Drought-Management Considerations for Climate-Change Adaptation: Focus on the Mekong Region

REPORT (VIET NAM)

Oxfam in Viet Nam and

Graduate School of Global Environmental Studies of Kyoto University, Japan

Participants in the national forum conducted in Hanoi, Viet Nam

Disclaimer

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Preface

The Mekong plays an important role in ensuring the well-being of China, Cambodia, Laos, Myanmar, Thailand, and Viet Nam, as the major river supporting agriculture and many other economic activities in the region. It also brings regular floods to the region which, although sometimes damaging, are an integral part of the lives of many communities in the Mekong River basin. However, in recent times the river basin has become increasingly vulnerable to droughts. A notable example is the drought of 2004, which began a couple of years earlier and had grown into serious proportions by the year 2004. Dealing with drought requires a different strategy from that of dealing with the floods and typhoons that have been experienced in the Mekong region for many years. Local communities, governments, and NGOs are aware of how to deal with these age-old problems; but drought, being a slow-onset disaster with crippling impacts, needs to be viewed from a different perspective. This is a particular challenge in a region that has less experience of drought, and less local knowledge of how to deal with it. There could be catastrophic results unless efforts are made to know and understand what drought means to this flood-prone region.

This study – the result of a three-way collaboration between Oxfam in Viet Nam, the International Environment and Disaster Management (IEDM) laboratory of the Graduate School of Global Environmental Studies (GSGES), Kyoto University, Japan, and the People's Committee of Ninh Thuan – considers some aspects of the recent droughts in the Mekong region and tries to discover what could be the reasons behind them and how best they could be mitigated. The study has yielded valuable information about how communities perceive drought and climate change, and how local governments and NGOs could manage climatic disasters, particularly drought. It concludes that the drought impacts are in a real sense a reflection of developmental problems, and it provides policy options that could be implemented by communities, governments, and NGOs.

Chapter 1 of this report forms the executive summary, and Chapter 2 introduces the background of the work, its objectives and aims. Chapter 2 also provides information on methodology, the concepts adopted, and an overview of study locations. Chapter 3 provides an overview of Ninh Thuan province, describing the developmental context of the province. The fourth chapter, on disaster and climate-change vulnerability, discusses the present status of various disasters and future projections of climate change. This chapter also makes observations on the climatic data, contrasting the perceptions of communities with what the study actually found. The actual results of the study are discussed in detail in Chapter 5. The policy options for dealing with drought risks are then presented in Chapter 6. This chapter also includes the recommendations of the National Forum on Community-Based Adaptation to Drought in the Context of Climate Change. Chapter 7 offers a brief note on future directions for all those interested in mitigating the risk of drought.

Readers whose time is limited are recommended to read the preface, executive summary, and introduction and then turn to Chapters 6 and 7. Summary checklist tables of drought impacts and root causes can be found in Tables 27, 28, and 29; other charts in these chapters outline the subsequent suggestions and recommendations.

Although this is an on-going pilot project, we hope that it will help to improve widespread understanding of the problem and help to initiate development programmes by bringing various stakeholders together. Feedback from readers would be greatly appreciated.

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1. Executive summary

During recent years, drought has become a common occurrence in most areas in the Mekong River Delta of the Mekong region, including nine provinces in the Southern Central and Central Highland regions in Viet Nam. The Department of Water Resources, Ministry of Agriculture and Rural Development (MARD), has estimated that between 1 and 1.3 million people (13–17 per cent of the total population) are affected by drought in these provinces and hence are in need of assistance. Ninh Thuan province is the worst affected of these provinces.

This project is part of a collaboration between the International Environment and Disaster Management (IEDM) laboratory of the Graduate School of Global Environmental Studies, Kyoto University, Japan, the People's Committee of Ninh Thuan, Viet Nam, and Oxfam in Viet Nam. The current research focuses on the impacts of recurring droughts on the livelihoods of the rural communities in the drought-prone areas of Ninh Thuan province. The study also examines the perceptions of local communities and government functionaries on the question of the extent to which drought-related vulnerabilities can be traced to climate change at the global level.

We assessed the drought vulnerability of the rural communities in the most drought-prone areas in Ninh Thuan province by identifying drought impacts on a range of livelihood sectors such as agriculture, animal husbandry, and fisheries. The impacts were ranked, and root causes were identified, on the basis of which appropriate policy interventions are suggested. Wherever possible, attempts were made to identify gender-disaggregated impacts and adaptation measures. At the end, a note has been provided on future directions for various potential stakeholders, in order to take forward the findings of the study.

The study revealed that rainfall in Ninh Thuan province has actually been increasing for some time. However, there are indications of increasing inter-annual variability, as evidenced by increasing deviation from the long-term mean. This could be the main reason for the increasing incidence of drought, rather than any decline in long-term rainfall. Another reason for increasing drought conditions is increasing demand for water. The province has witnessed a steady growth in the area under wet paddy cultivation and the production of maize and other perennial crops which need substantial inputs of water, compared with the dry rice grown in earlier years. Heavy reliance on groundwater has led to significant saline-water intrusion. The proliferation of aquaculture in many areas of the province has further contributed to the problems of drought.

The survey found that communities were well aware of climate changes happening around them, notably higher temperatures and erratic rainfall. They attributed the drought not only to decline in forest cover in the province, but also to the poor environment-management practices elsewhere. Communities were of the opinion that the provision of better financial facilities and initiatives to diversify their livelihoods would substantially reduce their vulnerability to climate-related extremes. Discussions with government and non-government officials have corroborated these findings.

Policy options identified in participatory consultation exercises with communities consist of better water-use management strategies, both at the field level and at the basin/command level, and introduction of better crop-management practices, including enhanced irrigation efficiency and introduction of drought-resistant crop varieties that use less water while not compromising the yield. The National Forum has recommended establishing dedicated Drought Management Boards at commune level on the lines of the flood-management boards, which have been successful. Such boards would not only enhance the response and relief operations but would also help to identify and implement appropriate drought-mitigation programmes by assessing local vulnerabilities.

2. Introduction

Climate change has brought new risks for humanity. It is important to understand the nature of these risks, the points at which natural and human systems are most vulnerable, and the likely benefits that may be achieved by adaptive responses.[1] Adaptation to climate change has the potential to reduce substantially many of the adverse effects of climate change, by enhancing the capacity of governments and communities to withstand the impacts. While climate-change adaptation, including organisational response, has been discussed for several years, little attention has been focused on community-level adaptation, and on integrating community-adaptation methods at the policy level.

Since climate change has particularly severe impacts on rural communities, whose livelihoods are dependent on agriculture, it is important to focus on their livelihoods and re-establish the conceptual links between poverty (defined as the lack of stable purchasing power to maintain decent living standards), livelihood, and environment. However, focusing on communities is not enough: if community initiatives do not become part of government policies, it is difficult to sustain local efforts, which means that the problem has to be addressed from both ends. Perhaps the most important prerequisite for creating sustainable livelihoods and for achieving sustainable development is good and accessible government.[2] Thus, the links between the community and local, state, and national governments are of utmost importance.

The research focuses on Ninh Thuan province. Rated the 59th poorest province of Viet Nam, Ninh Thuan is one of the nine provinces that are most severely affected by drought. Drought is not a new phenomenon in Ninh Thuan: it has been a regular occurrence down the ages. But droughts have been increasing – in number, duration, and intensity – during recent years. The province was severely affected by the major drought in August 2004, with normal rainfall declined by half. The drought continued in 2005 and 2006, with poor rainfall during the first two cropping seasons. Prolonged dry periods have caused significant damage to agriculture and changed the salinity of groundwater, thus damaging aquaculture. The increasing occurrence of drought in Ninh Thuan province is a major concern for both government authorities and local communities. A systematic study is needed in order to relate local conditions with climate change on a more general scale, and to understand what kinds of preparedness mechanism may be put in place to reduce the impacts of droughts. This research is a contribution to that process.

2.1. Aim and objectives

2.1.1. Aim

The aim of this study is to understand climate vulnerability and to improve resilience mechanisms through community-based risk-reduction planning in some of the areas most prone to climate risk in Ninh Thuan province. This study is regarded as a pilot initiative to increase understanding of various issues related to climate change, so that the focal areas for intervention in the risk-prone areas can be identified, and responses can be implemented.

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[1] *Climate Change 2001: Impacts, Adaptation and Vulnerability:* Contribution of Working Group II to the Third Assessment Report of the International Panel on Climate Change.

[2] *Sustainable Livelihoods,* Kristin Helmore and Naresh Singh, 2001.

2.1.2. Objectives

The specific objectives to achieve the above aim are as follow:

1. To assess the climate vulnerability of rural communities in the most drought-prone areas of Ninh Thuan province, Viet Nam. As part of this study, perception surveys were conducted to identify the degree to which the perceptions of communities limited the efficacy of the activities of various intervening agencies.
2. To identify possible adaptation measures to mitigate the impacts on rural communities of ever-increasing climate variability and change, in terms of droughts, with an emphasis on identification of gender-disaggregated impacts and adaptation measures. This objective is met through systematic use of a tool entitled 'How to Reduce Drought Risk' developed by the Preparedness and Mitigation Working Group of the Western Drought Coordination Council, USA.

2.2. Research methodology

The project used a mix of vulnerability-assessment methodologies, in response to the interdisciplinary nature of the problem. Much of the methodology has been drawn from 'How to Reduce Drought Risk',[3] because it is a simple step-by-step process for users (communities; local, provincial, and national governments; NGOs and other institutions) to identify actions to reduce the impacts. A combination of participatory rural appraisal techniques was used in the study.

2.2.1. Components

Figure 1 depicts the components of the methodology. The methodology is based on the previous impacts of the drought, for the very reason that the impacts clearly reflect the local vulnerabilities of communities, institutions, and governance mechanisms.

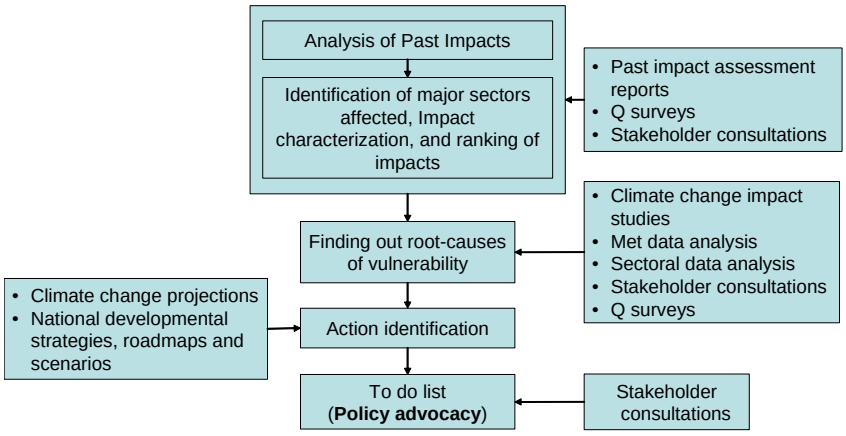

Figure 1: Components of the research methodology

Impact assessment

With impacts as the starting point, the study further investigates their root causes, which might be institutional and sectoral inefficiencies, community-vulnerability factors, or climatic factors. In areas where previous impact assessments could not be obtained or sufficient information is not

[3] C. Knutson, M. Hayes, and T. Phillips, 1998: *How to Reduce Drought Risk*, Western Drought Coordination Council, National Drought Mitigation Center, Nebraska, USA.

available, information from the questionnaire surveys and group discussions supplemented the process. Due emphasis was given to gender-related issues.

Impact characterisation

Drawing on the impact assessment, the sectors affected by previous droughts were identified and ranked in order of importance. The ranking was based on the extent of the impact on each sector and its relative importance for the general well-being of communities in the region. Impacts were ranked according to their relative degree of importance, in consultation with the stakeholders. Efforts were also made to identify whether certain kinds of impact are becoming more of a problem than others.

Identifying root causes

The differential impacts of drought, or the impacts *per se*, are linked to the root causes of vulnerability. The root causes could be lack of irrigation facilities, cultivation of susceptible crops and mismanaged cropping systems, the absence of dykes to stop floods, or the lack of coastal-belt plantations, among other factors. In order to find the root causes, discussions were held with communities, institutions, and governments. Problem trees or impact trees were constructed, based on the discussions, and the root causes or underlying factors were identified.

Action identification

Appropriate actions were identified, based on the above analysis. This was done through developing a matrix which lists the impacts and root causes of the impacts (vulnerabilities). Action identification also considered the possible mitigation of climate-change impacts. The actions were classified as mitigation, response, and preparedness actions, based on how they fit in the risk-management cycle.

Policy advocacy

While this study stops at the stage of action identification, policy advocacy, or preparation of a *to-do* list, all the stakeholders should discuss the outcomes of the above analysis. We suggest that the stakeholders should sit together and prioritise the actions to be taken, based on the resources available. This part is considered briefly in Chapter 7, on 'Future directions'.

