Attachment 10

Flood Forecasting and Warning Issuance

The Study on Flood Forecasting and Warning Issuance for Component 3 of the Project on a Comprehensive Flood Management Plan for Chao Phraya River basin in the Kingdom of Thailand

Preface

The great flood in 2011 caused tremendous damage in many parts of Thailand. It had been occurred since the end of July 2011 till the middle of January 2012. Finally, 65 of Thailand's 77 provinces were declared as flood disaster zones, and over 20,000 km^2 of farmland was damage. The estimated economic losses over 1,900 million Baht was calculated from damage to infrastructure, agricultural, industry and social sectors. Seven industrial estates were damaged due to barriers failure, resulting in flooding of dozen of major factories and country-wide disruption of manufacturing supply chains.

Therefore, Government of Thailand with the collaboration with professional agencies has urgently pushed the effort to provide various mitigation measures in order to protect and mitigate the damage due to flood that would be occurred in the future. The flood forecasting and early warning system is one of the effective measures that would be helpful for the communities under flood risk. However, in order to improve and/or establish the effective flood forecasting and warning system, the problem and obstacle dealing with the flood forecasting and warning issuance during 2011 inundation should be examined.

In this study, the actual situation of 2011 flood forecasting and warning processes has been investigated, including the roles of various government authorities and local agencies have also been examined as well. In addition, the expectation of community and factory in industrial estates also summarized. Thus, with uses of the survey result, the effective flood forecasting and early warning system will then be appropriately set up with consideration of natures of the target groups.

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The Study on Flood Forecasting and Warning Issuance for Component 3 of the Project on Comprehensive Flood Management Plan for Chao Phraya River Basin in the Kingdom of Thailand

1. Introduction

According to the flood that had been occurred in many parts of Thailand in 2011, it caused tremendous damage of about more than 1.44 trillion Baht, as estimated by the World Bank, and more than 800 deaths. Therefore, Government of Thailand (GOT), with the collaboration with professional agencies has urgently pushed the effort to provide various mitigation measures in order to protect and mitigate the damage due to flood that would be occurred in the future.

The flood forecasting and early warning system is one of the effective measures that would be helpful for the communities under flood risk. With uses of disaster warning information, the residents can prepare and take alleviation actions properly. It would mitigate the damage and decrease the severity due to flood. However, based on the result of questionnaire survey on flood information needs that was conducted in the lower reach of the Chao Phraya river basin, it was found that residents and factories that were affected by the 2011 inundation had low confidence in the existing warning and forecast system. Although, in some area, there was the early warning from government agencies, but they did not take any alleviation action since they felt that the warning information had low reliability. Some of them were confused with various information from different sources; while some of them who never had the flood experience did not know how to deal with the situation or how to prepare themselves. Obviously, it caused the enormous damages more than expected.

Therefore, in order to establish the effective flood forecasting and early warning issuing set-up, the actual situation of 2011 flood forecasting and warning processes should be investigated. The roles of various government authorities and local agencies should be examined. Furthermore, the order of disaster announcement judgment should be understood.

2. Objectives of the Study

During the study on flood forecasting and warning issuance for the project of Chao Phraya River Basin flood management plan, the important information related with 2011 flood has been gathered; the scope of inundation area, topographic map, demographic data, economic activities, etc. The actual situation of 2011 flood forecasting and warning processes has also been investigated via the questionnaire survey. The respondents in 5 provinces of the lower reach of the Chao Phraya River Basin, which are Ayutthaya, Sing Buri, Ang Thong, Chai Nat and Lopburi have been selected as divided into 4 groups as follows:-

- city resident and farmer,
- factory,
- local agency, and
- National Flood Defense Organization.

in order to:-

1. examine the actual situation of 2011 flood forecasting and warning processes,
2. understand the roles of related agencies, in order to forecast and make the disaster warning,
3. investigate the complexity of the existing forecasting and warning issuance, and
4. understand the order of disaster announcement judgment.

Therefore, in the future, the effective flood forecasting and early warning issuing set-up will be established and implemented appropriately.

3. Scopes of the Study

According to the flood that covered the lower reach of the Chao Phraya River basin, as shown in *Figure 1*, the questionnaire survey and interview have been conducted in 5 provinces; Ayutthaya, Sing Buri, Ang Thong, Chai Nat and Lopburi, as shown in *Figure 2*, including 7 industrial estates; Saharattananakorn, Hi-tech (Ban Wa), Factory land, Bang Pa-In, Bangkadi, Rojjana and Navanakorn, as shown in *Figure 3*. The number of interviewees of each group and surveyed areas are presented in *Table 1*.

Table 1 Number of Respondents of each Groups and Survey Areas

Respondent Category	Target Numbers of Interviewee	Target Areas of Survey
City resident / Farmer	Totally 300	In 5 provinces, which are:- 1. Ayuthhaya 2. Sing Buri 3. Ang Thong 4. Chai Nat 5. Lopburi
Factory	30 (approx.)	In 7 inundation industrial estates, which are:- 1. Saharattananakorn 2. Hi-tech (Ban Wa) 3. Factory land 4. Bang Pa-In 5. Bangkadi 6. Rojjana 7. Navanakorn
Local agencies	200 (approx.)	In 5 provinces
National Flood Defense Authority	20 (approx.)	
sum	**550 (approx.)**	

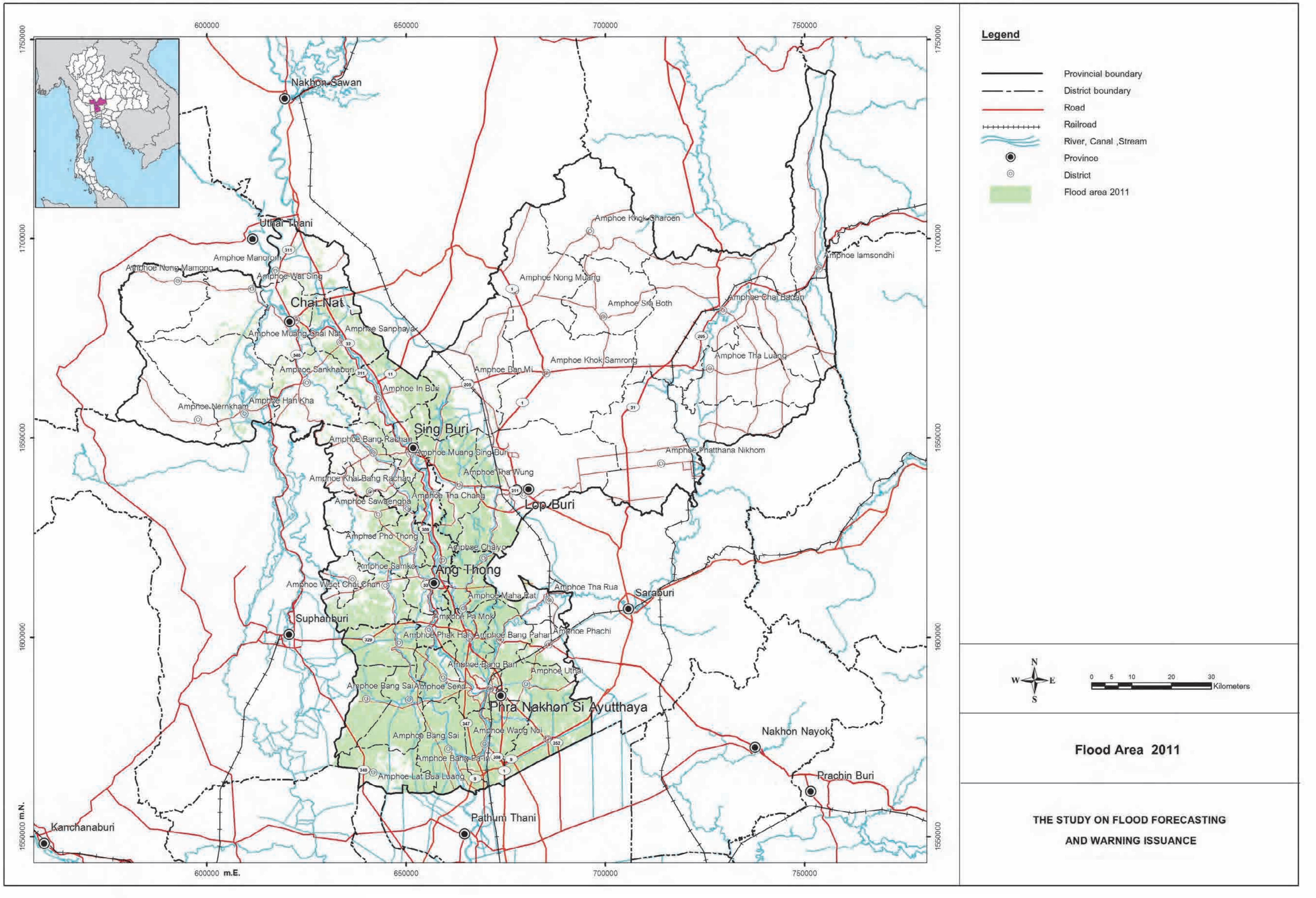


Figure 1 The inundation area, due to great flood in 2011, in the Chao Phraya River basin

