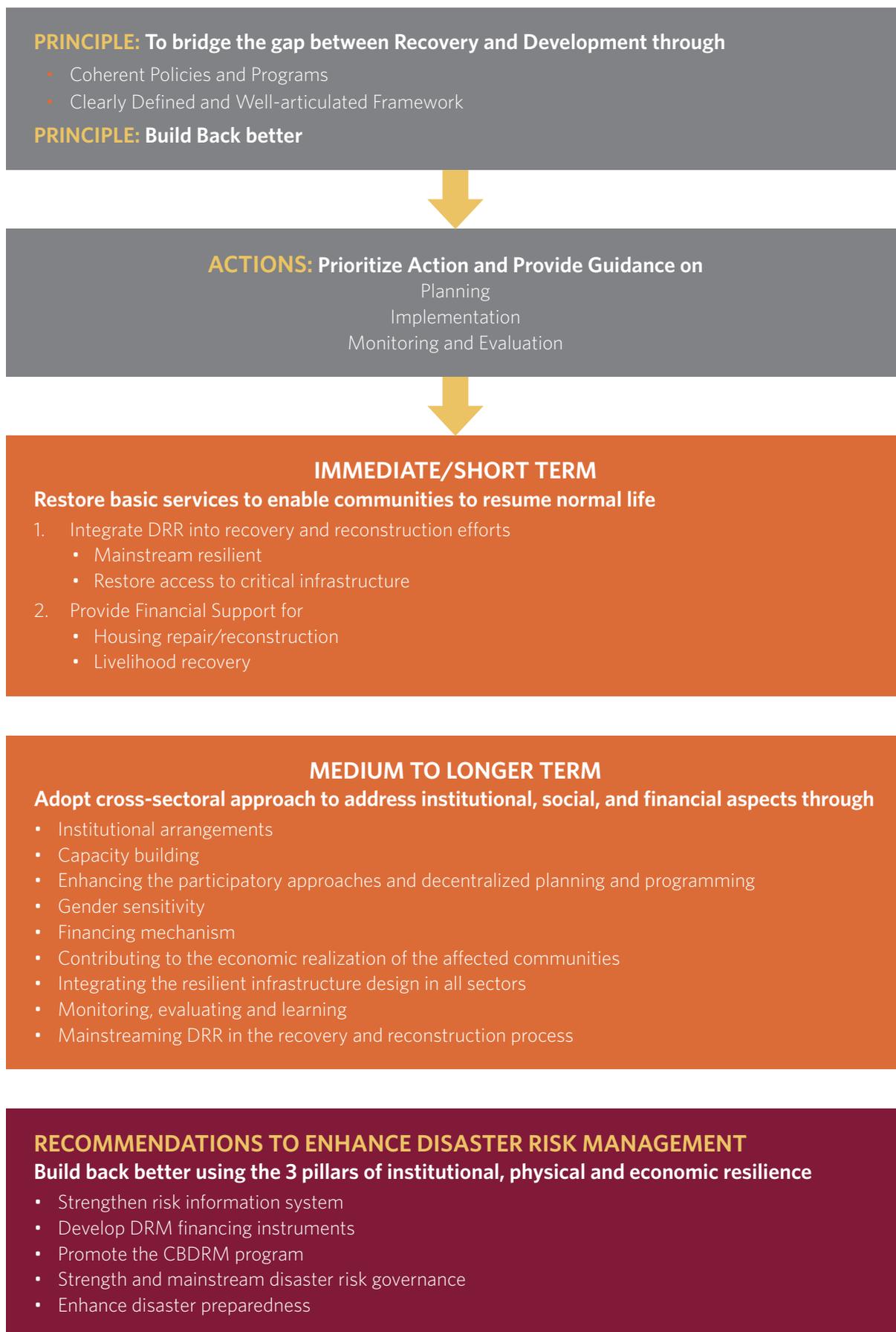
- Review recovery models for different disaster types to develop practical guideline/standard operating procedure (SOP) for recovery in common sectors such as agriculture and housing.
- Provide training for key government staff on recovery in common sectors such as agriculture and housing.
- Improve disaster risk related data to identify disaster risks, and mainstream into SEDP and sectoral plans (vertical and horizontal) for risk budgeting and financing purposes.
- Mainstream DRR in the recovery and reconstruction process. All recovery proposals should be supported by multi-hazard risk assessments with appropriate measures to manage and reduce risks.
- Reinforce DRM capacities at provincial, district and commune level.
- Integrate the resilient infrastructure design in housing, irrigation & flood control and transportation designs.
- Integrate DRR and DRM in the design and O&M of the public and private infrastructures.
- The land use plan should be consistent with hazard mapping, and identify safe sites for settlement/resettlement or evacuation. Certificate of safe places should be obtained from relevant government departments for approval of any settlement/resettlement or evacuation plan.