2.2.2. Study locations

Four villages in two communes, from two different districts, were identified in Ninh Thuan province. Table 1 and Figure 2 provide information on study locations.

Table 1: Study locations

Country	Province	Districts	Communes	Hamlet
Viet Nam	Ninh Thuan	Ninh Phuoc	An Hai	Long Binh Hoa Thanh-Nam Cuong
		Bac Ai	Phuoc Thanh	Da Ba Cai Ma Ro

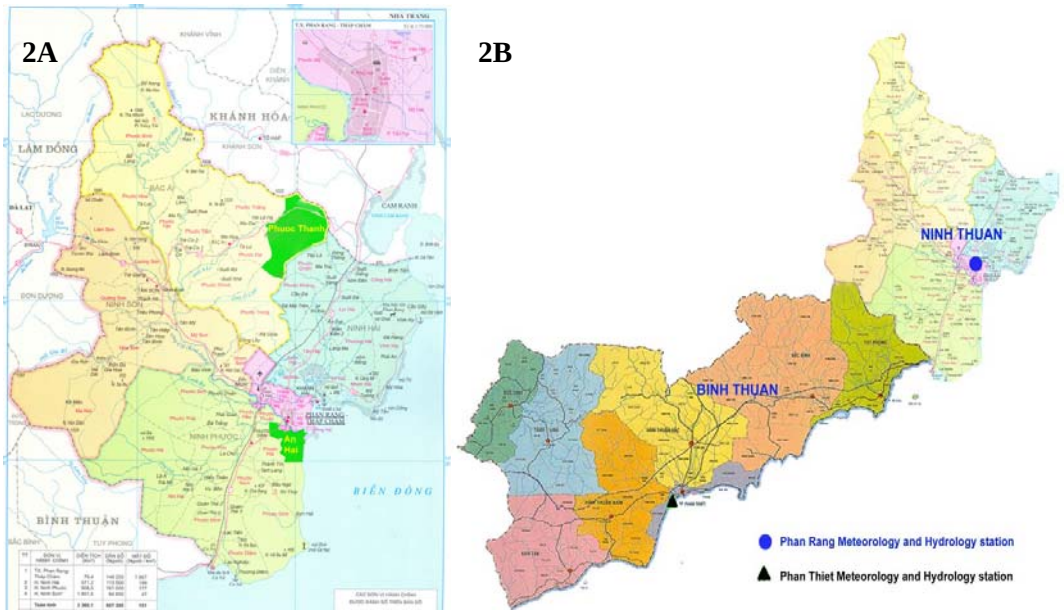

Figure 2: (a) Map showing the location of study villages in Ninh Thuan province;

(b): Map showing the location of hydro-meteorological stations from which the climatic data were obtained

An overview of Phuoc Thanh commune

Located in the north-west of Ninh Thuan province, Phuoc Thanh is a mountainous commune with an area of 10,086 ha. It has a forest cover of 7667 ha and an agricultural area of 9117 ha. The commune has a population of 2649, living in 527 households and five hamlets. There are 2547 Reglays ethnic communities (96.2 per cent of the total) and 102 Kinh communities (3.89 per cent). The main livelihood of the people is agriculture. They grow rice, maize, cassava, and cashew. Their secondary livelihood is animal husbandry, and they raise cattle and goats. Communities do not own much forested land and hence are planting and protecting the State's forest in various programmes. Due to poor conditions and shifting cultivation, the State's forests are usually affected by the negative impacts of human activities. Most households are poor, and food scarcity is common. According to the data of the People's Committee of Phuoc Thanh commune, there were 193 poor households (36.6 per cent of the total) in 2005.

An overview of An Hai commune

An Hai is one of the coastal communes located in the east of Ninh Thuan province. The commune has 1057 ha under agriculture, 4239 ha under forestry, and 4833 ha covered by dwellings; the rest of the area is under aquaculture and other uses.

The total population of An Hai commune in 2005 was 12,890, living in 2596 households in six hamlets. The main livelihood of the communities is agriculture, with main crops of rice, grape, and short-duration vegetables such as tomato, carrot, chilli, and potato. Animal husbandry is one of the strengths of An Hai commune, which rears cattle, sheep, and goats. Located along the 1A Highway and near Phan Rang–Thap Cham town, the An Hai commune has developed small-scale trading. Aquaculture has been extensively developed in the past five years in this commune, but now, due to diseases and water pollution, the area under aquaculture has been decreasing. According to the data of the People's Committee of An Hai commune, there were 521 (20.7 per cent) poor households in 2005.

2.2.3. Overview of respondents

Community respondents

Table 2 provides an overview of respondents. It shows that the majority of respondents are farmers, irrespective of the study location. However, a small difference may be observed between the coastal region and the mountainous region, with a major proportion of the population in the latter owning land, compared with the earlier. The majority of respondents are young (67.5 per cent), with a sex ratio little more than 1.7 males / females.

Table 2: Overview of the community respondents (numbers expressed as percentages)

S No	Parameter	Coastal Region		Mountainous Region	
		Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
1	Occupation				
a	Farmers	83.3	65.4	92.0	100.0
b	Landless labourers	6.7	19.2	4.0	0.0
c	Artisans	6.7	7.7	4.0	0.0
d	Traders	3.3	7.7		
2	Sex				
	Male	65.0	57.7	68.0	59.3
	Female	35.0	42.3	32.0	40.7
3	Age group				
	Young (20–50)	73.3	65.4	72.0	59.3
	Old (>50 years)	26.7	30.8	28.0	40.7

Government and mass organisations

The profile of respondents is given in Table 3. Twenty officials of government and mass organisations were interviewed by using structured questionnaires and personal interviews.

Table 3: Profile of respondents representing government and mass organisations in coastal and mountainous study regions

S No	Administrative boundary	Affiliations/Departments	Number of respondents
1	Commune	• Youth Union • People's Committee • Women's Union • Farmers' Association	9
2	District	• People's Committee • Department of Economics and Agriculture • Department of Animal Husbandry • Department of Natural Resources and Environment • Department of Statistics	6
3	Village	• Village Leaders	5

2.2.4. Data-collection procedure

Various participatory rural appraisal techniques, including structured questionnaire surveys, meetings, focus-group discussions, and transect walks to become familiar with the local conditions, were used in the study. Iinterviews and group discussions were conducted with the elected commune leader/s; commune, district, and provincial authorities; officials of the Departments of Meteorology, Agriculture and Rural Development, Animal Husbandry, and Water Resources; and staff of two leading NGOs active at the study locations (ActionAid and Red Cross).

At the Provincial Level, individuals were interviewed and secondary data were collected from the representatives of the Provincial People's Committee, the Planning and Investment Department, the Department of Agriculture and Rural Development, the Department of Natural Resources and Environment, and the Centre of Meteorology and Hydrology.

At the District Level, individuals were interviewed and secondary data were collected from the representatives of District People's Committees, the Department of Economics and Agriculture, the Women's Union, and ActionAid.

Figure 3: Training field volunteers to implement the survey

At the Commune Level, individual interviews were conducted and secondary data were collected from the representatives of Commune People's Committees, the Youth Union, the Farmers' Associations, and the Women's Union.

At the Village Level, interviews were conducted with the village heads, Managing Board members of the village, and households. Livelihood-sector ranking exercises were carried out.

Figure 4: Identifying root causes of drought in a focus-group discussion

Field volunteers were recruited to implement the questionnaire surveys. The volunteers were given a day-long orientation on the subject of the study and were trained to implement the questionnaire survey.

Workshops, forums, and stakeholder consultations

To obtain information on drought impacts, difficulties faced in managing droughts, and innovative solutions to overcome the problems, two workshops and one national forum were organised. Two workshops were organised with the participation of the Department of Irrigation (MARD), Meteorological and Hydrological Institute (MoNRE), Oxfam GB, and Red Cross and World Vision in Hanoi. The National Forum was organised by Oxfam GB, Red Cross, and MARD, with the participation of 80 individuals from eight provinces and various organisations. Consultation with Oxfam's Humanitarian and Livelihood Programme staff helped us to fine-tune the work, especially in terms of gender, impact assessment, and presenting policy suggestions.

Figure 5: Interviewing a member of the People's Committee of a commune

3. An overview of Ninh Thuan province

Ninh Thuan is located in the far south of central Viet Nam, with coordinates of 11°18'14" to 12°09'15" North latitude and from 108°09'08" to 109°14'25" East longitude. It borders Khanh Hoa to the north, Binh Thuan to the south, Lam Dong to the west, and East Sea to the east. The province has a total area of 3358 km^2, with 105 km of coastline. The geography is characterised by plains, mountains (with ranges surrounding the province), and coastal areas. The diversified terrain slopes to the east, towards the sea. The capital, Phan Rang, is at the centre of the province. There are five districts: Thuan Bac, Ninh Hai, Ninh Phuoc (coastal plain districts), and Ninh Son, Bac Ai (mountainous districts).

3.1. Topography

The province is surrounded by mountains on three sides. The land slopes from the west to the east and north-west to south-east. The high mountain areas occupy 60 per cent of the total geographical area. There are eight mountains higher than 1000 m: six in Bac Ai and two in Ninh Hai districts.

3.2. Meteorology and climate

Ninh Thuan is one of the hottest and most drought-ridden areas in the country. The Truong Son mountain range is situated such that it obstructs the wind throughout the year. The province has the lowest average rainfall in the country, but some storms and floods occur in October and November. The terrain intensifies the damaging impact of storms, characterised by heavy rains and floods, with harmful impacts on crop production and livelihoods.

Ninh Thuan province is the hottest province of Viet Nam, with an average temperature of about 27 ^{O}C. The highest temperature recorded was 40.5 ^{0}C at Nha Ho station in 1937. The lowest temperatures recorded were 14 ^{0}C at Nha Ho station in 1964, and 14.4 ^{0}C at Phan Rang station in 1931. There are two seasons: the rainy season, from July to November, and the dry season, from December to June. Normally, the amounts of rainfall received differ between the mountainous and the costal regions. The annual rainfall in the coastal town of Phan Rang–Thap Cham is 712 mm; it is 1071 mm in Tan My, and 1659 mm in Song Pha. Rainfall can reach 2200 mm/year in the upstream areas. Rainfall is heaviest from September to December.

3.3. Socio-economic conditions

3.3.1. Population

Ninh Thuan has a population density (167 persons/km^2) lower than the national average (252 persons/km^2). In 2005 it recorded a population of 564,403, with 279,097 (49.5 per cent) males and 285,306 (50.5 per cent) females. The fertility rate declined from 38.3 per cent in 1992 to 20.6 per cent in 2005, although the population continued to increase. The mortality rate declined between 1992 and 2004 and increased again in 2005. Population growth has imposed additional demands on the environment and natural resources.

There are 28 ethnic groups in Ninh Thuan province. In Ninh Thuan the largest groups are the Kinh, Cham, and Reglay communities. According to the census data of 1999, there were 57,100 (11.3 per cent) and 47,600 (9.4 per cent) Cham and Reglay communities, distributed in coastal and mountainous regions respectively.

3.3.2. Health services

Recently there has been reasonable development of health services in the province. The numbers of beds and medical staff have been increasing, although there are still not enough (feedback from the local communities).

Table 4: Health-service infrastructure in Ninh Thuan province

Number of health establishments	2001	2002	2003	2004	2005
Hospitals, clinics, sanatoriums, etc.	76	78	73	72	74
Number of sick-beds	1085	1154	1145	1165	1294
Total health staff	1289	1337	1324	1289	1299

3.3.3. Education

Education facilities in Ninh Thuan province have also shown rapid development, along with the population growth.

Table 5: The development of education facilities in Ninh Thuan province

Number	2001	2002	2003	2004	2005
Schools	168	175	181	194	198
Classes	3604	3754	3837	3871	3877
Teachers	4567	4750	4999	5139	5231
Students	122,834	126,444	126,696	128,607	126,138

3.4. Main livelihoods

Figure 6: Maize cultivation provides an assured income to the rural population in this part of Viet Nam

Accounting for 50 per cent of the province's gross domestic product (GDP), agriculture employs more than 70 per cent of the labour force. The main agricultural crops grown are rice, maize, and peas. Recently, in the coastal areas, the aquaculture industry (shrimp farming) has been established, with some remarkable initial benefits. The rearing of drought-resistant sheep breeds and the growing of grapes are on the rise. There has also been expansion in maize cultivation because of its versatility and low water requirements, compared with crops such as wetland rice.

3.4.1. Agriculture

The main crops of Ninh Thuan province are rice, maize, peas, grapes, and short-day crops such as tomato, carrot, and potato. The agriculture sector plays a very important role in the economic development, food supply, and livelihoods of most of the population of Ninh Thuan province. There has been a change in the area under paddy, due to growing population, economic development, and increasing demand for food. The area under paddy cultivation increased from 28,713 ha in 1992 to 33,852 ha in 2004. In 2005, due to drought, the area under paddy cultivation was reduced by half. Along with paddy, maize is a very important crop for the people of Ninh Thuan in general and Reglay communities, who live in mountainous areas, in particular. Maize is the secondary food source for the people here. Due to recent droughts, some of the paddy area has been converted into maize cultivation (Figure 7). As a result, the production of maize has grown by several multiples since the 1990s.