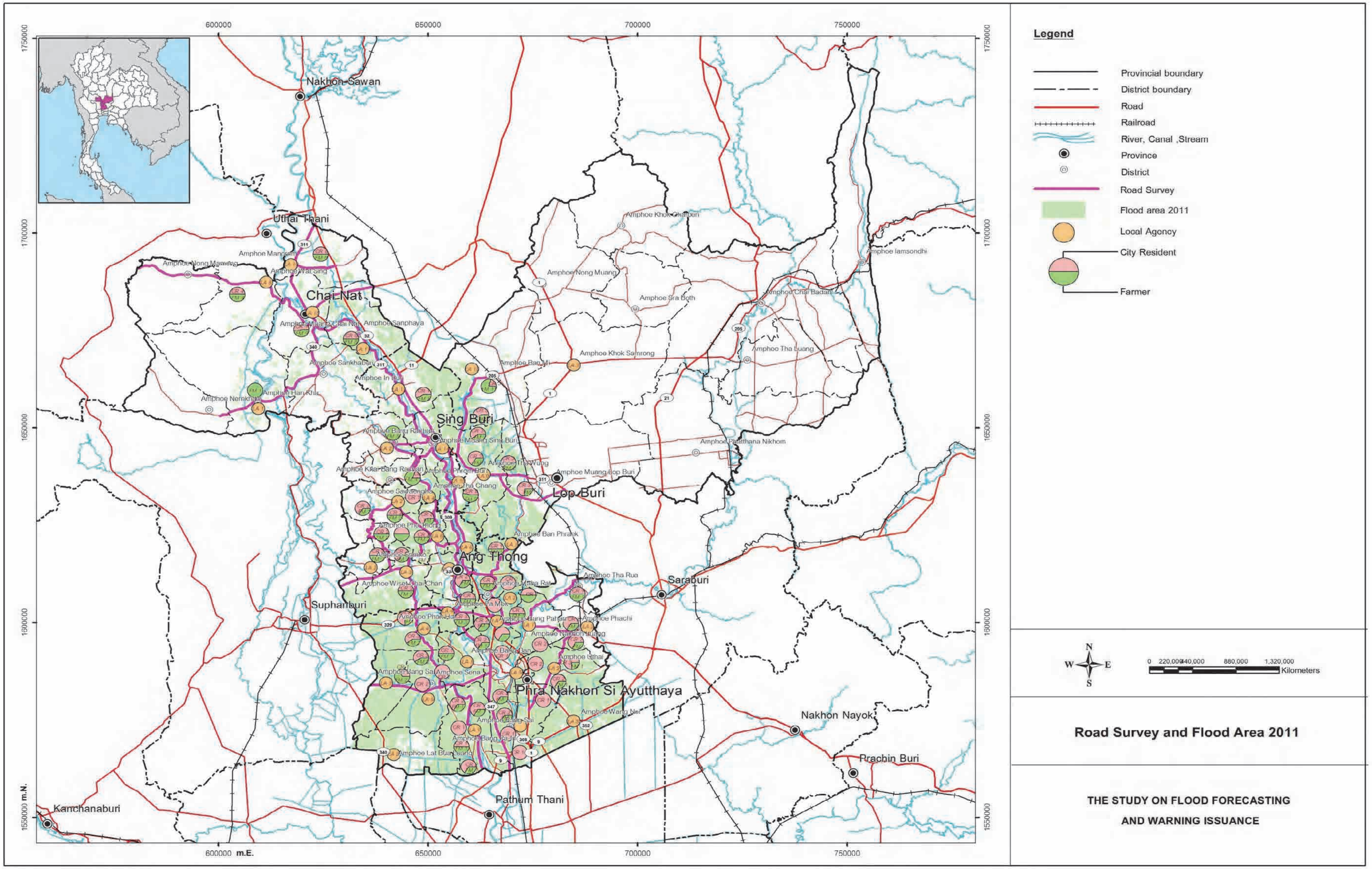


Figure 2 The residential area where questionnaire surveys have been conducted overlay with the inundation area due to great flood in 2011

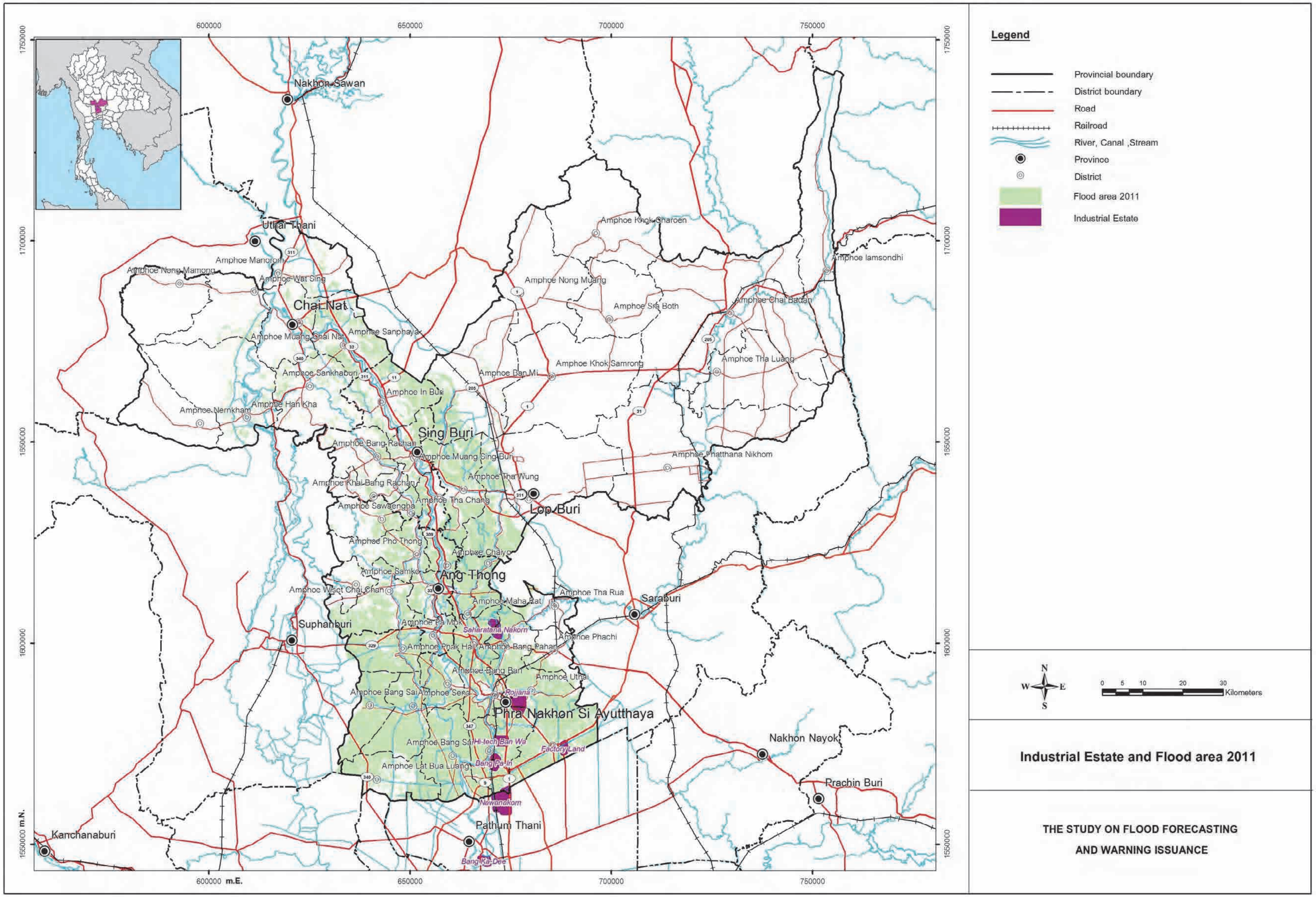


Figure 3 The industrial estate and the inundation area, due to great flood in 2011, in the Chao Phraya River Basin

4. Methodology

The study has been conducted in 7 steps as showed in *Figure 3*.