5. Enhancing disaster preparedness

- Improve the early warning system at community level by reinforcing the communication system and through best use of the practical technology innovations such as disaster forecast through mobile phone text messaging.
- Promote the insurance coverage for main livelihood activities such as fisheries, i.e., for aquaculture as well as for assets.
- Improve the safety of disaster prevention infrastructure including dams, safe-harbor for fishing vessels, flood control works, etc., to make them more resilient to disasters. All core infrastructure constructions such as reservoirs, safe harbors for fishing vessels, flood control works, etc., should be required to obtain the needed verification and/or assessment by DONRE/MONRE before beginning construction.

Table 6.1 summarizes the principle, strategy and recommended actions for effective disaster risk management outlined and discussed in sections 5 and 6.

TABLE 6.1: Recovery and Reconstruction: Principle, Strategy and Recommendations for Effective Disaster Risk Reduction and Management





APPENDIX: Explanatory Note on Methodology Applied to Calculate Damages and Losses, Recovery and Reconstruction Needs

Introduction

This rapid assessment is based on secondary information and some primary information provided by staff at the provincial and district level, specifically from the Division of Agriculture, Forestry and Fishery, the Division of Livestock and Animal Husbandry, and the District People's Committee in Ninh Hoa. The data collection was undertaken from March 14-21 in Nha Trang, Khanh Hoa province.

The based data have been sourced from the Division of Agriculture of the General Statistics Office (GSO) in Nha Trang, and from the Department of Agriculture and Rural Development (DARD) of PPCHK. Other relevant sources were agriculture country briefings and reports from international organizations. Additional baseline and post-disaster quantitative data on damages and losses were sourced from the Department of Flood Emergencies in the DARD using an ad-hoc template. Other data was completed using reports prepared by the Provincial People's Committees of Khanh Hoa, with data at the provincial and district level.

For certain items, the districts reported damages that were not reported by the province level. Those items have not been considered for the calculations. In addition to this, when both aggregates didn't coincide, the aggregate province-level damages reported have prevailed as the 'right number' and the figures reported at the district level were used to calculate the percentages to distribute the province-level aggregate damage.

For the calculations, the damages refer the destruction to the stock of buildings, animals, land, vehicles, equipment, and losses refer the reduction of the flows in the economic activity (lower or null sales of rice, mango, milk, eggs, shrimps ...). The damages are the cost of reconstruction or reparation of the affected stock. The losses are the value of the lost production.

Total damages reported at the province level were not always consistent with the damages disaggregated by district. For most items, the district-level data have been used to calculate the share of the damage, and accordingly distribute the damages reported at the province level. The reason to do so is that the data at the province level is been provided disaggregating damages by different types of crops, animals and aquaculture ponds, allowing to calculate variation in yields and prices more accurately. Such a detail in the provided information was not always available for data disaggregated at the district level.

Crops and forestry

Issues in the reported baseline and damages reported for crops and forestry are:

- The area reported for some crops as being under cultivation doesn't correspond neither with the season nor with the damaged area.
- Some crops were classified under generic categories, without further detail on which crops were included.
- The damages are reported as a percentage of the area affected. Thus, the classes used to report damages (completely, very heavily, heavily and partially damaged) refer to the extension, not the severity of the damaged area. This interpretation is not consistent with the guidance by the Circular 43/2015, that requires to report damages based on the impact on productivity.
- The General Statistics Office keep a good up-to-date record of changes in the cultivated and harvested areas, yields and production per crops. These figures offer the basis of a good estimate of damages and losses. Comparing data provided by the GSO and the Provincial People's Committee some inconsistencies arise, particularly on aggregate figures.