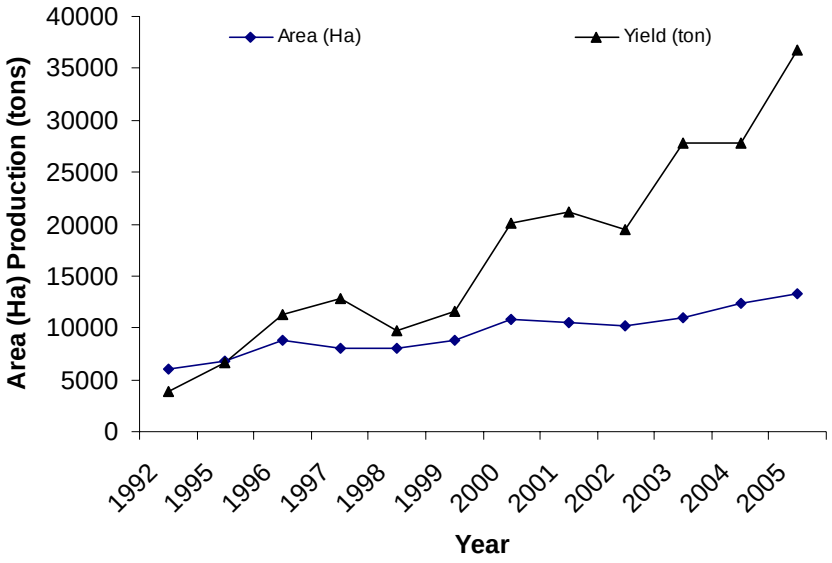

Figure 7: The area (ha) and production (tons) of maize in Ninh Thuan province since 1992

3.4.2. Animal husbandry

Farmers in Ninh Thuan province raise mixed flocks of goats and sheep. They keep large herds on small farms at a low cost by integrating their production with neighbouring farms. The animals are fed on a cut-and-carry basis during the wet (cropping) season. Most farmers grow Napier grass for cutting, or some other type of improved pasture. They also grow tree legumes such as Gliricidia, which provide forage and add nutrients to the soil.

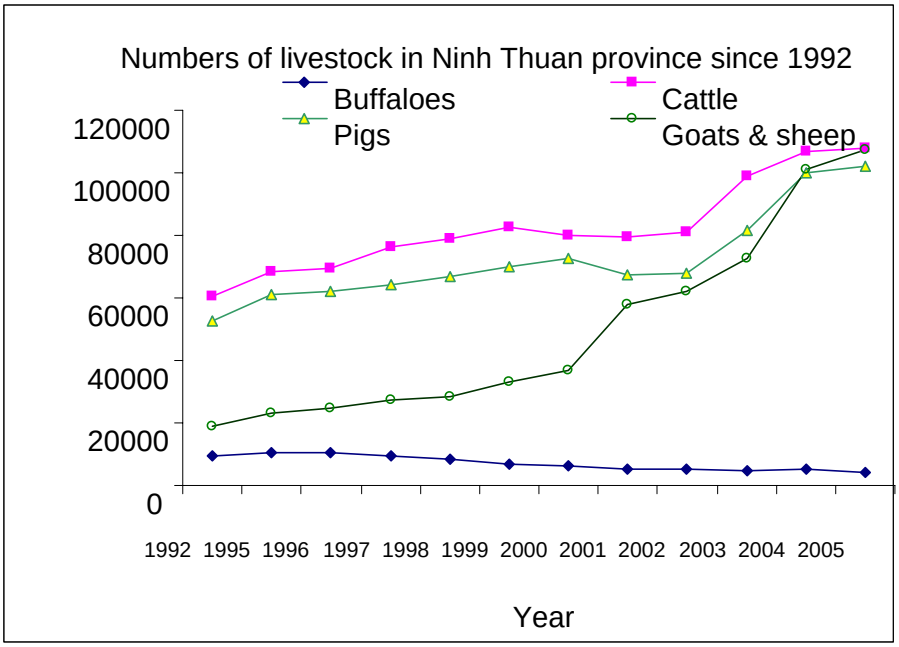

Figure 8: The change in numbers of domestic animals in Ninh Thuan province since 1992

The animals graze on the fallow land of neighbouring farms, as farmers are happy to let them graze in their fields during the dry season. The herds help to keep down weeds and fertilise the soil with their droppings. Some farmers sell the manure to fruit and vegetable farms in the upland areas. The Sultan breed of sheep from India, which tolerates high temperatures, is the most preferred breed in the province. They are bred for their meat and not for their wool, and hence do not need shearing. Most farmers keep mixed herds of sheep and goats. There is a good market demand for both sheep and goat meat, both selling at the same price. Cattle are also a priority animal and contribute to the livelihoods of communities.

Poultry keeping is another important livelihood activity for communities. Almost all the households keep poultry birds, which provide a regular source of proteins and income. However, recently, the number of poultry has been declining, due to avian flu.

3.4.3. Forestry as a source of livelihood

Ninh Thuan province had a forest area of 147,536 ha in 2005, consisting of 139,657 ha of natural forest area, 7879 ha of planted forest, 768,634 ha of bald hill, and 111,606 ha under others. There have been some changes in the forest area during recent years. Although the forest cover might seem high (43.9 per cent in 2005), forest density has declined, due to excessive illegal deforestation and severe drought-induced forest fires.

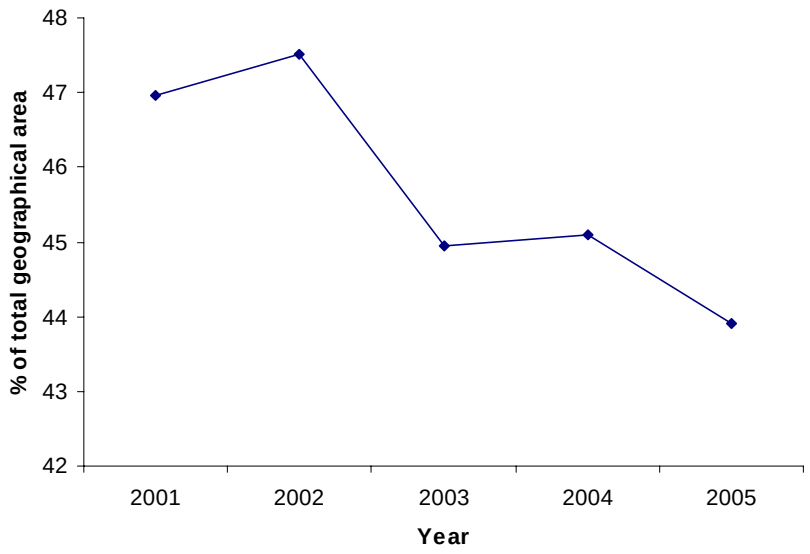

Figure 9: The percentage of area under forests in Ninh Thuan province in recent years

3.4.4. Fisheries and aquaculture

Ninh Thuan has a coastline of 105 km, covering 18,000 sq km, including the three seaports of Dong Hai, Ca Na, and Khanh Hai. Ninh Thuan territorial waters are one of the four biggest fishing grounds, supplying significant stocks of seafood to the country. The province also has great potential for developing tourism and the fishing industry. The sea near Ninh Thuan has more than 500 kinds of fish and shrimp, including read snapper, grouper, mackerel, tuna, prawn, and squid. The total fish and shrimp reserves amount to 120,000 tons.

"We got good income from shrimp cultivation during 2000-2003. Since 2004, we suffered losses due to lack of enough fresh water for managing the shrimp ponds. We are in severe debt to the bank."

Nguyen Van Thinh, Villager of Hoa Thanh hamlet

Figure 10: Coastal fisheries have expanded in the drought-prone province, putting more stress on already scarce water resources

The area under aquaculture reached 1591 ha in 2004, due to the expansion of lagoons, bays, and big sandbars which are convenient for making salt. Large-scale aquaculture is concentrated in Nai lagoon, Ca Na, and Vinh Hy. The area had diminished in 2005, due to droughts, diseases, and declining profits. Water pollution has also contributed to the decline in the area.

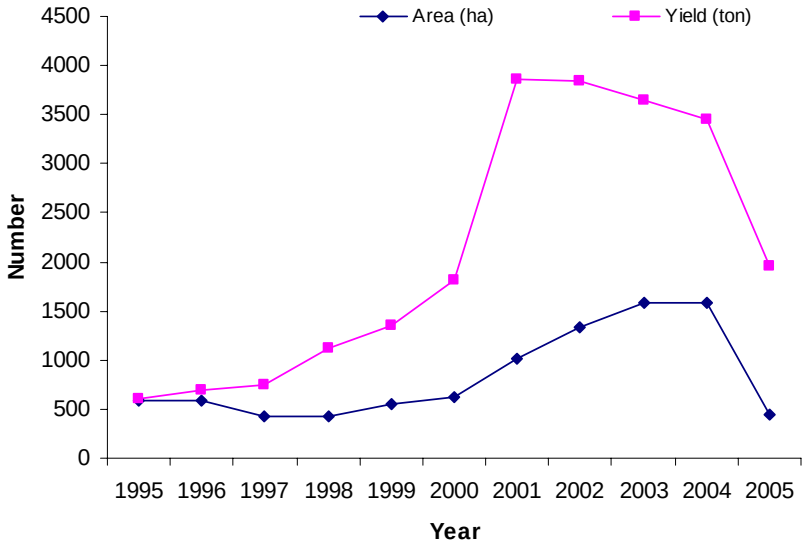

Figure 11: The change in area (ha) and yield (tons) of shrimp over the years

4. Disaster and climate-change vulnerability

4.1. Disaster vulnerability

4.1.1. Droughts

Fluctuations in the timing and duration of rains are the reasons for prolonged droughts affecting socio-economic conditions in Ninh Thuan province. Table 6 shows the impact of recurring droughts on various sectors. It shows that the drought that started in 2002 persisted until the end of 2004, making 2004 the most severe drought year. The 2004 drought was considered to be of historic significance, with severe impacts on socio-economic conditions in the province. During this year, the irrigated area of agricultural land was reduced by 5000 ha. This phenomenon was unknown to the governments and communities and caught them unawares. Lack of preparedness and lack of local knowledge in dealing with the persistent droughts has exacerbated the situation.

"The Central Government had built Song Sat dam and reservoir to provide water for four communes in Bac Ai district, but we don't have enough capacity to build the secondary canals to bring water from the reservoir."

Nguyen Van Tuan, Vice Chairman of People's Committee of Bac Ai

Some of the drought vulnerability of Ninh Thuan province may be attributed to lack of adequate surface and sub-surface water resources and the declining irrigation capacity of the irrigation infrastructure facilities. Analysis of the available irrigation facilities reveals that the designed irrigation capacity of six irrigation reservoirs and 76 small dams in the province is 25,229 ha in total. However, they could irrigate only 16,573 ha (66 per cent of their total potential), as indicated in Tables 7 and 8.

Table 6: Impacts of past droughts on different sectors

Sector	Unit	2002	2003	2004
1. Areas of agricultural land affected by drought	Ha	4,400	2,909	5,185
Paddy	Ha	750	607	1,241
Other crops	Ha	3,650	2,302	3,944
2. Loss of planted forest	Ha	730	NA	1,200
3. Areas of aquaculture affected by drought	Ha	600	500	NA
4. Number of people needing water	Person	138,823	45,000	150,000
5. Number of people needing food	Person	26,886	72,405	184,115
6. Number of livestock needing water	Heads	150,000	70,000	230,000
7. Economic damage	Billions VND	138	30	140

Table 7: Area (ha) served by irrigation reservoirs in Ninh Thuan province

Name of reservoir	Location	Area (km^2)	Design area (ha)	Current command area (ha)
1. Tan Giang	Ninh Phuoc	148.3	3,000	1,400
2. Thanh Son	Phan Rang	17.5	250	140
3. Suoi Lon	Ninh Phuoc	8.0	125	35
4. CK7	Ninh Phuoc	30	100	110
5. Song Sat	Bac Ai	137.0	3,510	Under construction
6. Bau Ngu	Ninh Phuoc	21.5	160	Under construction
Total			7,145	1,685

Table 8: Area (ha) served by 76 small dams in Ninh Thuan province

Name of dam	Location	Area (km^2)	Design area (ha)	Current command area (ha)
19/5	Ninh Son	32	300	200
Song Ong	Ninh Sin	30	3,200	2,000
Tra Co	Bac Ai	60	50	45
Ma Noi	Bac Ai	33	63	40
Nha Hui	Bac Ai	25	300	300
Nha Trinh	Ninh Hai, Phan Rang and Ninh Phuoc	2,140	12,800	11,515
Tuan Tu	Ninh Phuoc		250	180
30 other dams	Entire province		621	358
Underground water facility	Entire province		500	250
Total			18,084	14,888

There is a big gap between water demand and water supply in Ninh Thuan province. The capacity of irrigation systems can satisfy only 33 per cent of the demand.