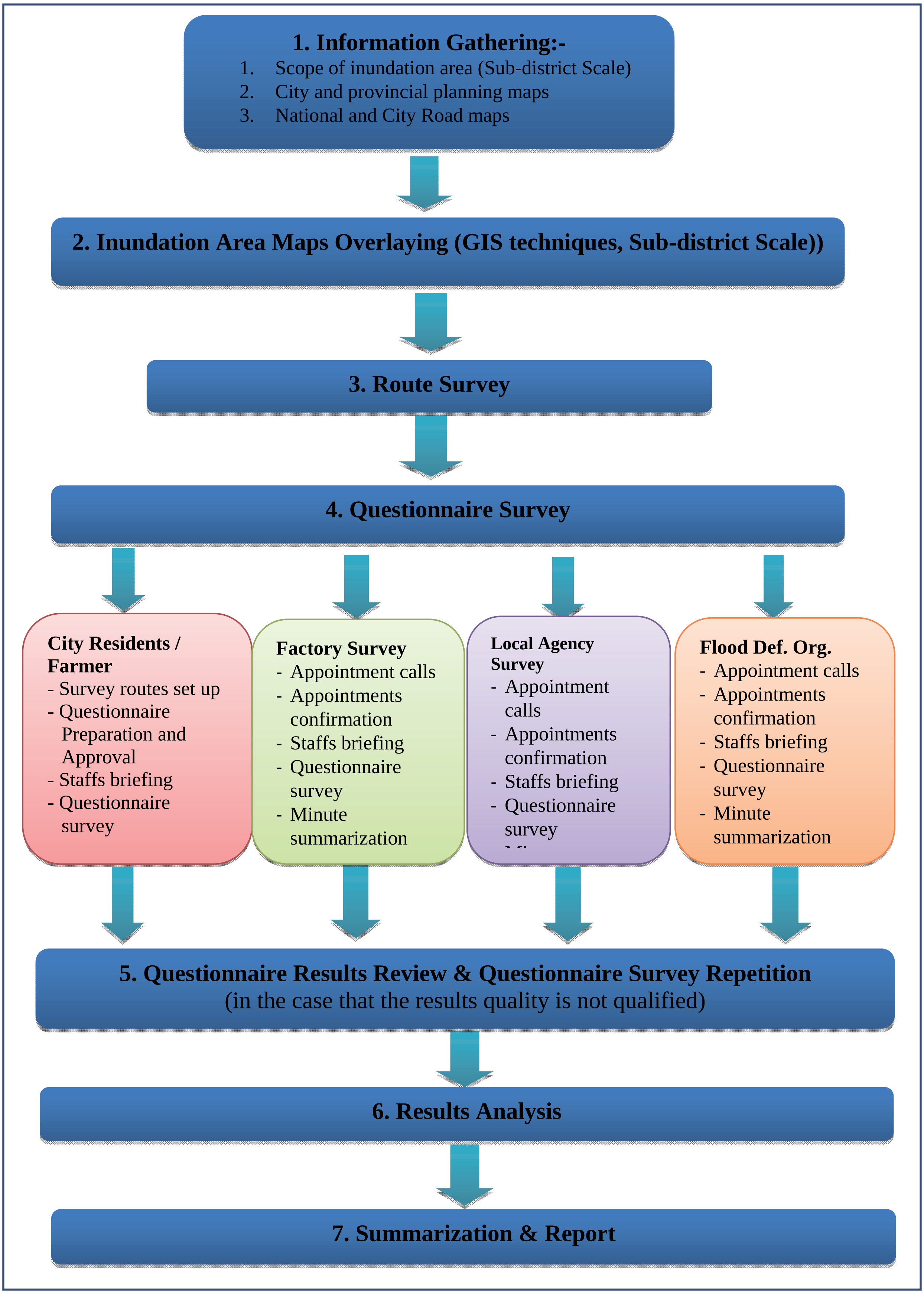


Figure 4 Steps of the Study

4.1 General Inundation Information and Surveyed Area Acquisition

In order to investigate the actual situation of 2011flood forecasting and warning processes, the related information of 5 provinces of the lower reach of the Chao Phraya River Basin, which are Ayutthaya, Sing Buri, Ang Thong, Chai Nat and Lopburi, has been gathered.

First of all, the information and secondary data such as inundation maps, city planning maps and road maps from related government agencies, such as Royal Irrigation Department and City Planning Office, have been collected. They have been analyzed and overlaid by GIS techniques. Then, survey target cities and survey route have been arranged. Meanwhile, the questionnaire for city resident and farmer has been prepared, under the supervision of JICA study team. The approved questionnaires, as attached in *Appendix A*, have then been distributed to the surveyors. They have been oriented, in order to make clearly understanding in purpose and detail of the questionnaires.

4.2 City Residents and Farmers Interview

The surveys have been conducted in August, 2012, in Ayutthaya, Sing Buri, Ang Thong, Chai Nat and Lopburi under the responsibility of coordinators and the team leader. The numbers of respondents in each province are presented in *Table 2* and the map of inundation area and surveyed road with the number of respondents in residential areas is shown in *Figure 5*.

Table 2 Respondents in each Sampling Province

Province	Number of Respondents	
	City residents	Farmers
Ayutthaya	46	36
Ang Thong	18	42
Sing Buri	30	30
Chai Nat	30	30
Lopburi	15	23
Sum	**139**	**161**

4.3 Local Agency Interview

In order to investigate the actual situation of 2011 flood warning and local agencies' action, the questionnaire has be prepared, as the guideline of the interview, and distributed to the surveyors. They have been oriented and emphasized to interview further about the roles and sequence of flood warning and evacuation order.

The officers from Subdistrict Administrative Organizations, SAO, and from Provincial Office Disaster Prevention and Mitigation, ODPM, have been chosen. They have been called and confirmed for the appointments. Then, the interviews have been carried out.

The result of SAO questionnaire survey have been statically analyzed and summarized with the Provincial ODPM interview.

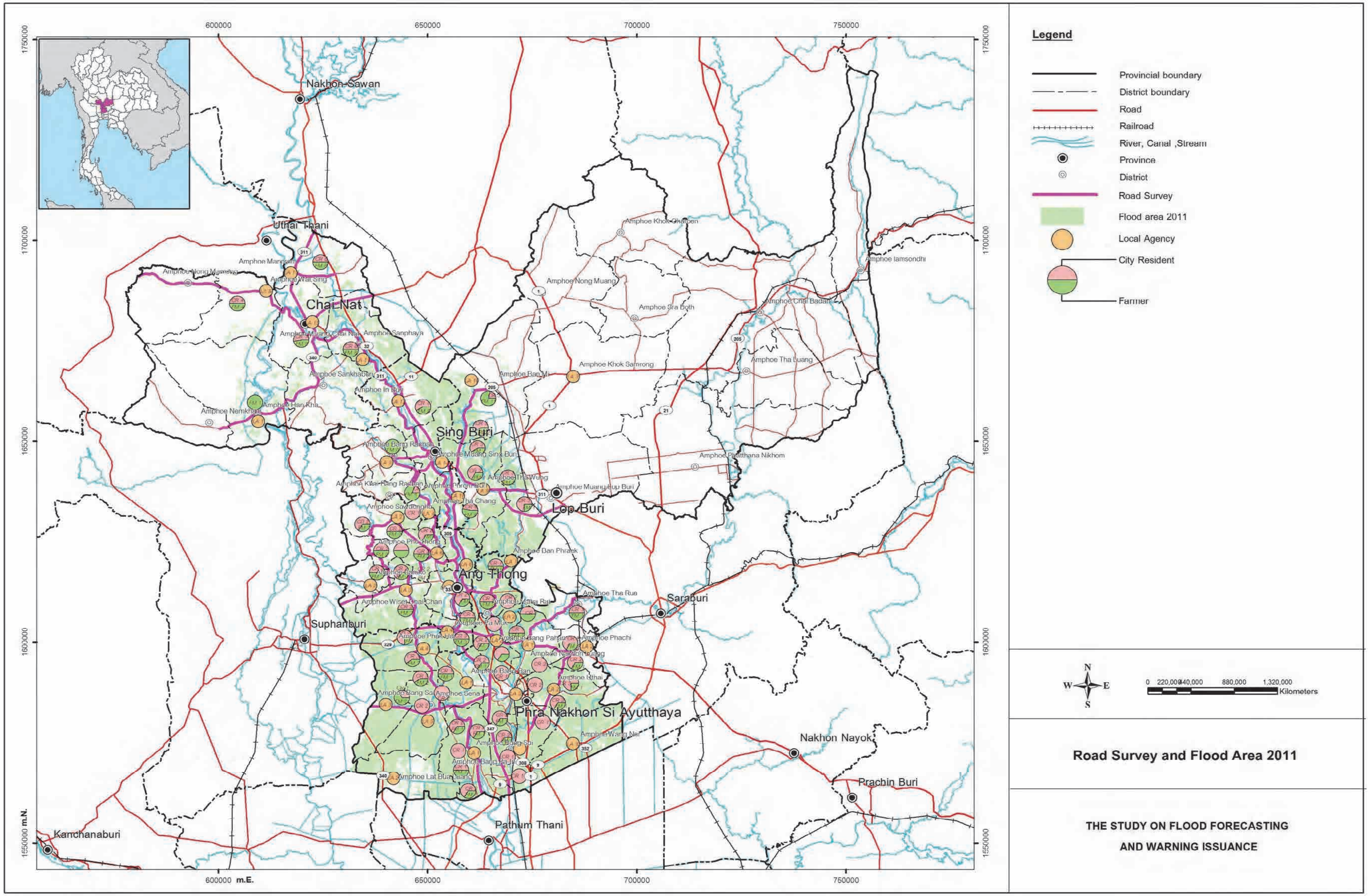


Figure 5 The 2011 inundation area and the surveyed residential area

4.4 Factories Interview

For the factories in seven-industrial estate interview, based on the inundation maps and secondary data, 35 factories have been randomly chosen, as the name listed in *Table 3.* They have been called and confirmed for the appointments. Then, the interviews have been carried out by using the questionnaire that has been prepared and approved. The results have then been statically analyzed, summarized and reported subsequently.

Table 3 Name list of Respondents from 35 Factories in 7 Industrial Estates

Industrial Estate	Factory / Company Name	Respondent
1. Hi-tech (Ban Wa)	1. Hana Semiconductor	Mr. Seri Sukchean, Facility Manager
	2. Kobe Electronics Material	Ms. Noossara Wongprasert, Admin. Manager
	3. Chiyoda Integra	Mr. Rattama Wanbucha, Admin. Manager
	4. Mikuni (Thailand)	Ms Tipawan Plangsorn, Div. Manager, Personnel & Gen. Affair Dep.
	5. Soode Nagano	Ms. Duangduen Lomkun, HR. & Admin. Manager
	6. Miyoshi Hi-Tech	Ms. Naipaporn Pattanausahakit, HR & Admin. Asst. Manager
2. Saharattananakorn	1. Siam Kensetsu	Ms. Atiporn Boonyawaropas, Admin. Manager
	2. Aqua Nishihara	Mr. Jaroon Boontae,
	3. Nexas Elechemic	Mr. Taweesak Chimjumroen, Factory Manager
	4. SIAM NKS	Mr. Santi Mekchay, Engineering Section Supervisor
	5. Yamamoto Foundry	Ms. Nattaman Nualsuk, HR Manager
3. Factory land	1. COLBREE Eng. Group	Ms. Nongnapha Kasikornrungroj, Logistics Manager
	2. Samco Seiki (Thailand)	Ms. Somjintana Sriplai, Executive Manager
	3. Fuji Autopart	Mr.Cherdyos Jirawattarak, Factory Manager
	4. Asada Chemical	Mr. Ladawan Kwamrak, Admin Staff
4. Bang Pa-In	1. Nippon Super	Mr. Komkid Pinthong, Personnel Dept. Manager
	2. Rockworth	Mr. Somchaii Nimitsukcharoen, Production Dept. Manager
	3. Mitsui Precision Thai	Mr. Suteera Kongprasertlap, Factory Manager
	4. MMC Tools	Mr. Chaget Kessri, Safety Dept. Manager
	5. HP Construction System	Mr. Preecha Simla, Ass. Manager