Assumptions:

- Due to incomplete or inconsistent data provided, items not included in the calculations of damages and losses of the crop subsector are: other perennial crops, flowers and bonsai trees, crops for animal feed, and fallen/broken shade trees, urban green areas.
- To calculate damages and losses in the perennial crops, the damaged area was based on the DARD estimates, and the baseline area as reported by GSO, reduced by the newly planted area in 2017.

Calculations

- The value of losses [col M] comes out of multiplying the lost production by the farm gate prices after the disaster hit to incorporate the disaster impact. The PDNA methodology suggests using pre-disaster prices.
- For each crop, the lost production results of multiplying the cultivated area by the post-disaster reduction in yield.
 - The cultivated area for each crops was sourced from GSO (as referred to in sheets baseline 1, 2 and 3), with the relevant corrections explained above for perennial crops.
 - The yield reduction is applied to the regular yield. Actual figures on the yield reduction per crop following the disaster were not reported. Thus it was assumed to be the 2016 yield as reported by GSO for Winter season in 2016 (monthly report, hard copy).
 - For some crops, reports by the GSO conclude that production levels after the typhoon were higher than those reported one year earlier, even if the planted area had not increased significantly. As more specific data on the impact was lacking, it was assumed a yield reduction of 10% following the data included in the GSO monthly and annual reports (Nov'2017, Dec'2017, and Jan'2018). The following yield reduction per crop have been assumed: 10% for paddy rice, 10% for peanut, 10% for other vegetables, 10% for other legumes, 17% for cashew, 2.2% for coffee, 10% for pepper, 6.2% for corn, 10% for cassava, 10% for

sugarcane, 3.2% for banana, 10% for jack fruit, 10% for coconut, 3.3% for mango, 10% for durian, 10% for pomelo, and 10% for existing forests.

- The farm prices used to calculate the output value in the reported crops with damaged area, before (Oct'17) and after the disaster (average price of Dec'17 and Jan'18), are:

TABLE 1: List of Prices of Crops

Product list (specific type and quality)	Unit	Average price - Oct 2017	Avg Price Dec17-Jan18
Popular variety of fragrant rice in winter-spring crop	đ/kg	5,658.7	5,839.6
Popular variety of corn VNL10	đ/kg	8,891.4	8,891.4
Fresh sweet potatoes, local strawberries	đ/kg	7,857.5	8,305.5
Dried cassava slices	đ/kg	3,422.5	3,422.5
Sugarcane for sugar production	đ/tấn	980,000.0	980,000.0
Dried tobacco leaf	đ/kg	44,000.0	45,000.0
Dried peanut with pods L14	đ/kg	21,141.9	21,297.4
White sesame	đ/kg	65,000.0	66,000.0
Hoa Loc Mango, 3 - 4 fruits/kg	đ/kg	40,000.0	48,100.5
Other banana varieties, golden banana	đ/kg	5,578.0	5,175.3
Pineapple, 1 fruit/kg	đ/kg	9,929.3	10,168.7
Durian, 2 - 3 kg/fruit	đ/kg	42,000.0	42,000.0
Other jackfruit varieties, 4 - 5 kg/fruit	đ/kg	12,390.4	12,390.4
Guava, 2 - 3 fruits/kg	đ/kg	7,958.1	7,958.1
Fresh coconut	đ/10 pcs	87,117.5	74,833.2
Orange, 3 to 4 fruits/kg	đ/kg	23,905.9	23,158.3
Other pamelo varieties, local pamelo	đ/kg	15,000.0	15,000.0
Dried cashew nuts	đ/kg	38,747.6	38,747.6
Dried pepper	đ/kg	160,000.0	162,500.0
Dried coffee	đ/kg	46,000.0	40,000.0
Round timber group 8	1000đ/m3	3,400.0	3,400.0