In addition to this irrigation and water infrastructure, water-supply systems have been established to provide piped water to the urban and rural areas. With the current water-supply systems, each person in the cities could get a water supply of 80 litres per day. In response to the policy of the Central Government on clean water supply for rural areas, the provincial governments, NGOs, and districts have built a number of groundwater systems supplying $50m^3$/day to $500m^3$/day of water to rural areas. This enabled nearly 46 per cent of the rural population to get clean water in 2004.

Table 9: Piped water supply for urban and rural areas

Water works	Number of projects	Water source	Capacity (m^3)
1. Urban waterworks	3		14,000
Thap Cham	1	Cai River	12,000
Phuoc Dan	1	Underground water	1000
Tan Son	1	Ong River	1000
2. Water supply for rural areas	39		6915
Ninh Phuoc	11	Groundwater	1869
Ninh Hai	14	Groundwater	2436
Ninh Son	5	Groundwater	1945
Bac Ai	9	Groundwater	665

4.1.2. Floods

According to the Floods and Storm Management Board, Ninh Thuan province is also vulnerable to floods. Table 10 provides an overview of the impacts of recurring floods on Ninh Thuan province.

Table 10: Impacts of flood on Ninh Thuan province

Sectors	Units	1998	1999	2000	2003
1. Human mortality	People	30	1	11	15
2. Houses collapsed	Houses	10,614	438	7,859	23,000
3. Classrooms damaged	Rooms	27	3	143	137
4. Boats sunk	Boats	9		5	22
5. Area flooded	Ha	13,094	3,083	7,082	15,591
Paddy	Ha	7,034	2,241	3,988	9,190
Other crops	Ha	4,012	552	2,199	4,886
Garden	Ha	2,048	290	895	1,515
Other trees	Ha	4,012	550	1.324	4,765
6. Livestock mortality	Heads	1,085	550	27,000	45,644
7. Irrigation systems damaged	Projects	18	15	17	50
8. Roads damaged	Projects	85	8	73	170
9. Aquaculture damaged	Ha	100	10	64	1,059
10. Economic damage	Billion VND	133.4	7.1	122.4	191.0

4.1.3. Storms

Storms caused by low atmospheric pressure often occur between October and December. On average, less than one storm event occurred in Ninh Thuan province per year (one in three years). Years 1968 and 1995 recorded two and three storms respectively, causing them to be considered as the most storm-affected years in the history of Ninh Thuan.

4.2. Climate-change vulnerability

Ninh Thuan province was formed in the year 1991, and the meteorological station established at Phan Rang began recording temperatures from 1993. For this study, the temperature data were obtained from Phan Thiet meteorological station (source: Institute of Meteorology and Hydrology, Hanoi), while the rainfall data were obtained from the Phan Rang station (source: Centre of Meteorology and Hydrology, Ninh Thuan province). Figures 12 and 13 show the long-term trend of annual total rainfall and mean minimum and maximum temperatures. Please refer to Figure 2b for the location of hydro-meteorological stations.

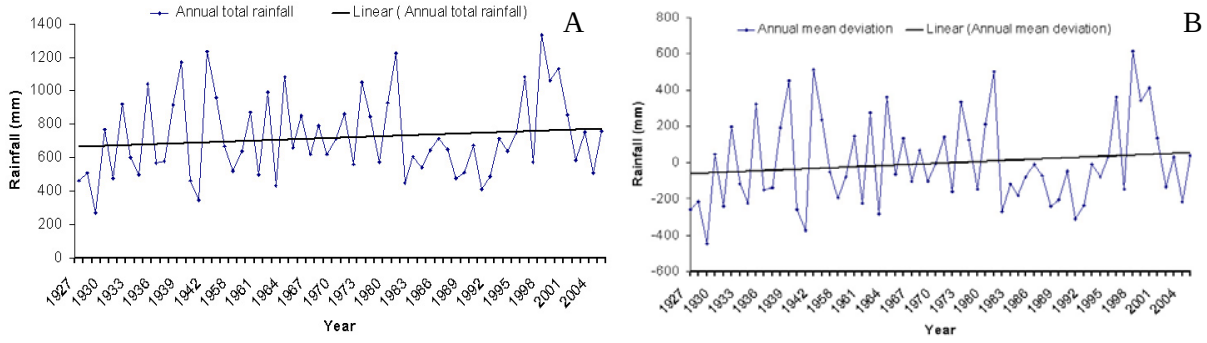

Figure 12: Annual total rainfall (A) and mean deviation of annual total rainfall (B) recorded at Phan Rang station in Ninh Thuan province

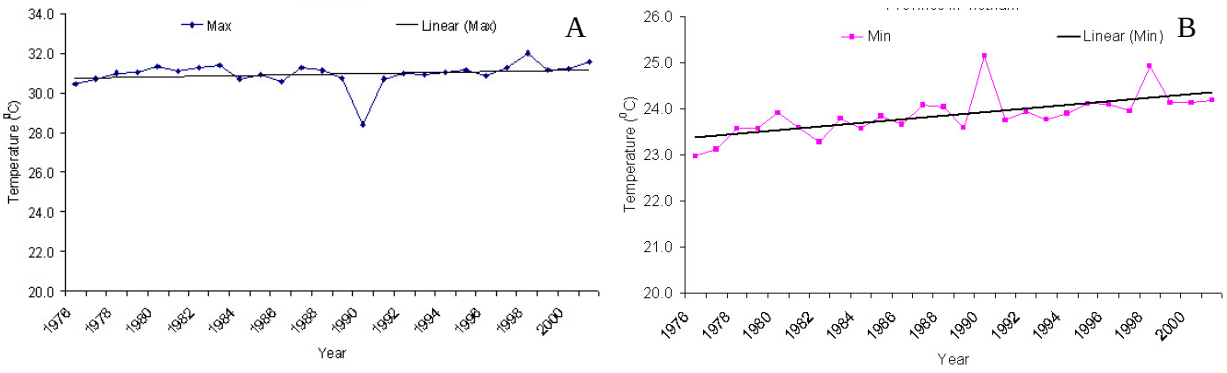

Figure 13: Mean annual maximum (A) and minimum temperatures (B) recorded at Phan Thiet in Binh Thuan province

The long-term data indicated an overall increase in rainfall, and also in the mean annual minimum and maximum temperatures. Although the increasing rainfall may appear to be a favourable phenomenon to some extent, caution is required in reading the data presented here. Figure 12(B) indicates a steady increase in the deviation of annual rainfall from the long-term mean. The figure also shows large differences between years, which is an indication of the high rainfall variability. Such a wide variation in rainfall could result in droughts and floods if surface-water resources and rainwater are not managed appropriately.

Figures 13(A) and 13(B) show changes in mean annual maximum and mean annual minimum temperatures, indicating a steady increase since 1978. The increase in the minimum temperature is much steeper than the increase in maximum temperature, an indication of warming nights over the years. This means more transpiration, even at night-time, and hence higher water demand by the crops.

The simulation experiments conducted by the Ministry of Natural Resources and Environment, Viet Nam (2003) indicated that the south of South-Central Viet Nam will receive increased rainfall of the order of +5 per cent of the long-term average (Table 11): a continuation of past trends. Under these circumstances, it is clear that the inter-annual rainfall variability will increasingly affect the economic sustainability of this region, and that relevant management practices may have to be adopted in order to deal with the risk.

Table 11: Climate-change simulations for Viet Nam[4]

Factors	Region	Season	2010	2050	2070
Temperature is increasing	North-west, northern of North		0.5	1.8	2.5
	Northern plain		0.3	1.1	1.5
	North of Central		0.3	1.1	1.5
	Middle of Central		0.3	1.1	1.5
	South of Central		0.3	1.1	1.5
	High land		0.5	1.8	2.5
	South		0.3	1.1	1.5
Rainfall is increasing (+) or decreasing (-) (%)	North-west, northern of North	Rainy	0	0 to +5	0 to +5
		Dry	0	-5 to +5	-5 to +5
	Northern plain	Rainy	0	0 to +5	0 to +5
		Dry	0	-5 to +5	-5 to +5
	North of Central	Rainy	0	0 to +10	0 to +10
		Dry	0	0 to +5	0 to +5
	Middle of Central	Rainy	0	0 to +10	0 to +10
		Dry	0	0 to +5	0 to +5
	Northern part of South Central	Rainy	0	0 to +10	0 to +10
		Dry	0	0 to +5	0 to +5
	Southern part of South Central	Rainy	0	0 to +5	0 to +5
		Dry	0	-5 to +5	-5 to +5
	Central Highland	Rainy	0	0 to +5	0 to +5
		Dry	0	-5 to +5	-5 to +5
	South	Rainy	0	0 to +5	0 to +5
		Dry	0	-5 to +5	-5 to +5
Sea-level rise (cm)	All coastline	-	9	33	45

[4] Initial National Communication, Ministry of Natural Resources and Environment, Socialist Republic of Viet Nam, Ha Noi, 2003.

5. Disaster and climate-change perceptions

This section discusses the results of questionnaire surveys conducted with communities and government officials. For the community responses, gender-disaggregated data are presented wherever possible.

5.1. Communities

5.1.1. Disasters and their trends

At all locations, respondents ranked droughts and floods as respectively the first and second most prevalent primary disasters at their locations. The survey revealed that the most prevalent secondary disaster is spread of infectious diseases – a reflection of deficiencies in the post-disaster response mechanisms.

Table 12: Ranking of disasters at study locations (percentage of respondents)

S No	Parameter		Coastal Region		Mountainous Region	
			Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
1	Most prevalent disaster I	Drought	85.0	100.0	100.0	100.0
2		Storm	15.0	0.0	0.0	0.0
3		Flood	0.0	0.0	0.0	0.0
	Most prevalent disaster II	Drought	15.0	0.0	100.0	0.0
		Storm	15.0	0.0	0.0	100.0
		Flood	85.0	100.0	0.0	0.0

Respondents could identify changes in disasters experienced at all locations in the past 30 years. They reported that the droughts are more prolonged, due to increasingly scanty rainfall. There is also a shift in the flood season, with floods taking place later than usual.

Table 13: Trends in disasters in the past 30 years

S No	Parameter	Coastal Region		Mountainous Region	
		Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
1	Prolonged drought	81.7	61.5	20.0	100.0
2	More flood events	10.0	3.8	0.0	0.0
3	More storm events	0.0	3.8	0.0	0.0
4	Flood season comes later	5.0	3.8	32.0	0.0
5	Reduction in rainfall	0.0	15.4	48.0	0.0
6	Cannot say	3.3	11.5	48.0	0.0

The reason for the change in disaster trends is not clearly understood by communities. However, respondents attributed the impacts to bad environmental practices elsewhere (36.7 per cent) rather than within their own community (14.3 per cent). (Only respondents in Ma Ro believed that the observed changes are due to bad practices within their community (25.9 per cent) rather than to practices elsewhere (14.8 per cent)).

5.1.2. Disaster impacts

Recurring disasters have multiple impacts on communities. The impacts identified by communities are listed in Table 14. The impact on crops and animals was identified as the most important. The loss of income, which is a cumulative effect of impact on cropping and animal husbandry, was ranked third at most of the study locations. Impact on availability of fodder and children's education has also emerged as significant.

"I am well but not happy. Our harvests are much smaller than usual. My family used to get about three quintals of rice, but we only got 50 kg per season in the last two years. The drought started in April 2004, and since then everything has dried up."

Le Xuan Tri, Hoa Thanh

Figure 14: Recurring crop failure due to severe droughts is a cause for concern

Table 14: Impacts of the most prevalent primary disaster on households

Impact	Coastal Region		Mountainous Region	
	Long Binh	**Hoa Thanh-Nam Cuong**	**Da Ba Cai**	**Ma Ro**
1	Crop failure	Crop failure	Crop failure	Crop failure
2	Losses in animal husbandry	Losses in animal husbandry	Losses in animal husbandry	Losses in animal husbandry
3	Loss of income	Loss of income	Impact on the health	Loss of income
4	Lack of fodder for cattle	Impact on the health	Death of garden and forest trees	Death of garden and forest trees
5	School dropout	School dropout	Loss of jobs	Loss of jobs

The responses by both men and women were disaggregated and tabulated in Table 15. Both sexes agreed on many of the drought impacts presented below.