Table 3 Name list of Respondents from 35 Factories in 7 Industrial Estates (Cont'd)

Industrial Estate	Factory / Company Name	Respondent
5. Bangkadi	1. ARRK Corporation (Thiland)	Mr. Srinual Angkasap, Asst. Manager, Personnel & Admin. Dept.
	2. Toshiba Lighting	Mr. Boonlert Wongsiri, Factory Manager
	3. Toshiba Hokuto Electronic Devices (Thailand)	Mr.Wichai Natisupalak, Director & Group Manager, General Admin. & Management Innovation Group
	4. Toshiba Semiconductor	Mr. Piti Yhuusathaporn, Factory Manager
	5. Nidec Shibaura	Ms.Sureeporn Thamniumjad, Office Staff
6. Rojjana	1. Nihon Seiki Thai	Ms. Primprapa Dumrichob, Manager, Administration Department
	2. Izumi Industry	Mr. Jawanat Kongkaew, HR Ass. Manager
	3. Thai Horikawa	Mr. Narong Kamlanglua, Factory Manager
	4. Mizuno Precision	Mr. Pairin Saelee, Production Dep. Manager
	5. Hitech Rubber Products	Ms. Siripan Pisessakulchai, HR Manager
7. Navanakorn	1. ARS Chemical (Thailand)	Mr. Chatchai Sankhampha, Supervisor, Production Dept.
	2. Panasonic Manufacturing (Thailand)	Ms. Petcharat Pratoomthop, Ass. Manager, ISO & Safety and Energy Section
	3. Tomy Thailand	Mr. Narapol Vongsaroch, Asst. Gen. Manager, Admin. Dep.
	4. Okamoto Rubber Products	Mr. Phitchakorn Berkbandee, Safety Officer
	5. Kawasumi Laboratory	Ms. Sawittree Makpetch, HR Manager

4.5 National Flood Defense Organization Interview

Flood defense organizations have been listed and called for the appointments. After the schedules have been confirmed, the interviews with 30 respondents from 9 organizations, as listed in *Table 4*, have been done. The minute of the meetings of each organization has been summarized and reported afterward.

Table 4 Name list of Respondents from National Flood Defense Organization Group

Organization	Respondent	Position / Organization
Royal Irrigation Department, Ministry of Agriculture and Cooperatives	1. Mr. Pongsak Aroonwijitsakul 2. Mr. Lerboon Udomsap 3. Dr. Ekkawit Jornpradit 4. Mr. Surat Thanusilp	Director of Operation & Maintenance Div. Head of Operation & Maintenance Div., RID 11 Researcher/Lecturer of Irrigation College Director of Irrigation Project, Phichit Province
Department of Drainage and Sewerage, BMA	1. Mr. Wirat Thathong 2. Mr. Sanset Ruengrit 3. Mr.Somjit Khanaewan 4. Mr.Sathaporn Muanglieng	Communication Expert Electrical Engineer Expert Statistical Expert Communication Staff
Meteorological Department, Ministry of Information and Communication Technology	1. Mr. Putchaphan Sirisap 2. Mr. Rittigrit Karin 3. Mr. Samrit Tangsuwan	Meteorologist, Professional Level Meteorologist, Practice Level Meteorological Technician, Professional Level
National Disaster and Warning Center, Ministry of Information and Communication Technology	1. Gp.Capt Somsak Khaosuwan 2. Air Chief Marshal Somnuak Sawadtuek	Director of National Disaster and Warning Center Senior Expert
Office of The National Broadcasting and Telecommunications Commission, Ministry of Information and Communication Technology	1. Mr. Prasert Aphiphunya 2. Acting Sub Lt Ekkachai Wittaya	Commissioner of NBTC Inspector and Evaluation Commission Operation Staff

Table 4 Name list of Respondents from National Flood Defense organization Group (Cont'd)

Organization	Respondent	Position / Organization
Department of Water Resources, Ministry of Natural Resources and Environment	1. Mr. Samrit Wilaipornratana 2. Mr. Tossaporn Suthajinda 3. Mr. Thanasak Prasertsri	Director of Development Research and Hydrology Civil Engineer, Senior Expert Director of GIS Div.
Department of Disaster Prevention and Mitigation, Ministry of Interior	1. Ms. Natchinya Chayao 2. Ms. Ansumalin Angsusingha 3. Ms. Nantaya Nhomphakdee 4. Ms. Duangnapha Uttamangkhapong	Website Information Update Staff Head of Situation Evaluation Section Policy and Planning Analyze Senior Staff Foreign Relations Senior Officer
Hydro and Agro Informatics Institute, Public Organization	1. Dr. Surajate Boonya-Aroonnet 2. Mr. Warin Sophonpattanakul 3. Ms. Walai Chaisombat 4. Mr. Nares Khengngern	Head of Hydro Modeling Section/ HAII Researcher Computer System Staff Head of Institute Communication Group
Hydrographic Department , Royal Thai Navy	1. CDR Siriwat Siriwattanakul 2. CDR Supasit Khongdee 3. LCDR Pichet Puahengsap 4. LCDR Ronnakorn Tarawetrak	Head of Navy Oceanography Royal Thai Navy Authority, responsible on Thai Gulf Royal Thai Navy Authority, responsible on Thai Gulf Royal Thai Navy Authority, responsible on Thai Gulf

5. Results

5.1 General Information of Surveyed Area

The questionnaire surveys have been conducted in the lower reach of the Chao Phraya river basin, in 5 provinces. Although all of them were submerged under water for more than 30 days, but the damage were different in sizes of both residential area and agricultural land, as presented in *Table 5* and *Figure 6.*

Table 5 Provincial Information with Inundation Area Size
(Period of concerned: January – October 2011)

Province	Population[1] (capita)	Provincial Area[1] (km^2)	Inundation Area[2] (km^2)	Percentage of Submerged Area (%)
Ayutthaya	754,595	2,556.640	2,326.927	91.02
Ang Thong	283,943	968.372	772.822	79.81
Sing Buri	216,969	822.478	645.873	78.53
Chai Nat	339,006	2,469.746	1,095.083	44.34
Lopburi	752,775	6,199.753	846.572	13.65

Source: 1. Department of Provincial Administration
2. Geo-Informatics and Space Technology Development Agency (Public Organization)

Most of the area in Ayutthaya, of about 90%, had been submerged while the number of inundation area in Ang Thong, Sing Buri, Chai Nat and Lopburi were about 79.81%, 78.53%, 44.34% and 13.65% respectively. The flooding situation in Ayutthaya seems worsen than ever and worsen than other area as the flood water entered the city and historical park, forcing evaluations.

Additionally, after the barriers protecting industrial estates failed, dozens of major factories in 7 industrial estates had been disrupted and caused country-wide manufacturing supply chains problem.

5.2 Farmers and City Residents Interview

The respondents in Residential area are divided into 2 groups; the farmer, and the city resident, which consist of government officer, businessman, employer, merchant, housewife, and student. *Figure 7* shows the surveyed road with the number of respondents in residential area, in which the numbers are 139 and 161 for city resident and farmer, respectively.

The questionnaire result indicates that 46.76% of them live in single story and 41.01% live in multi-story house. It was found that during 2011 flood, the water covered first floor of their houses, but did not conceal the whole level, in which the period that the water approached until dried out was over 2 months.