- For some items, the reports refer to aggregate classes without details of the included crops; e.g. vegetables and legumes, under the vegetables & cash crops group; others, under the group of perennial crops; crops for animal feed and scented herbaceous plants, under annual non-industrial crops; others, under fruit trees. GSO reports data on area, yield and production quantity for some of these groups (vegetables and legumes), as per sheet 'baseline 2 GSO'. This data have been used to calculate the corresponding area and yields for these items. The weighted average of prices can be found in the sheet CROPS-veget, legum, in 'Farm gate price - Oct17-Feb18'.
- In addition to the losses due to reduced yields, it has been assumed that the typhoon fully destroyed a 10% of the damaged area of perennial crops and fruit trees, forest. That 10% is an heuristic based on the field visits. Losses are assumed to extend over up to 7 years, which correspond to the time needed for newly planted trees to bear fruit again. This includes: 3 years for cashew (with 4,214.4 Ha affected), 5 years for coffee (59.7 Ha affected), 4 years for pepper (8.2 Ha), 3 years for banana (2,322.9 Ha), 3 years for jack fruit (249.6 Ha), 6 years for coconut (777.1 Ha), 5 years for mango (5,078.6 Ha), 7 years for durian (168.7 Ha), 6 years for pomelo (456.9 Ha). The losses are calculated multiplying the lost production by the farm gate price of the corresponding crop. The lost production is the result of multiplying the expected yield by the fully destroyed area. The distribution of the total losses across the years is done assuming that 60% needs to be spent the first year, and the outstanding amount is distributed across the remaining years.
- For forestry, since damage was largely done to plantations of young acacias (under 3 years), price taken from the lower range of prices for round timber (as per sheet Forestry, in 'Farm gate price - Oct17-Feb18'). The

detail of schedule, costs and activities for the reconstruction and recovery actions in the damaged acacia plantations is sourced from Tuan, D.A. et al (2014), Assessing opportunity and implementation cost of forest certification for ecosystem services, VNForest – SNV – ForCES, Hanoi. The estimate of damages per Ha (VND 40,210.1 thousand) have been multiplied by the total damaged area (19,683.0 Ha). It has been assumed that the total area is destroyed, and no revenues for selling timber are added.

On Livestock

Due to incomplete or inconsistent data provided, items not included in the calculations of damages and losses of the crop subsector are: livestock supplies washed away or damaged; damaged barns or equipment.

Assumptions:

- The data for the baseline and on the damages were reported by the GSO, through the report number 010N/BCC-NLTS, and the Division of Livestock and Animal Husbandry at the DARD. The data reported by DARD as “CHN04 Other animals” by Nha Trang City and Ninh Hoa Town have been reassigned to the category “Dear or washed away poultry”.

Calculations:

- The value of damages is the result of multiplying the number of dead animals by the price of live animals [col I]. Based on those estimates of damages, a first estimate of reconstruction needs are calculated, including value of restocking large and small animals.
- The prices to calculate the value of live animals and the output value, before and after the disaster, as well as the prices for vaccines and animal feed were provided by the DARD:

TABLE 2: List of Prices of Vaccines and Animal Feed

VẬT NUÔI	ĐƠN VỊ TÍNH/ Unit (vnd)	CHI PHÍ THỨC ĂN/ feed cost	CHI PHÍ THUỐC THỦ Y VÀ VẮC XIN/ vaccination
BÒ/ cow	Đ/KG Tăng trọng (cost/kg)	45,000	500
LỢN THỊT/ pig	Đ/KG Tăng trọng	24,200	1,800
GÀ THỊT CÔNG NGHIỆP/ industrial chicken	Đ/KG Tăng trọng	22,500	800
GÀ TRỨNG CÔNG NGHIỆP/egg	Đ/quả	1,300	60
GÀ THẢ VƯỜN LAI/ garden chicken	Đ/KG Tăng trọng	32,000	1,200
Vịt thịt/ duck	Đ/KG Tăng trọng	40,000	1,200
	Average weight (kg/head)	Feed cost (VND)	Vaccine (VND)
Cow	200.87	9,039,288.11	100,436.53
Pig	81.21	1,965,168.18	146,169.53
Industrial chicken	2.13	47,972.15	1,705.68
Garden chicken	1.80	57,597.36	2,159.90
Duck	1.59	63,637.86	1,909.14

- To calculate the losses, the only damages are reported on animals producing meat and milk. The losses in meat production come out of multiplying the number of dead animals producing meat, by the average weight per head, by the differing years before the calves and chicks can be considered productive again, times the share of animals to be slaughtered and by the estimate price of meat. The losses in milk production result of multiplying the dairy production per head times the number of dead animals producing milk and the price of milk.