Table 15: Top five ranked impacts of drought on households (gender-disaggregated data)

Impact	Coastal Region		Mountainous Region	
	Long Binh	**Hoa Thanh-Nam Cuong**	**Da Ba Cai**	**Ma Ro**
Males	1. Unprofitable aquaculture 2. Unprofitable animal husbandry 3. School dropouts 4. Loss of jobs 5. Lack of feed for animals	1. Failure of crops 2. Unprofitable animal husbandry 3. Lower income from animal produce 4. Loss of income 5. School dropouts	1. Failure of crops 2. Unprofitable animal husbandry 3. Loss of income 4. Death of vegetation 5. Loss of jobs	1. Failure of crops 2. Unprofitable animal husbandry 3. Loss of income 4. Death of vegetation 5. Loss of jobs
Females	1. Unprofitable agriculture 2. Unprofitable animal husbandry 3. Lack of feed for animals 4. Health losses 5. School dropouts	1. Failure of crops 2. Loss of income 3. Unprofitable aquaculture 4. Loss of jobs 5. School dropouts	1. Failure of crops 2. Unprofitable animal husbandry 3. Lack of fodder for animals 4. Decline in water resources 5. Loss of income	1. Failure of crops 2. Unprofitable animal husbandry 3. Death of natural vegetation 4. Loss of income 5. Loss of jobs

Drought impacts at the community level

The following impacts were identified by the National Forum conducted in Hanoi.

Livelihoods

1. Lack of fodder; lack of drinking water for cattle, for irrigation purposes, and industries
2. Reduced crop yield and reduced quality
3. Impaired productivity of forest land
4. Land degradation
5. Damage to fish farming

Food security

1. Loss of availability of food
2. Loss of availability of nutritious food

Health

1. Dependence on unsafe drinking-water sources
2. Insufficient water for hygiene purposes
3. Stress due to loss of livelihoods and income

Economic impacts

1. Loss of income from agriculture and fishery
2. Loss of employment
3. Increased prices of food and fodder

Social impacts

1. Migration and related impact on families/communities and on social structure
2. Loss of human life
3. Increased inequity among social groups
4. Increased conflicts
5. Increased mental and physical stress
6. Increase in crime rate
7. Reduction in school attendance
8. Increased burden on women and children
9. Increased burden on government and non-government organisations

Environmental impacts

1. Increase in deforestation, partially due to forest fires
2. Environmental pollution
3. Extinction of endangered species and loss of bio-diversity

Impacts on different sexes, age groups, and livelihoods

The impact of drought on women and children needs to be emphasised. Women in these communities collect water from the nearest water source (farther and farther away as each drought takes its toll). They do work such as cooking and cleaning, rearing children, and collecting firewood. In addition, they also work in agricultural farms, earning income for their family. Women in these communities lack the skills needed for employment in less burdensome jobs. So they have to cope with enormous physical burdens on a daily basis. The situation worsens during droughts. With fewer water sources near the dwelling, they will have to walk long distances to fetch drinking water.

"My children had to drop out of school to help me to collect drinking water from the stream very far from our house."

Ca To Thieu, Villager of Ma Ro hamlet

Figure 15: Interviewing female respondents: exploring the gender-differentiated impacts of drought

Sixty-three per cent of respondents agreed that recurring disasters have differential impacts on males and females; 74 per cent of respondents believed that the women were more severely affected by the drought than the men. The percentage of respondents who reported greater impact on females was higher in Hoa Thanh-Nam Cuong (91.7 per cent) than at other locations. Respondents said that differential impacts of the drought were due to the differing needs for water of males and females. Water scarcity obliges women to walk long distances to fetch water. The survey also reiterated that older members of society and children are much more vulnerable to the drought. These impacts were attributed to the prevalence of heat waves and malnourishment during drought.

Table 16: Does drought have differential impacts on males and females?

S No		Coastal Region Respondents		Mountainous Region Respondents	
		Male	Female	Male	Female
1	Yes	50.3	53.6	74.6	59.7
2	No	49.7	46.4	25.4	40.3

Respondents believed that farmers are more affected by drought than any other section of society. This response was uniform throughout the study locations. It signifies that the primary impact of the drought is on crops. Due to insufficient water resources, both surface and subsurface, crops are often vulnerable to drought. Rural artisans were ranked the second most severely affected after farmers. This opinion is linked to the declining purchasing power in rural areas, which in turn affects much-needed economic activities required to maintain secondary rural livelihoods, such as those of rural artisans.

In general, men and women agreed about the gender-differentiated impacts of the drought. However, a wider difference of opinion was found in the mountainous region, where more men (74.6 per cent) than women (59.7 per cent) believed that drought has differential impacts on males and females.

Table 17: Vulnerability of different sections of society to drought impacts (gender-disaggregated data)

Respondents	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Males	All are vulnerable	All are vulnerable	All are vulnerable	Men
	Old persons	Old persons	Children	Old persons
Females	All are vulnerable	All are vulnerable	All are vulnerable	Women
	Old persons	Old persons	Children	Old persons

Table 17 compares men's and women's perceptions about the vulnerability of different sections of society to drought. There was agreement on the vulnerability of all to the drought, and on the particular vulnerability of old persons and children. Surprisingly, the male respondents from Ma Ro believed that males are more vulnerable than others – a belief most probably due to the failure of crops and the consequent loss of jobs and income. They believed that women engaged in no economic activity and hence had nothing to lose due to the drought.

Increase in health problems in women

Unhygienic conditions and drought are closely related in the study areas. Water shortage means that many women either do not bathe or bathe sparingly, which leads to hygiene-related health problems. The proportion of women affected by gynaecological diseases increased from 57 per cent in 2004 to more than 60 per cent in March 2005 across the province, while in the Bac Ai and Ninh Phuoc districts the figures were 55 per cent and 61 per cent (2004), respectively (source: Oxfam's assessment report conducted in 2005).

Increase in the prevalence of diarrhoea among the children

According to the statistics of the Provincial Health Centre, 1304 cases of diarrhoea in children were reported in 2004 in the whole province, an increase of 4.9 per cent compared with normal levels. The increase was attributed to water scarcity and unhygienic conditions. Boiling water was not a prevalent practice, either because it was never necessary before, or due to scarcity of firewood (source: Oxfam's assessment report conducted in 2005).

5.1.3. Vulnerability trends

Communities believed that they were increasingly becoming vulnerable to natural disasters such as droughts and floods (77.3 per cent of respondents). The percentage of such respondents was higher in the coastal region than in the mountainous region, although the differences were not great (statistically not tested). Interestingly, the percentage of respondents who believed that their vulnerability is diminishing over time was higher in the mountainous region (13.6 per cent) than in the coastal region (1.9 per cent). This vulnerability is cumulative, relating to both primary and secondary disasters in both the regions. However, the percentage of respondents who did not perceive any change in their vulnerability was higher in the coastal region (18.5 per cent) than in the mountainous region (11.6 per cent). It could be argued that vulnerabilities are increasing despite development initiatives.

"The humans and animals use the same water source in this stream. The polluted water is the source of health problems."

Cato Sinh, Da Ba Cai hamlet

Alternatively, it could be inferred that development initiatives have failed to instill confidence among communities.

The gender-disaggregated analysis of changes in vulnerability did not reveal much difference in opinion among respondents. However, female respondents in the mountainous region were more likely to believe that their vulnerability was diminishing over time than were their counterparts in the coastal region.

Table 18: Is your vulnerability changing over the years?

S No		Coastal Region		Mountainous Region	
		Males	Female	Male	Female
1	Increasing	79.5	79.2	81.8	61.4
2	Decreasing	3.3	0.0	12.1	17.0
3	No change	17.2	20.8	6.1	21.6

The discussions and questionnaire surveys did not reveal much information on communities' perceptions of the reasons why their vulnerabilities to natural disasters are increasing. Across the study locations, 83.6 per cent of respondents could not identify reasons why their vulnerabilities were increasing. However, more respondents in the coastal region could suggest reasons (19.5 per cent cited cutting of forests) than in the mountainous region (3.9 per cent cited changing weather patterns). When asked if the changes that they observed were due to climate change, only 12.7 per cent agreed, while 83 per cent could not comment.

"We don't want to go to forest to cut trees, but we have no choice. We have to go there for our food."

Chamale Anh, Ma Ro hamlet

Figure 16: Illegal cutting of forests is a major cause for concern

5.1.4. Disaster management

Communities were also asked for their opinions about the disaster-management systems in operation in their location. Questions focused on the early warning and preparedness mechanisms, because they enable communities to be prepared and they help to reduce the impact of recurring disasters.

Limitations of current drought-management initiatives

The following limitations were identified by the National Forum conducted in Hanoi.

1.1.1. Policy-related and regulation-related limitations

- Insufficient importance given to drought-risk management, including preparedness programmes, by the government institutions
- Lack of drought-management boards at provincial, district and commune levels
- Absence of policies for agricultural assistance
- Lack of long-term programmes for drought preparedness
- Poor participation of appropriate authorities in decision making and development planning
- Conflict between various social and economic sectoral organizations, hindering the development and implementation of drought-risk management initiatives
- Overlap of authority and decision-making powers in administrative management
- Lack of appropriate regulation on water exploitation
- Poor management of irrigation projects
- Poor participation of communities in long-term drought-mitigation programmes

1.1.2. Knowledge, technology, and human resources

- Lack of knowledge of drought preparedness
- Lack of information on appropriate agricultural practices
- Lack of human resources, especially technical staff who can advise farmers on better management practices
- Absence of reliable drought-forecasting mechanism
- Ill-informed attitudes of communities and some government institutes on climate change, drought, and environment
- Lack of drought-resistant crop varieties and animal breeds

1.1.3. Financial limitations

- Lack of sufficient financial support during periods of drought
- Financial deficits on irrigation projects
- No budget for drought preparedness at provincial level and below

Early-warning systems

Drought is known to provide several natural indicators before and during its occurrence. Globally, there has been much emphasis on identifying such traditional early-warning signs. Indicators used

in traditional systems include changes in animal behaviour, vegetation characteristics, nutritional characteristics, and weather and climate patterns. However, the survey could not identify the existence of traditional early-warning mechanisms such as observation of changes in animal behaviour, because these seem to have been overshadowed by modern approaches such as obtaining weather information from community leaders and from other communication channels such as radio and television. More communities obtained early-warning information from their community leaders in the mountainous region (55.2 per cent) than in the coastal region (0 per cent), reflecting the active community leadership in disaster-risk management in the mountains. Coastal communities obtained early warnings through modern communication media such as radio and television (86.5 per cent of respondents). By contrast, only 16 per cent of respondents in the mountainous region obtained early warning from radio and television. This could be interpreted as an indication of developmental differences between these two regions. When asked specifically about their sources of early warning within the government, the majority of respondents, irrespective of the region, said that they obtained early warning from local community leaders (78.2 per cent). Early-warning mechanisms were better developed for flood forecasting than for drought.

Figure 17: Early-warning systems are well developed for floods, but not for drought

Most respondents felt that the existing early-warning systems were sufficient for them to identify impending disaster such as floods (52.9 per cent). This number is much higher in the coastal region (67.8 per cent) than in the mountainous region (37.9 per cent). Such differences could be potentially attributed to the medium through which the early warning is received (community leaders in the mountainous region vs. television and radio in the coastal region), and the type of information they received (the survey did not consider the contents of the early warning provided to communities). Asked if the warnings they receive are timely, 77.6 per cent of respondents agreed. Improving the radio broadcasting system emerged as a major suggestion from communities at all study locations in the coastal region (64 per cent). In Hoa Thanh-Nam Cuong, communities wanted training to help them to understand the early-warning and dissemination systems (11.5 per cent), and some wanted weather information to be provided direct to communities, to enable it to be readily disseminated within the community (3.8 per cent).

When asked about the time taken for their areas to be declared disaster-affected, 55.8 per cent of respondents in the coastal region said they usually received the declaration in the second week

after the occurrence of disaster. The time taken to declare the areas affected by the disaster is much longer in the mountainous region. Communities in the mountains believe that typically they are not declared as disaster-affected until three weeks after a disaster occurs (36.4 per cent). When asked about the role of communities in the disaster declaration, 38 per cent of respondents believed that they had no role. This percentage was higher in the coastal region (52.7) than in the mountainous region (23.3). However, community members had a role in reporting disaster impacts to community leaders at both study locations, according to 44.6 per cent of respondents. The communication of disaster information to neighbours was higher in the mountains (30.1 per cent) than in the coastal region (4.7 per cent). This corroborates earlier results on information sources at both locations. Communities said they had a role in reporting the damage (40.1 per cent) and damage assessment (15.4 per cent), while 44.5 per cent of respondents felt they were not involved in disaster-damage assessment or disaster declaration. More communities were involved in reporting the damage in the mountainous region (57.2 per cent) than in the coastal region (23.1 per cent).

Disaster response

The objective of providing early warning is to enhance preparedness, to speed up the response after the disaster and ensure that the impacts are reduced to a minimum. Irrespective of the study location, respondents believed that communities are the first to respond to disasters (85.4 per cent). All respondents in the coastal region reported communities as the first respondents. NGOs (20 per cent in Da Ba Cai) and local government (18.5 per cent in Ma Ro) were also reported to be first respondents to disasters in the mountainous region. Food preservation (storage) appears to be the major adaptation mechanism of communities (32.7 per cent of respondents), followed by preservation of seeds for the next cropping season (24.6 per cent). Communities in the coastal region accorded greater priority to saving water (21.3 per cent of respondents) than in the mountainous region (13.3 per cent), due to its greater relative scarcity in the former.