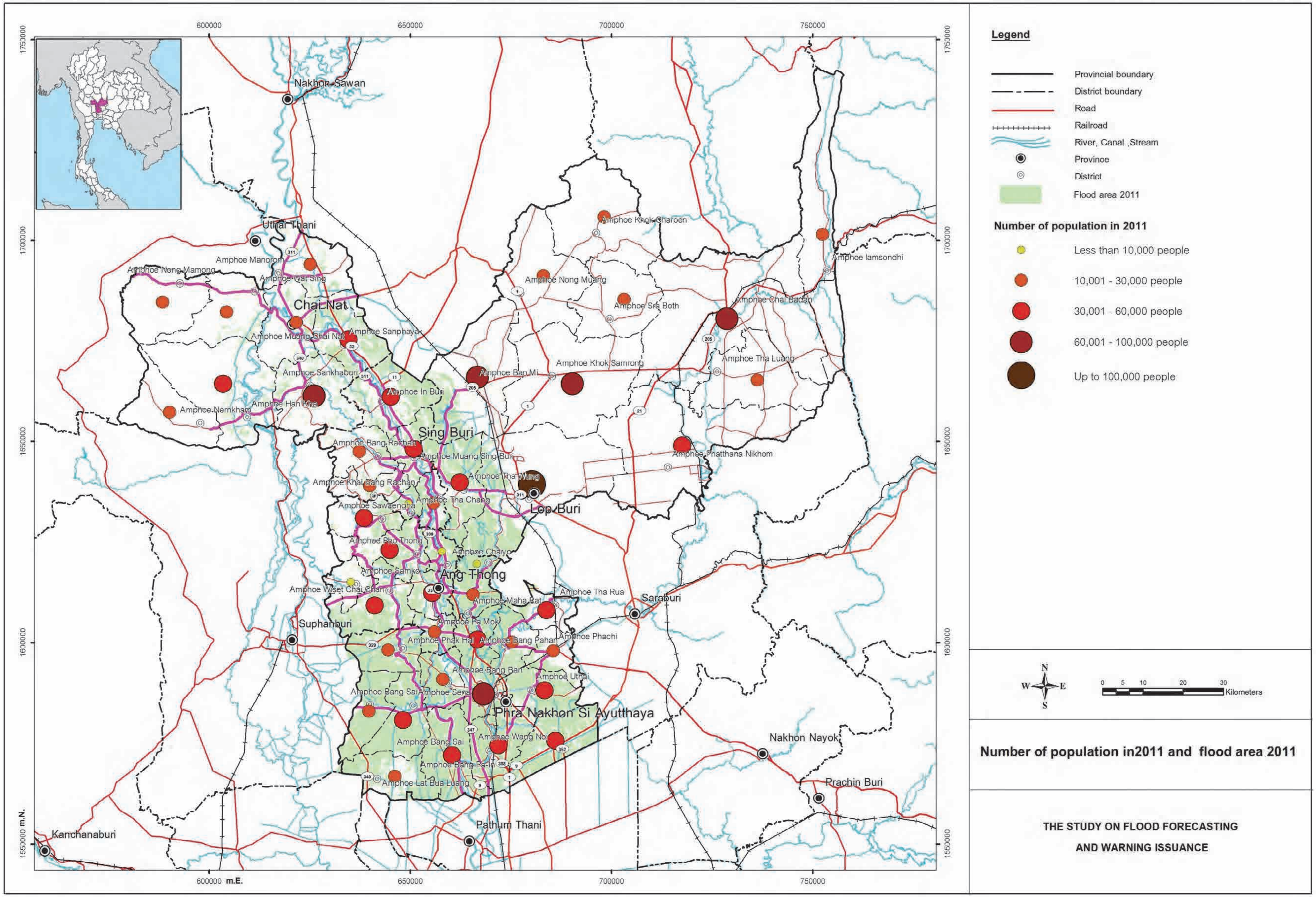


Figure 5 The 2011 Inundation Area in 5 Provinces in the Chao Phraya River Basin, with Population Number

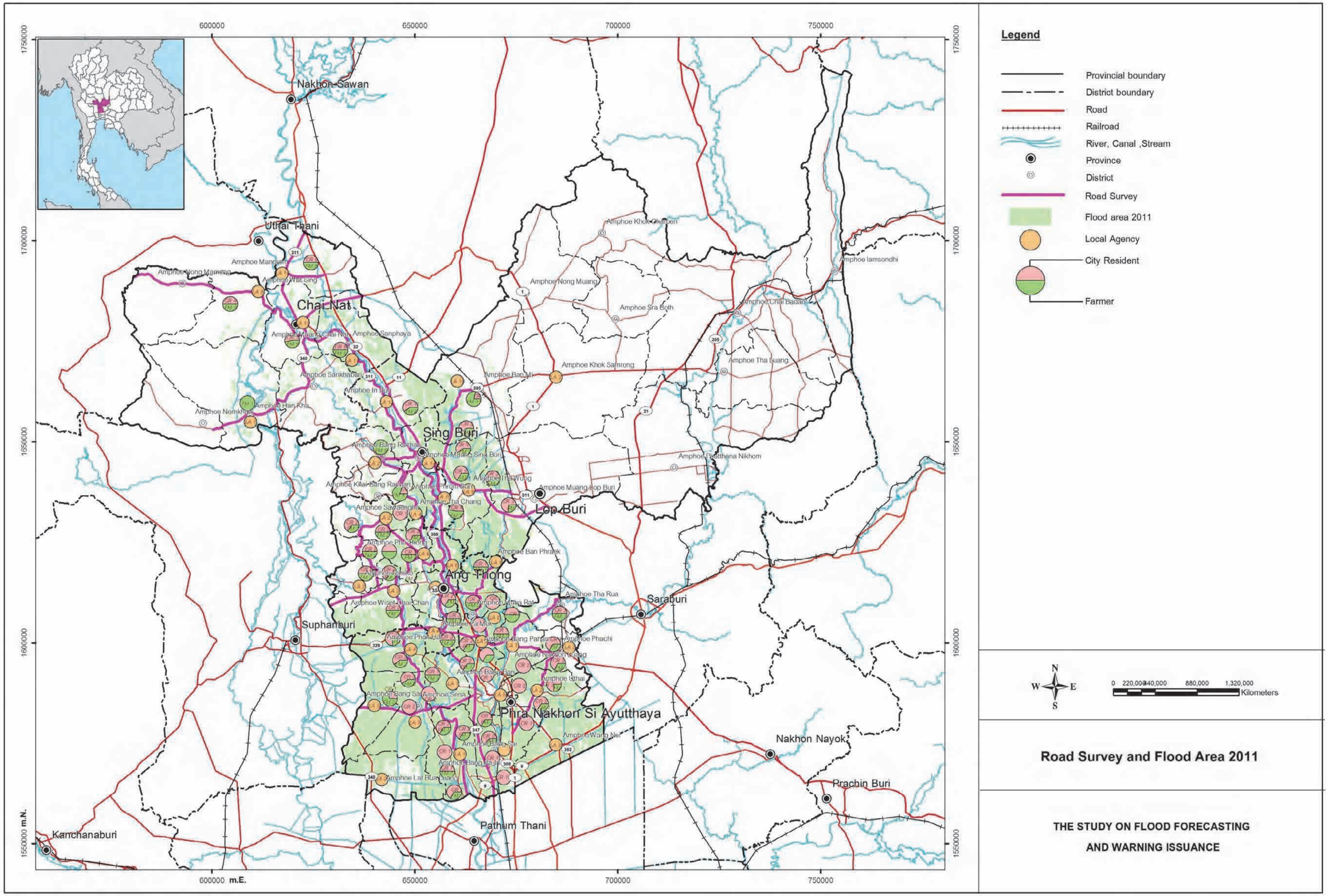


Figure 7 Inundation area and surveyed road with the number of respondents in residential areas

5.2.1 Farmers Interview

In the study on flood forecasting and warning issuance, the surveyors interviewed 161 farmers in 5 provinces of the lower reach of the Chao Phraya River Basin. The interview results are numerically reported in *Appendix B.*

According to the questionnaire survey, it was found that most of the farmers did receive the information of the situation and alarm, as the numbers shown in *Figure 8-1* and the percentage shown in *Figure 8-2* ; i.e. 80.56%, 73.81%, 86.96%, 80.00% and 83.33% of the respondents in Ayutthaya, Angthong, Lopburi, Chai Nat and Sing Buri, got the information and warning. They also mentioned that most of the announcements were from local authority, local people, and local people network, as the result shown in *Figure 9-1* and *Figure 9-2*.

Before the flood reached their places, the farmers received information from television, word of mouth, announcement by amplifying car, and by radio, as the result shown in *Figure 10-1* and *10-2.* The information they got were the water level in rivers and nearby waterways, the amount of rain in the area, and the amount of rain in the upstream area, as the result shown in *Figure 11-1* and *11-2*, in the form of narration, in which daily updated.

According to the adequacy of the received information, more than 75% of the respondents who received the information said that the received information was sufficient and useful for making decision and/or taking alleviation action. Besides, 45.74% of all respondents who received the information indicated that the reliability of the information was average and 50.39% mentioned that the information was very reliable, as the result shown in *Figure 12-1* and *12-2*. More than 90% of all respondents who received the information mentioned that the received information was average to very useful, in which 31.78% felt averagely satisfied and 46.51% felt much satisfied on the system.

However, in order to improve the flood warning system, the respondents suggested improving the accuracy of the flood forecast and warning system, with more frequency of information issuance such as more than once per day, as the survey result shown in *Figure 13-1* and *13-2.*

During the flood period, more than 60% of respondents received the flood warning, as shown in *Figure 14-1* and *14-2*, in which most of them got the daily information from local government authority, local people and local people network, as shown in *Figure-15-1* and *15-2*. It seems that the most effective ways to make the communications are word to mouth, television, radio and by amplifying car, as shown in *Figure 16-1* and *16-2*, in which the distributed information were water level in waterways, amount of rainfall in the upstream area and within the area, including the name list of contact persons / officials / agencies to contact for assistance and the evacuation routes, in case of emergency, as the result shown in *Figure 17-1* and *17-2*.

Figure 18-1, *18-2* show the period of time that the respondents received information and warning. In Ayutthaya, about 35% of the respondents who received the information got the warning more than 1 week before the water reached their places, while about 25%, 50%, and 59% of the respondents, who received the information, in Ang Thong, Lopburi and Sing Buri got the information about 1 week before the water reached, and 79% of the respondents, who received the information, in Chai Nat got the warning on the day that water reached their places. However, more than 80% of all respondents who received the information indicated that the received information was sufficient for taking action, as shown in *Figure 19-1*, *19-2*, while the respondents who said that the information was insufficient needed the information of evacuation routes, location of evacuation camp and the name list of contact person or agency that they can request for assistance.

In additional, more than 80% indicated that the reliability of the information was average to high and they satisfied on the existing flood forecasting and warning issuance system, as the result shown in *Figure 20-1, 20-2, 21-1* and *21-2*. However, they gave the suggestion, in order to improve the system, as shown in *Figure 22-1, 22-2,* that the accuracy of the flood forecast and warning system should be improved, with more frequency of information issuance such as more than once per day and they also needed more information of evacuation, as previously mentioned.

During the recovery period, more than 90% of respondents in Chai Nat and Sing Buri received the information while just about a half of respondents in Ayutthaya, Ang Thong and Lopburi got the information, as shown in *Figure 23-1* and *23-2*. It indicates the uncertainty of issuance system by local agency authority, local people and local people network, *Figure 24-1, 24-2*, in which the most effective ways to make information issuance are word to mouth, radio, television and by amplifying car, as shown in *Figure 25-1, 25-2.*

The information that was announced were the predicted data of rainfalls, the amount of rain in the area, and the amount of / Location of evacuation points, as shown in *Figure 26-1, 26-2.* More than 75% - 100% of the respondents, who received the information, said that the information received during the recovery period; since the water dry out until the situation is back to normal, was sufficient for taking action, as more than 50% of them satisfied on the system, as shown in *Figure 27-1, 27-2.*

It could be summarized in the whole picture that the respondents in the upper part of the lower reach of the Chao Phraya River Basin, that is Sing Buri and Chai Nat spent higher attention on flood forecasting and warning issuance than the other 3 provinces lower, as the result in *Figure 28-1, 28-2,* which show the number of people prepared to handle the flood. It seems that people believed in their experiences and their own consideration, thus both the people who have flood experience and never had flood experience did not take any flood alleviation action even though they received the warning issuance.