- Based on these estimates of losses, a first estimate of the recovery needs include the provision of animal feed and vaccination costs. The former is usually calculated over a share of the baseline (in this case 20%), and the latter, assuming that a share of the live animals need vaccinations, based on the share of the flooded total area in the province, not only agricultural (assumed to be 3%). Both percentages are heuristics. The unit costs of vaccines and animal feed are based on data provided by DARD.

On Fisheries

Due to incomplete or inconsistent data provided, items not included in the calculations of damages and losses of the fishery subsector are: aquaculture cages, and fishing tools and communication facilities, and damages to hatchery farms.

There were some issues with the data reported on damages:

- The damages are reported as a percentage of the area affected. Thus, the classes used to report damages (completely, very heavily, heavily and partially damaged) refer to the extension, not the severity of the damaged area. In this regard, the Circular 43/2015 requires to report on the level of damage, without specifying how to quantify that level (in crops, it is required to report the reduction of productivity). As a result, the data on reduced yield was not provided.
- For some items, the total damaged area was higher than the corresponding baseline or projected area (e.g. compare baseline area and damaged area for fish farming in small ponds, farming of white leg shrimp, and area for *babylonia areolata*).
- A total of VND 2,039 million were reported as damages to equipments and facilities, without further specification on the type of affected assets.
- The data of damages reported on cages for aquaculture and to farm sea fish and lobsters were not consistent with the baseline.

Assumptions:

- To calculate damages and losses, the damaged area was based on the data from DARD, and the baseline area, including farmed area, production levels and prices, as reported by GSO.
- The total sea catches reported by GSO at the end of 2017 total 85,632 tons [sheet Production], while the total used as baseline amounts 65,644.5 tons. The difference refers to items for which no prices were available. Given the remarkable size of the relevant production (over 19,987.5 tons), those products were not added in order to avoid an overestimation of the subsector losses. The products not included and the relevant caught volume are: plaice (1,050 tons), pompano (7,032 tons), herring (165 tons), snapper (36 tons), shark (2,325 tons), leiognathidae (2,150 tons), beltfish (7,230 tons) and swallow nest (2.6 tons).
- Distribution of damages by type of boat follow the criteria of caught capacity, defined in Teh et al (2010)²⁷. It is assumed that boats with <20 CV assigned as to subsistence fishing, boats with 20-90CV to artisanal fishing, and above 90CV as industrial fishing.

Calculations:

- Data on farmed area and production are sourced from the GSO. Reporting criteria (labels and codes) for each subject were different, thus first it was necessary to match up the items of production and area. In addition, prices (Table 3) were added from the sheet FISHERIES, in the file Farm gate prices. In aquaculture farming, colors correspond to different types of produce (red for fish, blue for shrimp, green for other species,

²⁷ Teh et al (2010), *Reconstructing Vietnam's Marine Fisheries Catch, 1950-2010*, Working Paper #2014-17, Fisheries Center, The University of British Columbia, Vancouver.

and orange for aquaculture farming in cages). For categories of products, prices were sourced only from a selected group of relevant items.