"We built five big cement tanks for filling drinking water from the streams, but the streams have dried up so there is no water to fill the tanks."

Chamale Tien, Chairman of Phuoc Thanh People's committee

Figure 18: Water-storage jars supplied by UNICEF in Phuoc Thanh commune

The response of NGOs to droughts includes provision of water-storage facilities such as temporary storage tanks and water jars (23.5 per cent of respondents in the coastal region and 18.5 per cent in the mountainous region) (Figure 18); supply of food grains (20.2 per cent on the coast and 5.6 per cent in the mountains); and providing training in disaster management (only in the coastal region). Provision of food grains, building community wells, and establishing

community volunteer teems to supply water constitute the primary responses of local and provincial governments (Table 19), while the central government is known to provide food and financial assistance.

The adequacy of disaster response by communities, NGOs, and governments was found to be different at different locations. Communities in the coastal region were more happy with the response by various stakeholders (59.2 per cent said it was adequate) compared with respondents in the mountainous region (where only 4 per cent said that the response was adequate). Lack of knowledge in dealing with drought situations and insufficient means of storing water were identified as major limitations in drought-risk management across the study locations, despite the efforts made by various stakeholders at all study locations.

Table 19: Responses of local, provincial, and central governments to drought (% of responses)

Responses	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Communities				
1. Saving water	35.0	7.7	0.0	0.0
2. Preserving food	13.3	38.5	44.0	0.0
3. Preserving seeds	0.0	11.5	56.0	0.0
4. All the above	51.7	42.3		100.0
NGOs				
1. Water-storage facilities (tanks, ring wells, and jars)	31.7	15.4	0.0	37.0
2. Food assistance	25.0	15.4	0.0	11.1
3. Disaster training	-*	7.7	-	-
4. All the above	23.3	53.8	100.0	51.9
0. Do not know	20.0	7.7	-	
Local government				
1. Providing seeds	0.0	7.7	0.0	0.0
2. Building commune wells	0.0	19.2	0.0	0.0
3. Establishing volunteer teams to provide free water	-	30.8	-	-
3. All the above	100.0	42.3	100.0	100.0
Provincial government				
1. Food assistance	0.0	0.0	0	0.0
2. Irrigation facilities	0.0	0.0	100	0.0
3. All the above	100.0	100.0	-	100.0
Central government				
1. Food assistance	0.0	46.2	0	100.0
2. Loans	0.0	42.3	0	-
3. All the above	100.0	0.0	100	-
4.. Do not know	-	11.5	-	-

* indicates no data from these open-ended questions, due to failure to identify them as options

Communities were aware of the existing long-term drought-mitigation programmes being implemented by NGOs and local governments (85.6 per cent responded positively). However, the majority of respondents believed that they had no role in these programmes (89.3 per cent), while others identified roles such as participation in the local risk-identification process (risk mapping, for example), and identification of possible drought-mitigation programmes. However, the number of people who participated in such programmes and processes was low: only 10.7 per cent of respondents said they participated. Some of the drought-mitigation programmes in operation are listed in Table 20.

Table 20: Drought-mitigation programmes being implemented at study locations by NGOs and governments

	Organisations	Mountainous areas	Coastal areas
1	Central Government	Programme Number 135 (*) Programme Number 134 (*) Reforestation programme (*) Constructing irrigation systems (*) Food assistance	Reforestation programme (*) Constructing irrigation systems (*) Food assistance
2	Provincial Government	Development of new drought-resistant varieties (*) by the centre at Nha Ho Constructing irrigation systems (*) Digging wells Provision of new seeds for farmers at low cost	Development of new drought-resistant varieties (*) by Nha Ho centre Constructing irrigation systems. (*) Digging wells Subsidies for new varieties
3	Local Government	Digging wells	Digging wells
4	Oxfam GB	Improving food and income security for poor women and men in Bac Ai district (*) Poverty-reduction project in 2 communes in Bac Ai district (*) Storage facilities for food and water and public-health camps for communities in Bac Ai district Construction of wells and small water reservoirs Establishing pump service team in all villages of 2 communes in Bac Ai district Drought-response fund for 2 communes in Bac Ai district	Food and water storage facilities and public-health camps for communities in Ninh Phuoc district
5	UNICEF	Water supply for ethnic groups (*)	Installation of pump wells
6	ActionAid		Community-based model for disaster mitigation and management in Ninh Phuoc district. (*) (training and relief assistance)
7	Red Cross	Storage facilities for food and water	Storage facilities for food and water
8	World Vision	Storage facilities for food and water in Bac Ai district	
9	Counterpart International	Food assistance for 5 districts of Ninh Thuan province	

* Long term programmes

"Animal husbandry in Ninh Phuoc district has been coping with many problems. There is not enough fodder and drinking water for animals in the dry season. The price of fodder is increasing, and the price of animals is decreasing."

Ba Nien Huong, veterinary doctor of Ninh Phuoc district.

Figure 19: Indigenous cattle should be replaced by improved breeds for better income security and drought resistance

5.1.5. Climate change

Impacts

An attempt was made to ascertain whether communities understand and differentiate short-term weather phenomena and long-term climate-change phenomena. To our surprise, all respondents said they knew the difference between weather and climatic processes. However, none could explain the difference. In addition, it was not easy to obtain information on how communities use information about weather and climate in crop planning. Farmers here mostly rely upon the crop calendar decided by the agricultural department of the provincial government, which provides information on when to sow the seeds and when to apply particular management practices. Respondents said that their reliance on this mechanism made them think independently of weather and climatic information available outside the crop calendar.

Awareness of climate change plays an important part in prompting stakeholders to initiate positive action. Communities on the coast and in the mountains differed in their awareness. Most respondents in the coastal region were aware that the climate is changing (88.7 per cent of respondents), while none in the mountainous region stated a belief that the climate is changing.

"I do not know about the climate change, I just feel the change of weather. It is getting hotter day by day."

Chamale Hung, Villager of Da Ba Cai hamlet

Communities were asked to identify specific changes that they had observed in the climate. Their responses are presented in Table 21. Communities could identify increasing temperatures, declining rainfall, reduction in biodiversity (number, density, and composition), and increasing occurrence of disasters. It is possible to conclude from the results that, although communities in the mountainous region could not state that the 'climate is changing', they could very well identify the changes in various parameters of climate, such as those listed in Table 21. This suggests that the term 'climate change' may not be in common currency among communities, even though they could always identify its impacts.

However, the majority of respondents could not identify reasons for these changes (73.7 per cent in the coastal region and 100 per cent in the mountainous region). It is relevant here to cross-check these findings with the actual data presented in Figure 12, which show trends in rainfall patterns. The difference between observed and perceived trends could be attributed to the lack of long-term memory among communities, which put more emphasis on short-term changes in the climate, such as inter-annual variability of rainfall and temperature.

Table 21: Climate-change trends observed by communities (% of responses)

Impacts	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
1. Temperature (increasing)	83.3	73.0	80.0	92.3
2. Rainfall (declining)	76.7	73.1	80.0	65.4
3. Biodiversity composition (declining)	53.3	50.0	60.0	57.7
4. Biodiversity number/density (declining)	50.0	48.0	52.0	80.8
5. Disaster (magnitude, duration, and intensity)	80.0	52.0	76.0	88.5

The gender-disaggregated analysis of responses on impacts of climate change revealed more or less agreement between men and women. While both males and females could identify, broadly, that rainfall and local biodiversity were decreasing and temperatures and disasters were increasing, they differed to a certain extent in their awareness of the finer details of trends that they reported. The differences were much higher in Da Ba Cai, where female respondents observed no change in local biodiversity, while males reported a moderate decline in quantity and composition of biodiversity (Table 22).

Table 22: Gender-disaggregated responses on awareness of climate-change impacts

Impacts	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Males				
Temperatures	Moderately increasing	Steeply increasing	Steeply increasing	Steeply increasing
Rainfall	Decreasing steeply	Moderately decreasing	Moderately decreasing	Moderately decreasing
Biodiversity composition	Decreasing steeply	Moderately decreasing	Moderately decreasing	Moderately decreasing
Biodiversity number	No change	Moderately decreasing	Moderately decreasing	Moderately decreasing
Disasters	Increasing steeply	Steeply increasing	Moderately increasing	Steeply increasing
Females				
Temperatures	Moderately increasing	Steeply increasing	Steeply increasing	Steeply increasing
Rainfall	Decreasing steeply	Steeply decreasing	Steeply decreasing	Moderately decreasing
Biodiversity composition	Decreasing steeply	Moderately increasing	No change	Moderately decreasing
Biodiversity number	Decreasing steeply	No change	No change	Moderately decreasing
Disasters	Increasing steeply	No change/Steeply increasing	Moderately or steeply increasing	Steeply increasing

Adaptation strategies

Both autonomous and planned adaptation strategies were discussed with communities, and the results are presented here.

Autonomous adaptation strategies

The summary of findings is provided in Table 23. Communities could identify currently prevailing autonomous adaptation strategies in agriculture, animal husbandry, water resources, food, and economic security. Growing new crop varieties and formulation of seasonal calendars were major autonomous adaptation strategies designed to deal with impacts of drought on agriculture. In animal husbandry, introducing alternative livestock breeds and finding new feed and fodder sources were the most important practices in the mountainous region, while growing fodder crops had become an important strategy in the coastal region. Communities in the coastal region adopted a wider number of animal-husbandry strategies than in the mountainous region – a fact which could be a reflection of their developmental level.

Table 23: Autonomous adaptation strategies identified by communities (% of responses)

Strategy	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Agriculture				
1. Saving seeds	5.0	11.5	60	3.8
2. Changing the crop plan	16.7	46.2	40	0.0
3. Changing seeds (drought-resistant, short-day crops)	6.7	26.9	-*	69.2
4. Changing seeds and crop plan	55.0	15.4	-	26.9
5. All the above	16.7	0.0	-	-
Animal husbandry				
1. Changing breeds	0.0	11.5	32	19.2
2. Looking for new feed sources	0.0	7.7	68	38.5
3. Growing grass	42.0	26.9	-	-
4. Vaccinating animals	0.0	7.7	-	-
5. All the above	58.0	3.8	-	42.3
6. No action		42.3		
Water resources				
1. Digging wells	21.7	50.0	32	30.8
2. Re-using water	15.0	19.2	44	30.8
3. Economising on water use	55.0	26.9	24.0	15.4
4. All the above	8.3	3.8	-	23.1
Food safety				
1. Saving food	95.0	69.2	-	61.5
2. No action	5.0	30.8	100	38.5
Economic security (by improved income)				
1. Looking for new jobs	21.7	26.9	-	-
2. Moving to big cities for job	26.7	15.4	-	-
3. Saving money		3.8		
4. No action	51.7	53.8	100	100.0

* indicates no data from these open-ended questions, as respondents could not identify any adaptation practice in current use.

Planned adaptation strategies

Information on planned adaptation strategies is presented in Table 24. The major planned option in agriculture is to extend irrigation facilities by establishing deep wells and open wells. Provision of the latest varieties of seed at low prices has also been taken up by governments and NGOs. Vaccines for animals were provided in Long Binh during drought periods. Other major adaptation measures found in the water sector were the digging of wells (by both NGOs and governments) and provision of water-storage facilities such as portable tanks and jars (by NGOs). Supply of food grains and provision of loans during times of stress were other adaptation measures taken up by the NGOs and governments. Respondents felt that these measures could help them to reduce some of the impacts of drought (59 per cent of respondents). Male and female respondents from the mountainous region have fewer migration opportunities, due to their limited education and their lack of knowledge and skills that may be of use elsewhere. Most mountainous people belong to the ethnic-minority community and are deprived of education facilities. They prefer to live without much external intervention, as one of the respondents observed.

Table 24: Planned adaptation actions identified at study locations (% of responses)

Parameter	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Agriculture				
1. Build irrigation system (NGOs & government)	0.0	76.9	20	30.8
2. Provide low-price seeds (government)	0.0	15.4	24	69.2
3. All the above	100.0	7.7	56	-*
Animal husbandry				
1. Vaccinate (government)	100.0	34.6	-	42.3
2. Do nothing	0.0	65.4	100	57.7
Water resources				
1. Provide tools to collect and save water (NGO)	0.0	23.1	100	100.0
2. Dig pump wells (NGO & government)	0.0	15.4	-	-
3. Provide chemicals to treat polluted water	0.0	15.4	-	-
4. All the above	100.0	7.7	-	-
5. Do not know	-	38.5	-	-
Food storage/safety				
1. Give food assistance (NGO & government)	66.7	53.8	100	100.0
2. Do not know	33.3	46.2	-	-
Economic security				
1. Offer loans (government)	65.0	50	100	50.0
2. Do nothing	35.0	50	-	50.0

* indicates no data from these open-ended questions, due to failure to identify them as options.