The similar trend can be seen in *Figure 29-1, 29-2,* when the respondents were asked about the preparation to handle the future flooding; almost 100% of respondents in Sing Buri and Chai Nat decided to build new house or level up the current house. However, it was found that a half of the respondents in 5 provinces decided to build surround walls to prevent water approach, as shown in *Figure 30-1, 30-2,* since they think that the flood might be occurred again in the future.

*Figure 31-1*and *31-2* present how the respondents feel about the existing flood forecasting and warning systems. About 40% mentioned that although the system is not very good, but it is useful combining with other information, while about 29% felt that although the system is not very good, but better than nothing. The respondents suggested that the forecasting and warning systems should be improved by earlier of warnings, increasing the accuracy of forecasting, more frequency of information updating and displaying information in the pattern that is easier to understand, as the result shown in *Figure 32-1, 32-2.*

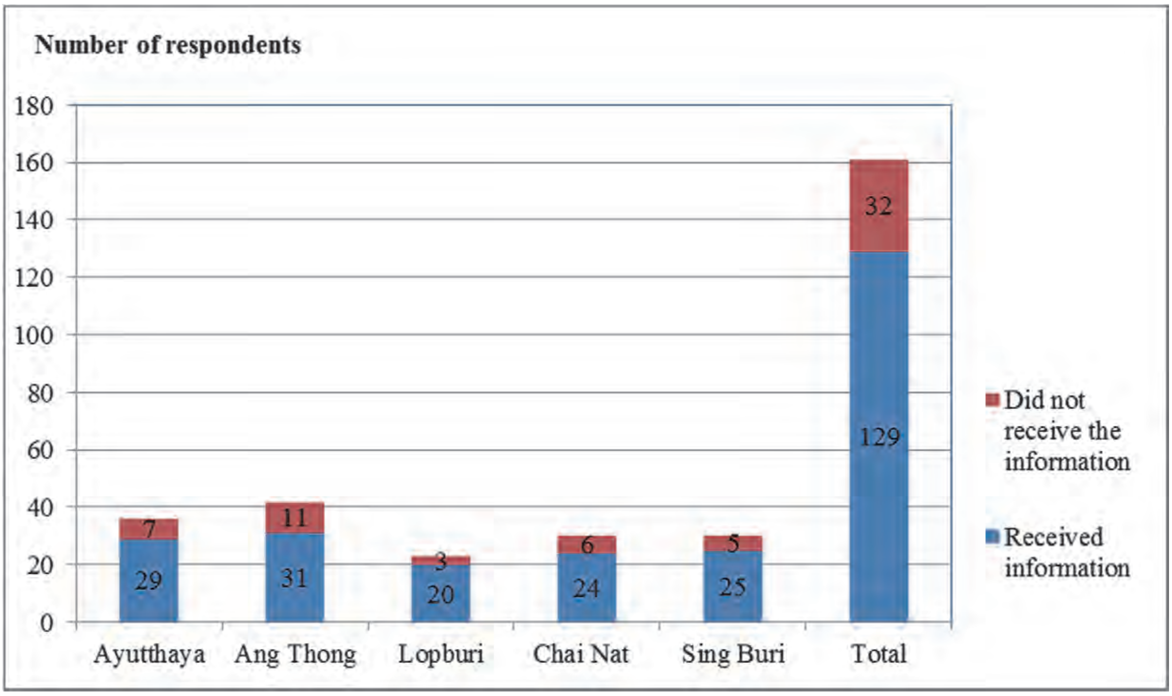


Figure 8-1 Farmer in 5 Provinces Survey: Number of respondents received the information and warning, before the flood reaches the area

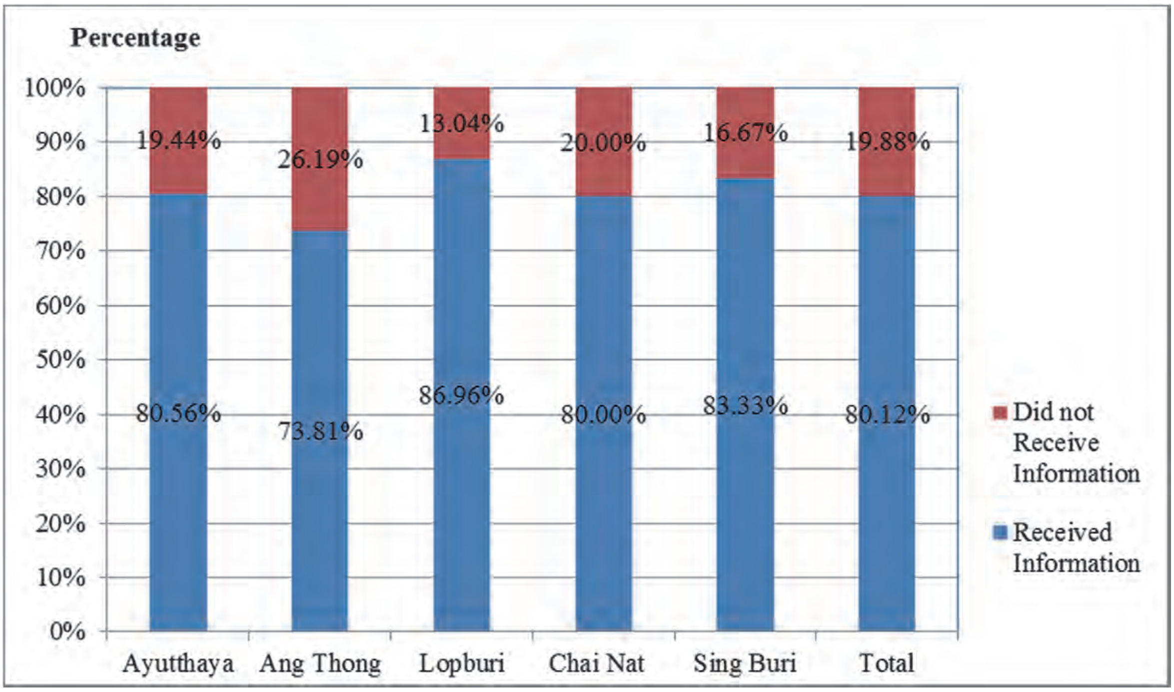


Figure 8-2 Farmer in 5 Provinces Survey: Percentage of respondents received the information and warning, before the flood reaches the area

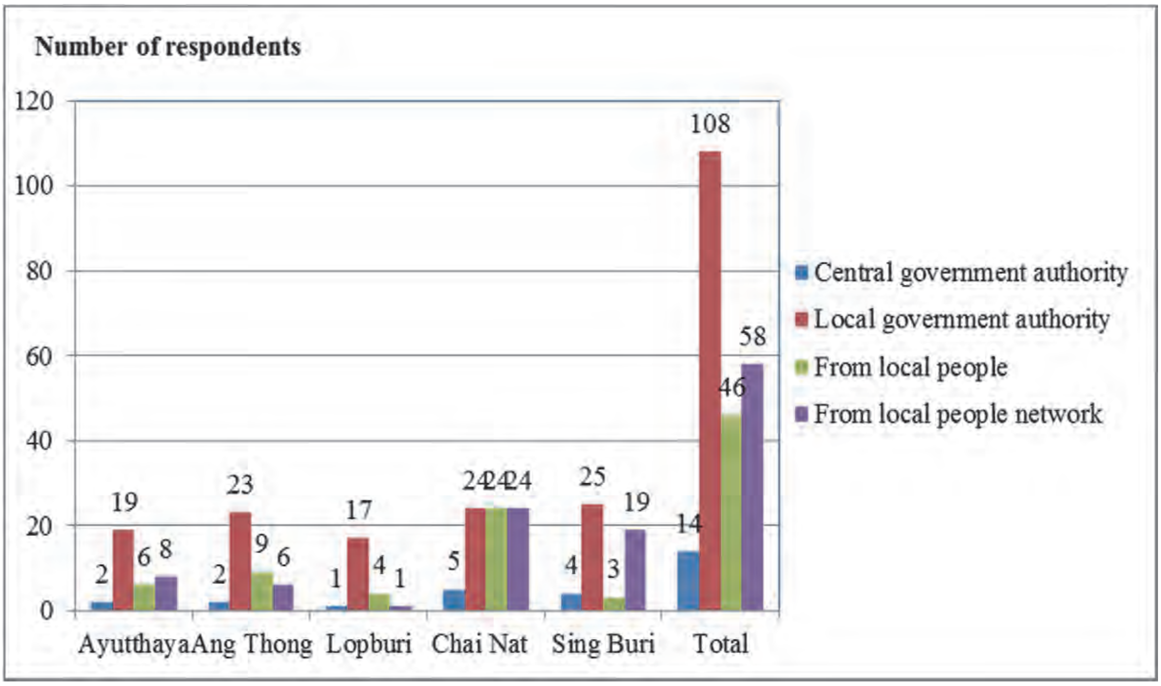


Figure 9-1 Farmer in 5 Provinces Survey: Number of respondents per source of inundation information and warning, before the flood reaches the area