TABLE 3: List of Prices of Fishery Products

Produce list (specific type and quality)	Unit	Average price - Oct 2017	Avg Price Dec17-Jan18
Fresh mackerel, 3kg/head or more	đ/kg	176,553.7	200,179.0
Fresh mackerel, 1-3kg/head	đ/kg	148,498.5	173,931.6
Fresh mackerel, under 1 kg/head	đ/kg	116,767.4	137,658.3
Fresh red snapper, 0.5kg/head or more	đ/kg	90,119.8	95,043.5
Fresh red snapper, under 0.5 kg/head	đ/kg	84,756.1	86,889.8
Fresh tuna (other than ocean tuna)	đ/kg	63,331.9	67,007.4
Other fresh tuna, from 1kg/head or more	đ/kg	57,411.0	60,491.9
Fresh tuna, less than 1kg/head	đ/kg	48,401.1	50,673.6
Yellow stripe scad	đ/kg	27,890.0	27,890.0
Anchovy	đ/kg	22,288.1	25,139.0
Trash fish	đ/kg	18,000.0	19,593.8
Seabass	đ/kg	64,845.9	66,247.2
Lobster (400g/head or more)	đ/kg	1,723,368.8	1,479,552.3
Lobster (less than 400g/head)	đ/kg	1,389,964.0	1,113,408.0
Black tiger shrimp, 60 - 70 heads/kg	đ/kg	213,758.7	220,570.4
Small shrimp, 80 - 90 heads/kg	đ/kg	119,878.2	122,256.2
Whiteleg shrimp, 60 - 70 heads/kg	đ/kg	111,931.0	118,651.7
Fresh squid, 5-7 heads/kg	đ/kg	142,601.2	157,469.0
Fresh squid, 25-30 heads/kg g	đ/kg	119,237.4	127,685.8
Fresh squid, 30-40 heads/kg	đ/kg	98,418.8	105,011.0
Mud crab, 0.3-0.5 kg/head	đ/kg	201,218.6	203,747.0
Carp	đ/kg	31,464.3	31,464.3
Clam	đ/kg	18,566.4	20,000.0
Babylonia areolata	đ/kg	188,229.2	193,191.6
Seaweed	đ/kg	6,000.0	6,000.0
Crab	đ/kg	194,935.9	194,935.9
Tilapia, 0.5-1kg/head	đ/kg	32,491.1	29,719.6
Tilapia, 0.3-0.5kg/head	đ/kg	28,231.1	25,838.3
Tilapia, less than 0.3 kg/head	đ/kg	21,544.4	21,544.4

- *The damages to fishing ships and vessels* uses as baseline the data on stock reported by GSO. The damages to boats follow the categories used by the government to report on damages. The assumptions are: for completely damaged vessels (>70% damage), the vessels are irreparable (their productive capacity is lost 100 percent); for very heavily damaged (50%-70% damage), their productive capacity is 60% damaged and are repairable; for heavily damaged (30%-50% damage), their productive capacity is 40% damaged and are repairable; for partially damaged (<30% damage), their productive capacity remains intact. The unit cost of reparation was sourced from DARD, and the costs of reparation are calculated for each type of vessel.
- *The losses due to damages to fishing ships* are based on an estimate of the lost productivity due to the time of reparation required for each type of vessel. To calculate the productivity of each type of vessel, it was used the criteria to distribute the sea captures and classify the type of vessels defined in Teh et al (2010). Sea captures available as baseline for 2017 as reported by GSO are distributed among the three types of vessels. Discarded captures are distributed between artisanal and industrial. The time of reparation is the time that the vessel will not be productive. In terms of productivity, it has been assumed that their productivity is reduced by x percent.

The assumptions to calculate the lost output [col W]: for completely damaged vessels (100% damage), thus total loss; for very heavily damaged (50-70% damage), their productive capacity is reduced 60%; for heavily damaged (30-50% damage), their productive capacity is reduced 40%. To calculate the value of that lost output, it has been used an estimate of unit price that comes out of dividing the baseline values of captures by the volume of captures. This unit price is applied to every produce from sea captures, regardless of the type of vessel.

- *The losses due to damages in aquaculture ponds* are based on the lower productivity of the affected aquaculture ponds. The damaged area reported by DARD for black tiger shrimp and white leg shrimp and for other products (*babylonia areolata*) were higher than the baseline area in 2017 or the projected area for 2018 by DARD. Instead of using two different data sources for the baseline data, it was decided to use a single source. Thus the baseline data for farmed area, and production level for every type of aquaculture farming is sourced from the GSO, and accordingly, the baseline yield is calculated. Specifically for aquaculture shrimp, calculations are done to aggregate the area damaged for both products (1,475 Ha), using as baseline the farmed area reported by GSO in 2017 (2,136 Ha). The lost output is calculated by subtracting the surviving production from the baseline production. The surviving production is calculated multiplying the baseline yield by the not-damaged area. The prices used to calculate the lost output value, after the disaster (average price of Dec'17 and Jan'18), are as indicated in Table 3. For aquaculture shrimp farming in salt and brackish water, the price is an average price of the relevant species weighted by production level in 2017. The prices are: for lobster (400g/head or more, less than 400g/head), black tiger shrimp (60/70 heads/kg) and whiteleg shrimp (60-70 heads/kg). For this later, the price corresponds to February 2018. For aquaculture other product farming in salt and brackish water, the price is a simple average of the relevant species

Recovery and reconstruction

The estimation of financial needs to achieve post-disaster recovery and reconstruction is based, respectively, on the value of the production losses and the value of damages to physical assets.