Heavy reliance on groundwater had resulted in a decline of the groundwater table and an increase in saline water ingression in coastal areas. Communities believed that better financial support by government and better access to markets were needed in order to reduce their vulnerabilities. While better education, facilities for income diversification, and improving livelihoods were prioritised by the coastal communities, communities from the mountainous region identified income diversification and provision of better financial facilities as the most important strategies to reduce their vulnerability. At both locations, respondents feel that very few livelihood options are available to them. Communities rated government and NGOs equally in their interventions to reduce their vulnerabilities.

"Most of the villagers are trying to dig new wells, but the wells have become saline since 2003."

Vo Xuan Thanh, Hoa Thanh hamlet

Figure 20: Digging wells is a preferred drought-adaptation option for many intervening agencies, but the factor of groundwater recharge has been ignored

Gender-disaggregated responses showed that communities prefer financial support rather than other options for reducing their vulnerability to climatic events. However, more of the female respondents in Da Ba Cai and Ma Ro believed in income diversification than in direct financial support. This can be explained by the fact that both locations are in the mountainous region, where income-generation opportunities are poorly developed.

Table 25: Gender-disaggregated responses to initiatives to reduce vulnerability to climatic events (top-ranked options by respondents)

Impacts	Coastal Region		Mountainous Region	
	Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Males	Better financial support	Better financial support	Better financial support	Better financial support
Females	Better financial support	Better financial support	Income diversification	Income diversification

5.2. Government officials and mass organisations

This section describes interaction with government and non-government officials at village, commune, and district levels. The aim was to assess their perceptions of climate change and the disaster-management interventions currently in operation.

Officials, irrespective of the level at which they operate (i.e. village, commune, and provincial levels, in both coastal and mountainous regions), were well aware that the climate has been changing. However, they were not aware of how to translate this knowledge into tangible actions in their respective departments, because they lacked information on what kind of intervention could be implemented to reduce the impact of climate change. Officers were asked to rank sectors in terms of their vulnerability to climate-change impacts. Results from the coastal region showed a perception that agriculture is the sector most vulnerable to climate change, followed by animal husbandry, aquaculture, and forestry (Table 26).

Table 26: Vulnerability to climate change, ranked by sector

Coastal Region		Mountainous region	
Rank	**Sector**	**Rank**	**Sector**
1	Agriculture	1	Agriculture
2	Animal husbandry	2	Animal husbandry
3	Aquaculture	3	Forestry
4	Forestry		

Some indicators of change in disaster profile are given below:

- Change from floods and storms to drought conditions
- Increasing temperatures
- Decline in the number and intensity of storms.

The change in disaster patterns (in terms of intensity, duration, and periodicity of occurrence) was attributed to climate change. All respondents were aware that communities, governments, and NGOs can adapt to the changing climate. The following options were identified during focus-group discussions.

1. Preparation of hazard, vulnerability, and risk maps
2. Providing training to farming communities on various best-management practices that reduce water consumption while obtaining higher productivity
3. Introduction of high-yielding, short-duration, and high-temperature-resistant cultivars
4. Establishing small-scale irrigation schemes
5. Provision of micro-finance loans for women to initiate small-scale livelihood options such as petty trading, purchasing livestock, and growing crops
6. Providing training on raising new shrimp breeds that can withstand higher temperatures and resist diseases.

The following issues emerged during the group discussion conducted with government officials, when they were introduced to the findings of the study.

One of the root causes of community vulnerability to climatic events is related to local people's poor knowledge and lack of capacity to cope with natural disasters. It is more to do with the developmental state of communities in the study locations than with changing rainfall patterns. Inadequate food availability and consumption have been common problems with ethnic communities in the mountainous region since time immemorial, due to harsh environmental conditions and lack of knowledge of better management practices.

"We do not have enough fresh water for our basic needs since 2004. Almost all the pump wells in this village are affected by the saline water intrusion."

Mr. Diem, Long Binh village leader

Drought (lack of water and saline-water intrusion into fresh-water areas) is believed to be partly due to methods of cultivation. For example, there has been tremendous growth in the area under wet paddy, due to conversion from the dry paddy – a trend which has considerably increased the demand for water. Introduction of high-yielding varieties has only increased the burden on limited

water resources. Part of the increasing water demand was also due to increases in population. In addition, factors such as heavy reliance on groundwater resources, deforestation, and shifting cultivation have worsened the situation. Another reason is the increasing area under shrimp cultivation. There has been a tremendous boost in shrimp cultivation during recent years. Figure 11 supports this fact. The area devoted to shrimp production decreased in 2005 due to declining availability of fresh water, increasing diseases, and water pollution. For example, in the past 40 years annual per capita water availability was about 17,000 m^3. By 2005, that volume had declined to 4600 m^3. The root cause is the 'water war' between sectors such as agriculture, aquaculture, industry, and tourism. There is a need to share limited water resources among all sectors, paying particular attention to the needs of priority sectors such as agriculture, which provides livelihoods to more people than any other livelihood option. Health problems during drought, as well as normal times, are partly due to the prevalence of unhygienic conditions created by raising animals near houses and water sources, and using the same water source for animal and human consumption.

5.2.1. Short-term programmes

Several short-term options emerged during discussions with officers, including the provision, by NGOs, government, and other agencies, of food assistance and fresh-water supplies in drought seasons for both regions – mountainous and coastal.

5.2.2. Long-term programmes

The following long-term options emerged during discussions with officials.

Programmes	**Mountainous region**	**Coastal region**
Raise community awareness of environmental and natural-resource issues	x	x
Develop drought-resistant crop seeds	x	x
Enhance irrigation efficiency	x	x
Establish/find markets for animal products, grapes, cashew, etc.	x	x
Reduce the area under paddy cultivation and change land-use practices		x
Create new livelihoods that rely less on water (e.g. handcrafts, small-scale industries)	x	x
Establish individual water-supply companies to provide water for rural areas	x	x
Introduce legislation to encourage forest conservation and reforestation on bald hills to enable groundwater recharging	x	x
Reduce the area under shrimp farming and improve drainage canals		x

The water war between different sectors could be alleviated by assessing water needs and water supply for each sector; controlling water usage through taxes and subsidies as incentives; and increasing water-use efficiency.

6. Policy options

Policy options for planning drought-risk mitigation and reducing vulnerability to climate variability and change are identified in this section. Many of the options identified here corroborate suggestions made by officials, presented in the previous section.

6.1. Impacts

Impacts of recurring droughts and their root causes were identified through focus-group discussions. Initially, participants were asked to identify various impacts of droughts in their locality. These impacts were subsequently ranked according to the relative importance accorded to them by communities. Identified impacts were grouped into economic, social, and environmental categories and are presented in Table 27.

Table 27: Ranked impacts of recurring droughts in Ninh Thuan province

Category	Sub category	Coastal Region		Mountainous Region	
		Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
Economic	Agriculture	• Damage to crops • Unavailability of water for irrigation • Income loss	• Damage to crops • Income loss	• Death of maize, rice, and cassava crops • Drying and shedding of cashew nut fruits • Income loss	• Death of maize and cassava crops • Drying and shedding of cashew nut fruits • Income loss
	Animal husbandry	• Reduced productivity of cattle • Unavailability of feed and fodder • Unavailability of water	• Lack of fodder • Lack of water	• Lack of fodder • Lack of water • Diseases, under-nutrition, and starvation	• Lack of fodder • Lack of water • Diseases, under-nutrition, and starvation
	Water resources	• Lack of water • High cost of water	• Lack of water • High cost of water	• Disruption of water supplies for various activities • Lack of water	• Disruption of water supplies for various activities • Lack of water
Social	Health and nutrition	• Health-related problems (diarrhea and cold) • Food shortage	• Health-related problems • Food shortage	• Health-related problems (malaria, diarrhea, heat stroke) • Food shortage	• Health-related problems (malaria, diarrhea, heat stroke) • Food shortage
	Gender	• Both sexes spend considerable time in fetching water from long distances	• Both sexes spend considerable time in fetching water from long distances	• More stress on women when carrying water • Less per capita consumption of water by females	• More stress on women when carrying water • Women suffer more nutritional problems

Category	Sub category	Coastal Region		Mountainous Region	
		Long Binh	Hoa Thanh-Nam Cuong	Da Ba Cai	Ma Ro
	Others	• School drop-out • Migration to other provinces and cities for work • Old people are left unattended due to excessive migration of young people	• Short-duration migration • Migration to other provinces and cities for work	• Shifting into small dwellings	
Environmental		Loss of biodiversity	• Saline-water intrusion • Over-exploitation of groundwater • Loss of biodiversity	Loss of biodiversity	• Cutting down of forests for firewood as an economic activity • Loss of biodiversity

6.2. Root causes

In this section, underlying causes of climate-related problems are identified. Impact-tree diagrams were constructed for ranked impacts, and root causes were identified by asking probing questions such as '*Why the lack of water?*'. Some examples are given in Figures 23 and 24. Root causes are presented in Table 28. In some instances, more than one root cause was identified for each impact. Similarly, the same root cause can be traced to multiple impacts. Root causes for different hamlets within coastal and mountainous regions were merged, because root causes were identical within the region.

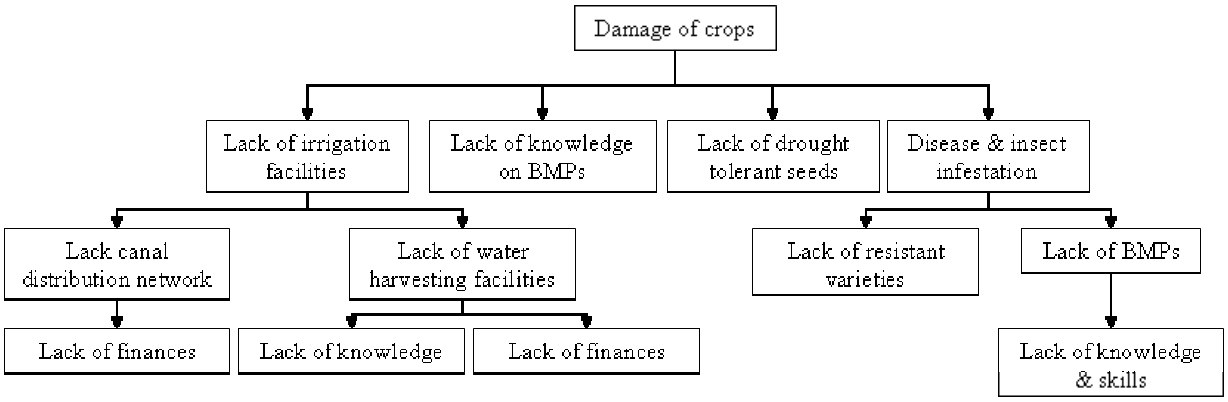

Figure 21: An example of an impact-tree diagram for agriculture

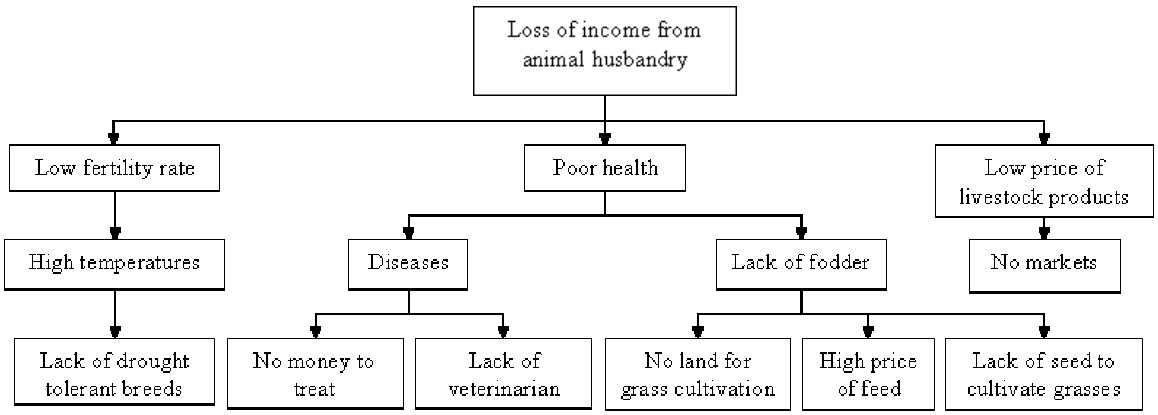

Figure 22: An example of an impact-tree diagram for animal husbandry

Table 28: Root causes identified for the highest-ranked impacts

Category	Drought Impact	Important root causes	
		Coastal Region (Long Binh & Hoa Thanh-Nam Cuong)	**Mountainous Region (Da Ba Cai & Ma Ro)**
Economic	Damage to crops	• Lack of financial capital • Rainfall variability • Lack of timely weather forecasting and agro-meteorological advice	• Lack of drought-tolerant maize and cassava varieties • Rainfall variability • Lack of timely weather forecasting and agro-meteorological advice • Lack of knowledge of best management practices
	Unavailability of irrigation and drinking water	• Unlawful withholding of water at upper reaches of canal • Decline in the water table • Decline in storage capacity of reservoirs and dams • Lack of sufficient electricity • Lack of rain-water harvesting	• Lack of canal distribution network for the existing water-storage facilities • Lack of rains • Lack of financial capital
	Income loss	• Lack of alternative livelihood activities and sole dependence on agriculture	• No access to good market facilities, hence less power to bargain good prices
	Loss of productivity of cattle and degradation of health	• Lack of financial capital • Lack of knowledge of better rearing practices • Lack of drought-tolerant breeds • Lack of veterinary health facilities • Lack of better fodder varieties • High fodder prices	• Lack of financial capital • Lack of knowledge of better rearing practices • Inability to diversify to poultry due to avian flu • Inability to diversify to piggery due to lack of productive stock • Lack of veterinary health facilities • Lack of better fodder varieties
	Lack of fodder	• Lack of common grazing land • Insufficient or no fodder supply during relief	• Lack of common grazing land • Insufficient or no fodder supply during relief