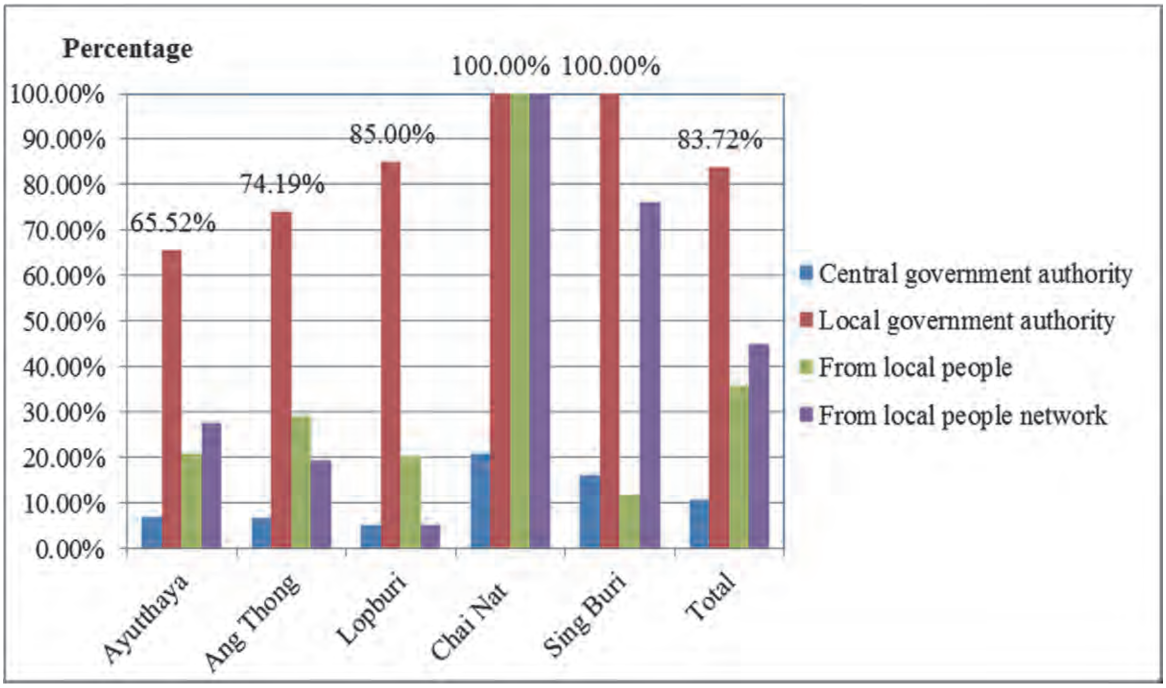


Figure 9-2 Farmer in 5 Provinces Survey: Percentage of respondents per source of inundation information and warning, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 8-1, as the total number of each group of respondent*

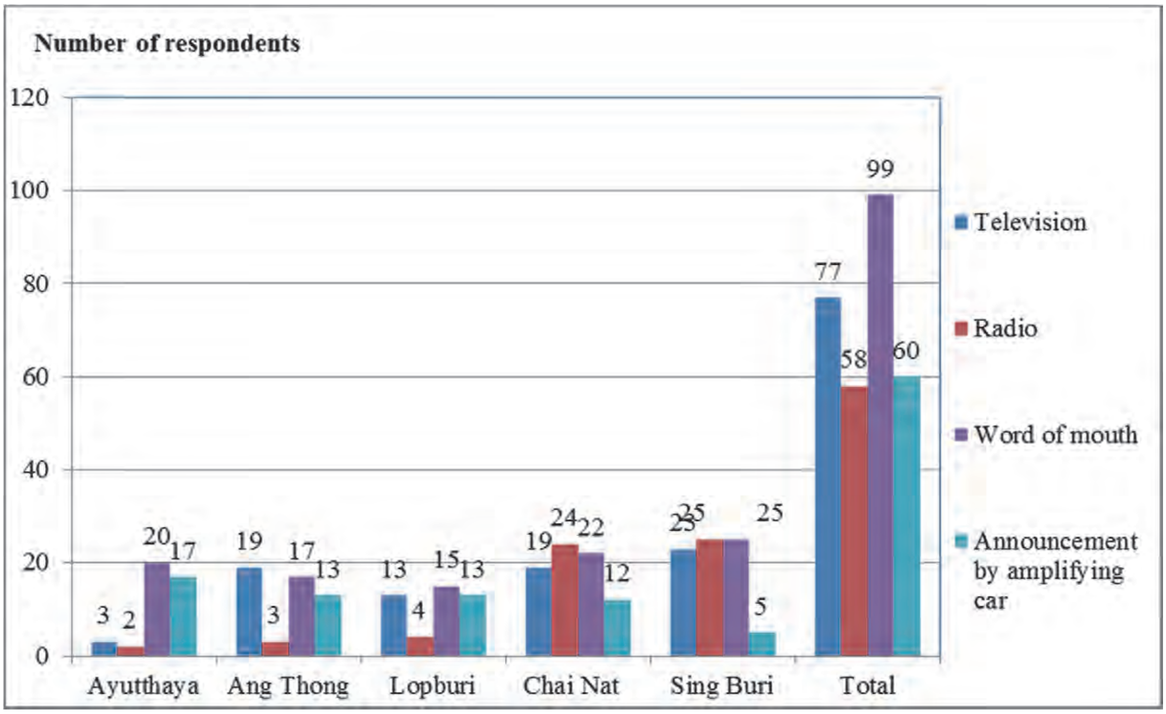


Figure 10-1 Farmer in 5 Provinces Survey: Number of respondents per Channel of inundation information and warning, before the flood reaches the area

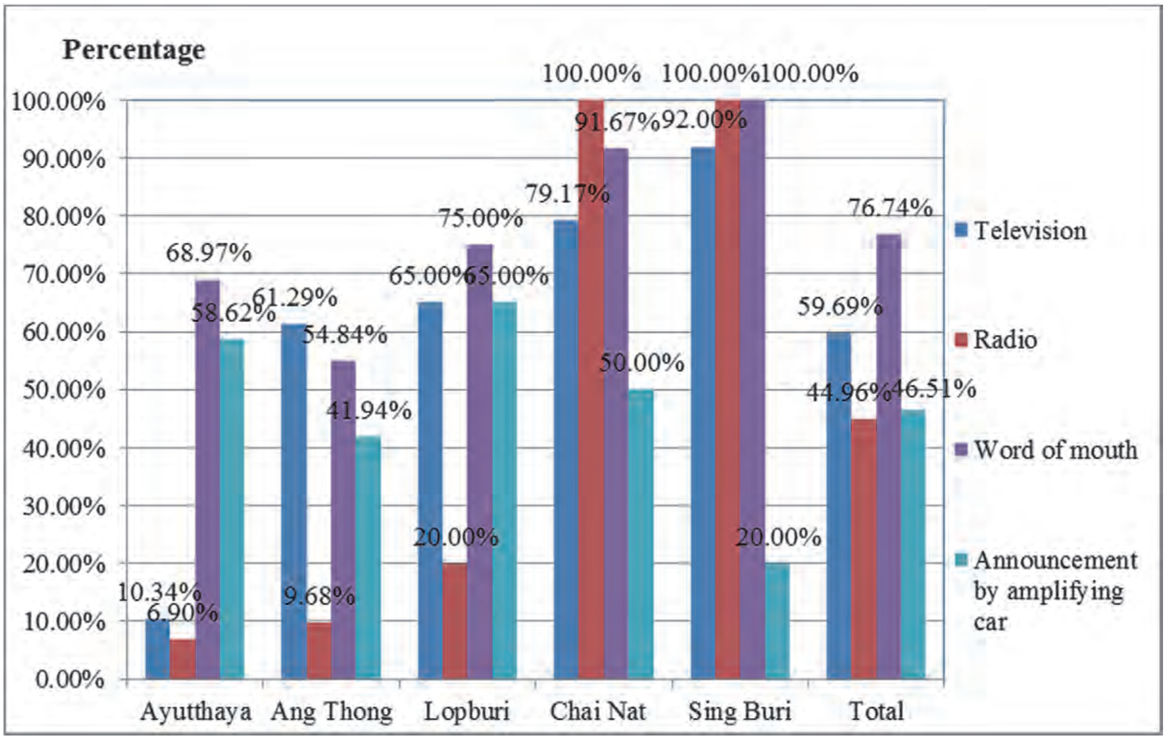


Figure 10-2 Farmer in 5 Provinces Survey: Percentage of respondents per Channel of inundation information and warning, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 8-1, as the total number of each group of respondent*