Economic recovery activities are essentially short- to medium-term interventions designed to mitigate and shorten the sectoral, macroeconomic, and personal or household disaster impact. Recovery activities in the agricultural sector normally include replanting the crops eliminated by the disaster, preventing and controlling animal disease, providing animal food and replanting pasture, restocking fry and fingerlings, and making in-kind donation of tools and gear for the fishermen. Reconstruction refers to the replacement or repair of physical assets destroyed or damaged by disasters. Following a postdisaster "building back better" strategy, those assets are rebuilt with the inclusion of improved, disaster-resilient standards to ensure continued availability after disasters, and to reduce the negative impact of such events in the future.

The reconstruction needs are defined on the basis of the estimated value of damages, supplemented by the additional needs involved in the building-back better approach (involving a disaster-resilience coefficient with values ranging from 1.10 to 1.40). The recovery needs are calculated on the basis of a fraction of the value of production losses (usually 25 or 40 percent of the production losses)²⁸.

²⁸ For a more detail explanation, see the Damage, Loss, and Needs Assessment Guidance Notes, Volume 2. Conducting Damage and Loss Assessments after Disasters (<http://hdl.handle.net/10986/19046>) and Volume 3. Estimation of Post-Disaster Needs for Recovery and Reconstruction (<http://hdl.handle.net/10986/19045>).

Code 01	Code 02	Indicator	Unit	DARD Reported: Damages at Province level	Calculated: Aggregate Damages at District Level	Cam Ranh City	Dien Khanh District	Nha Trang City	Ninh Hoa Town	Khanh Vinh District	Cam Lam District	Khanh Son District	Van Ninh District
6.19	NLN19	Other losses to agriculture, forestry and salt production (*)	VND mil										
7	CHN	LOSS TO LIVESTOCK PRODUCTION	VND mil										
7.1	CHN1	Dead or washed away cattle	head	4,703.0	5,656.0	20.0		3,895.0	767.0	167.0	222.0	3.0	582.0
7.1.1	CHN01	Cattle and horse	head	540.0	540.0	3.0		462.0	33.0		1.0		41.0
7.1.2	CHN02	Deer, sheep and goat	head	611.0	611.0	12.0		523.0			63.0		13.0
7.1.3	CHN03	Pig	head	4,248.0	4,248.0	5.0		2,910.0	647.0		158.0		528.0
7.2	CHN02	Dead or washed away poultry	head	591,268.0	576,965.0	2,174.0		351,893.0	134,644.0	8,644.0	9,531.0	41.0	70,038.0
7.2.1	CHN021	Chicken, duck and goose	head	264,107.0	264,107.0	2,174.0		48,720.0	133,644.0		9,531.0		70,038.0
7.2.2	CHN023	Other poultry	head	9,173.0	9,173.0			8,173.0	1,000.0				
7.1.4	CHN04	Other animals	head	295,087.0	295,087.0			295,000.0	87.0				
7.3	CHN03	Other dead or washed away animals	head										
7.4	CHN04	Animal feed washed away, buried or damaged	ton										
7.5	CHN05	Livestock supplies washed away or damaged	VND million		1.0			1.0					
7.6	CHN06	Damaged barns or equipment	VND million		75.0	72.0		3.0					
7.7	CHN07	Shortages of water for concentrated livestock production	m3										
7.8	CHN07	Other losses to livestock production (*)	VND million										
10	TS	LOSS TO FISHERIES	VND mil		0.2							0.2	
10.1	TS01	Area of conventional fish farming		160.5	3.2			3.0				0.2	
10.2	TS021	Area of fish farming		95.0									
10.3	TS03	Area of shrimp farming	ha	1,475.0	2,563.3	2.6		1,910.8			38.0		612.0
10.4	TS04	Area of clam farming	ha	880.7	2.9	2.8					0.1		
10.5	TS05	Other aquaculture species (*)	ha	136.4	65.3	7.7			20.9		36.8		
10.6	TS06	Cages of aquaculture farming	100m3/ cage		19,593.8	1,118.1		755.3	1,187.3		3.0		16,530.0



GFDRR

Global Facility for Disaster Reduction and Recovery



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