Category	Drought Impact	Important root causes	
		Coastal Region (Long Binh & Hoa Thanh-Nam Cuong)	**Mountainous Region (Da Ba Cai & Ma Ro)**
	Loss of employment	• Increased availability of labour within the hamlet • Lack of work opportunities within the hamlet	• Insufficient economic activity within the hamlet • Lack of diversified skills (dependence on primitive livelihood activities)
Social	Health, nutritional, and physical problems	• Social structure (less power in decision making) • Male prejudice about women's workload	• Inability to speak Vietnamese hinders women from participation in economic activities
	Food shortage	• Inadequate relief supplies	• Inadequate relief supplies
	Migration	• Lack of jobs locally	• Lack of jobs locally
	Stress on old people	• Migration of young people	• Migration of young people
Environmental	Cutting of forests	• Lack of employment facilities	• Lack of alternative employment
	Loss of biodiversity	• Recurring droughts and heat stress	• Recurring droughts and heat stress
	Saline-water intrusion	• Excessive withdrawal of groundwater	-
	Over-exploitation of groundwater	• Lack of regulatory policies	

6.3. Policy options to reduce drought vulnerability

Based on the root causes presented above, policy options were identified for drought-risk reduction (Table 30). These could be implemented by governments, NGOs, and communities. Emphasis has been placed on identifying a mix of policy options containing mitigation and response strategies.

A national forum was organised on 3–4 May 2007 in Hanoi to consider adaptation to drought in the context of climate change. Officials of provincial, district, and commune levels from eight provinces affected by the drought participated in the forum. The forum focused on impacts of drought at the commune level and identified difficulties and existing gaps in measures to cope with the drought. The forum also produced appropriate suggestions to overcome community vulnerability to drought. The suggestions are listed below.

Communities

- Strengthen community organisation by establishing or building upon social institutions like village Self-Help Groups (SHGs), women's groups, and village water sub-committees.
- Set up a commune seed bank / food credit coupon system.
- Establish 'Village emergency funds'
- Develop understanding that the drought may be a recurring phenomenon and that communities should prepare themselves to minimise the impact.
- Promote better forest management and the avoidance of forest fires.

Table 29: Drought-risk reduction action-identification matrix

Impact of drought	Root causes	Possible actions	Mitigation (M), response (R)
Damage to crops	• Lack of financial capital	• Provide more micro-finance options	M
	• Rainfall variability	• Enhance weather monitoring and forecasting	M
	• Lack of timely weather forecasting and agro-meteorological advice	• Improve agro-meteorological advisory services	M
Unavailability of irrigation and drinking water	• Lack of regulations to stop unlawful withholding of water at the upper reaches of the canal • 'Water war' due to increased demand by different sections of the society	• Enforce regulations to restrict water usage through strict command-level irrigation scheduling and water distribution • Educate farmers on best management practices • Provide better access to water by establishing water-allocation systems	M
	• Decline in the water table	• Educate communities in better irrigation practices to enhance irrigation efficiency	M
	• Decline in storage capacity of reservoirs and dams	• Control siltation through land stabilisation in watersheds • Introduce soil-conservation practices in watersheds	M
	• Lack of sufficient electricity to pump water	• Supply solar-power systems, using co-operative societies	M
	• Lack of rainwater-harvesting practices	• Educate and introduce watershed-management practices	M
Income loss	• Lack of alternative livelihood activities and sole dependence on agriculture	• Create self-help groups and micro-credit systems • Introduce non-agriculture-based livelihood practices • Provide training in alternative livelihood practices	M
Loss of productivity of cattle and degradation of health	• Lack of financial capital	• Provide improved cattle breeds by means of subsidies • Establish cattle-health camps • Train livestock farmers to maintain cattle herds during drought times	M
	• Lack of knowledge about better rearing practices	• Train livestock farmers in improved animal-rearing practices	M
Lack of fodder	• Lack of common grazing land • Lack of fodder-storage facilities and know-how	• Offer training in fodder-storage practices • Offer training in better feed-management practices • Establish community-based fodder banks	M
	• Insufficient or no fodder supply during relief distributions	• Supply fodder during relief	R
Loss of employment	• Greater availability of labour within the village • Insufficient jobs within the village	• Identify and enhance skills through training programmes • Provide co-operative facilities to market the outputs	M
Health, nutritional, and physical problems in children	• Social structure (less power for women in making decisions on how the food is distributed in the family)	• Offer education and awareness-generation programmes for all sections of the society • Promote the culture of collective action	M

Impact of drought	Root causes	Possible actions	Mitigation (M), response (R)
	• Assumption [by men] that women do less burdensome work is leading to reduced food allocation for them • Lack of water and knowledge about hygiene • Lack of nutritious food	• Promote good hygiene practices • Provide clean drinking water • Provide additional food to women, especially pregnant and nursing mothers, through public distribution system	
Food shortage	• Inadequate relief supply • Lack of purchasing power	• Modify relief-distribution practices based on the review of existing relief management • Establish local buffer stocks of food (action needed by both the government and local communities) • Promote non-agricultural livelihood options such as crafts	R
Migration	• Lack of local employment	• Identify and enhance skills through training programmes • Provide co-operative facilities to market the outputs	M
Increased workload on women	• Women do more household work and field work, and their burden increases during droughts	• Share workload among family members • Make more water available (as discussed above) • Identify water-supply points near dwellings and piped water supply	M
Less participation of women in community programmes	• Women (especially ethnic women) have no security of land tenure • Women in general lack access to formal resources • Women are discriminated against in employment, so they fail to gain skills • Social role is restricted to household activities • Lack of social recognition of their work	• Facilitate advocacy to change land-tenure systems and implement Grassroots Democracy Decree • Increase women's participation and representation through empowerment • Create opportunities for women to work through skill development and providing small credit, technical training, jobs, and market information • Promote social mobilisation to change attitudes towards women • Increase community awareness of gender equity	M
Stress on old people	• Migration of young people	• Same as above • Establish village teams to take care of old people in the migration season	M
Cutting of forests	• Lack of employment facilities	• Same as above	M
Loss of biodiversity	• Recurring drought and heat stress	• Identify vulnerable species • Encourage community involvement in maintaining biodiversity	M
Saline-water intrusion and over-exploitation of groundwater	• Excessive withdrawal of groundwater • Lack of regulatory policies	• Introduce better irrigation-management practices • Promote water pricing and other similar regulatory policies	M

Agriculture

- Develop drought-resistant crop varieties.
- Provide training in dry-season cropping techniques.
- Ensure that appropriate crop seeds are in place before the rains.
- Develop village seed banks with seeds of traditional and improved drought-resistant crops/varieties.
- Provide training in economical water use.
- Subsidise/facilitate supplies of seeds/irrigation equipment.
- Establish field schools and mobile libraries for farmers.
- Provide meteorological forecasts and corresponding advice on cultivation.
- Improve soil-moisture management.
- Reduce run-off / increase rainwater infiltration by planting barriers such as Vetiver, Lemon grass, and Agave.
- Increase fertility and water-holding capacity of the soil through addition of organic manures and green manures.
- Introduce proper land-use planning as per the land-capability classification system.
- Promote mulching practices so that the limited available soil moisture is saved during critical stages of crop growth.

Livelihood strategies

- Support and protect livelihoods and livelihood diversification (carpentry, petty shops, handicraft, etc.), so that people have a safety net to rely on during all stages of drought.
- Establish/strengthen micro-credit systems.

Domestic water use

- Encourage rainwater harvesting (e.g. roof-top rainwater harvesting).
- Install water pumps/wells.
- Promote ‘home-made’, cheap, and water-efficient drip irrigation for vegetable gardens (for home consumption).

Health

- Provide training in first aid (e.g. treating diarrhea and respiratory diseases).
- Promote public health by raising awareness of health and hygiene issues.
- Raise awareness of nutrition and home gardening.
- Improve access to clean water.
- Provide hygiene kits and teach women how to use them.

Animal husbandry

- Store rice, paddy husk, and other crop residues in barns for use during scarcity.
- Grow seasonal grasses/perennial fodder trees in community forest, fallow lands, and permanent pastures.
- Recommend farmers to avoid burning crop residues in the field and to use them instead as animal feed by treating them appropriately.
- Establish fodder banks at community/household level.
- Improve the quality and productivity of the existing livestock population, either through artificial insemination or other breeding practices or by replacing them with exotic breeds.
- Preserve endangered productive and drought-resistant local animal breeds.
- Promote the rearing of goats, sheep, and dry ducks in areas where feed and water are scarce.
- Construct rainwater-harvesting structures (mini-ponds, tanks).

Formation of drought-management boards

Viet Nam is one of the most disaster-prone countries in the Mekong region. Floods and typhoons have been very frequent during the past three decades and seem to be increasing in severity. Floods and typhoons have been a constant threat to the life and productivity of the Vietnamese people. Government authorities have responded by establishing flood-management boards at province, district, and commune levels.

It is often difficult to predict the exact onset and cessation of drought, which makes it difficult to initiate timely response and relief operations. The absence of reliable drought-forecasting mechanisms makes things even worse. In the light of the success of boards for dealing with the flood and typhoon risks, the national forum suggested that the government should establish drought-management boards at various levels of government and other organisations.

To begin with, the existing boards may be equipped to deal with the drought-related contingencies. Gradually, upon obtaining sufficient resources, dedicated boards could be established to plan for drought-risk mitigation, in addition to drought response and relief. These boards would need to be staffed by personnel with sufficient technical skills to keep a watch on local meteorological conditions and develop contingency plans in association with agriculture, water resources, and rural development personnel. The participants suggested roles for a range of organisations serving on drought-management boards (Table 30).

Table 30: Responsibilities of different bodies in drought-management boards

Body	Responsibility
Central government	Provide guidance at the national level
Provincial governments	Provide guidance at the provincial level
Ministry of Agriculture and Rural development - Department of Irrigation - Department of Agriculture and Rural Development in provincial areas	Water supply Research on strategies for land-use planning and water regulation Cropping patterns Cropping schedules
Ministry of Health	Provide health facilities in case of emergency
Ministry of Natural Resource and Environment - Department of Natural Resource and Environment	Drought forecasting Drought declaration Drought assessment Development planning

Body	Responsibility
Ministry of Labour	Food supply Implementation of food-for-work programmes
Ministry of Transportation	Support for other organisations in case of emergency Water-transportation management
Ministry of Finance	Provide finances for long-term and short-term programmes to cope with and mitigate impacts of drought
Other social organisations (women's union, farmers' associations, etc.)	Participate in meetings Provide ideas for better implementation Promote public participation in programmes
Red Cross (and other international NGOs)	Provide relief Conduct strategic research Assess community needs
Local NGOs	Food assistance Capacity building Promotion of sustainable livelihoods for communities
Scientists and research institutes	Conduct research and training in drought-risk mitigation Develop sustainable livelihoods for communities
Communities	Participate in programmes Help various stakeholders to understand impacts of drought and to design better management programmes Cope with impacts of drought
Water supply and irrigation companies	Water supply Implementation of water regulations
Media	Disseminate drought forecasts and better management practices
Ministry of Foreign Affairs	Negotiate the sharing of water resource with other countries

7. Future directions

There is a need to measure the water demand of all sectors in Ninh Thuan province and to identify appropriate water sources, including extending irrigation and water-harvesting facilities, to bridge the gap between supply and demand. Sectors to which water should be provided should be decided thorough consultation with stakeholders, according to the relative importance of each sector in the economic well-being of the province. NGOs, government, and communities should sit together to discuss and agree solutions for drought-prone areas.

We recommend that the following activities should be undertaken before acting upon the policy options identified in the previous section.

1. Conduct feasibility studies to
    - narrow down the policy options
    - increase the success of identified policy options.
2. Conduct stakeholder consultations to
    - identify stakeholders and distribute responsibilities
    - prioritise the policy options based on the resources available with various stakeholders
    - identify the financial, technological, and human resources needed for drought risk-reduction activities
    - identify the gaps in the existing capacity within the intervening agencies, and
    - identify the time-frame for implementation of drought risk-reduction activities.

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