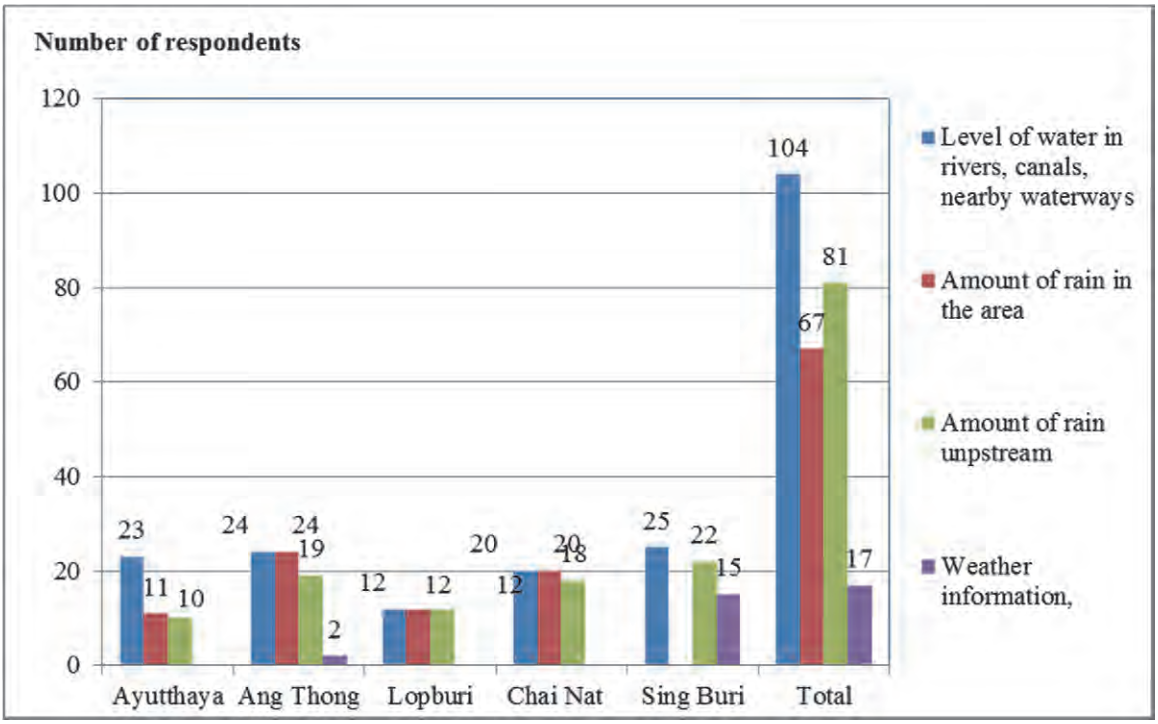


Figure 11-1 Farmer in 5 Provinces Survey: <u>Number of respondents</u> per received Information, before the flood reaches the area

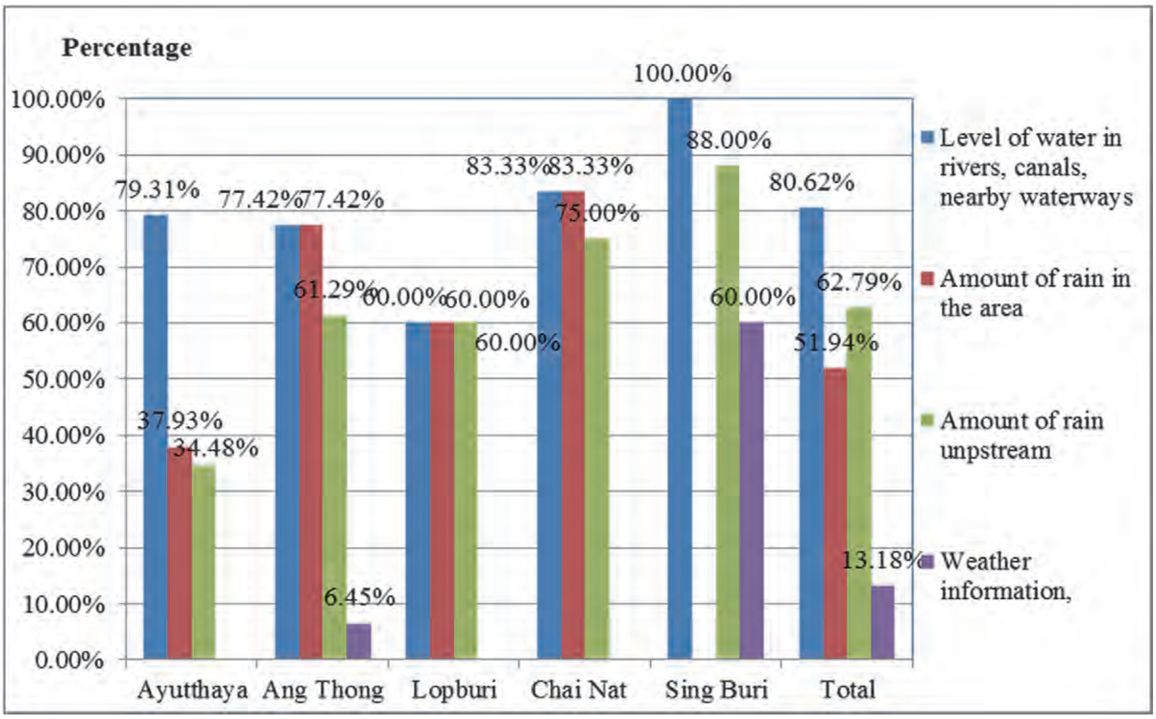


Figure 11-2 Farmer in 5 Provinces Survey: <u>Percentage of respondents</u> per received Information, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 8-1, as the total number of each group of respondent*

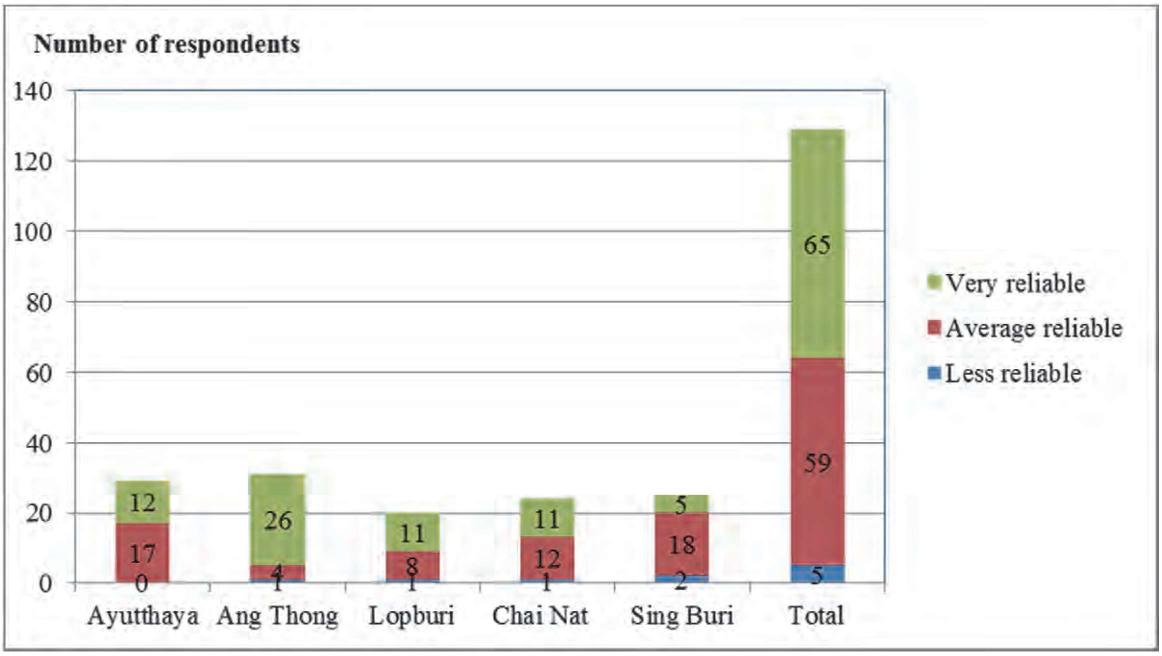


Figure 12-1 Farmer in 5 Provinces Survey: Number of respondents per reliability of received information and warning issuance, before the flood reaches the area

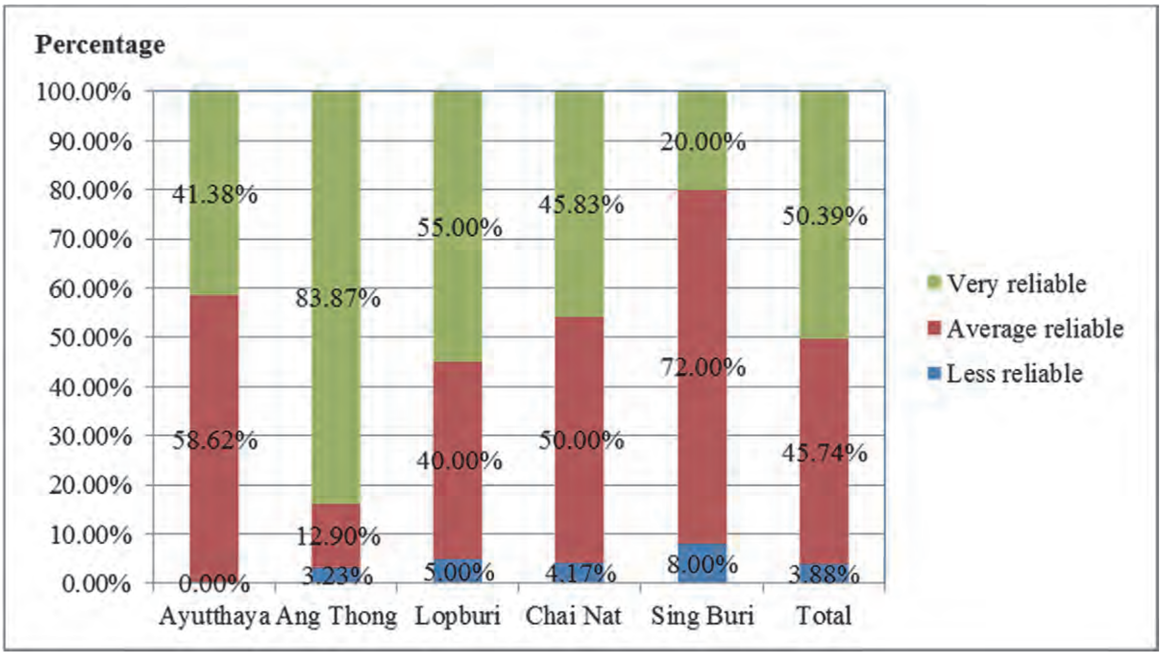


Figure 12-2 Farmer in 5 Provinces Survey: Percentage of respondents per reliability of received information and warning issuance, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 8-1, as the total number of each group of respondent*

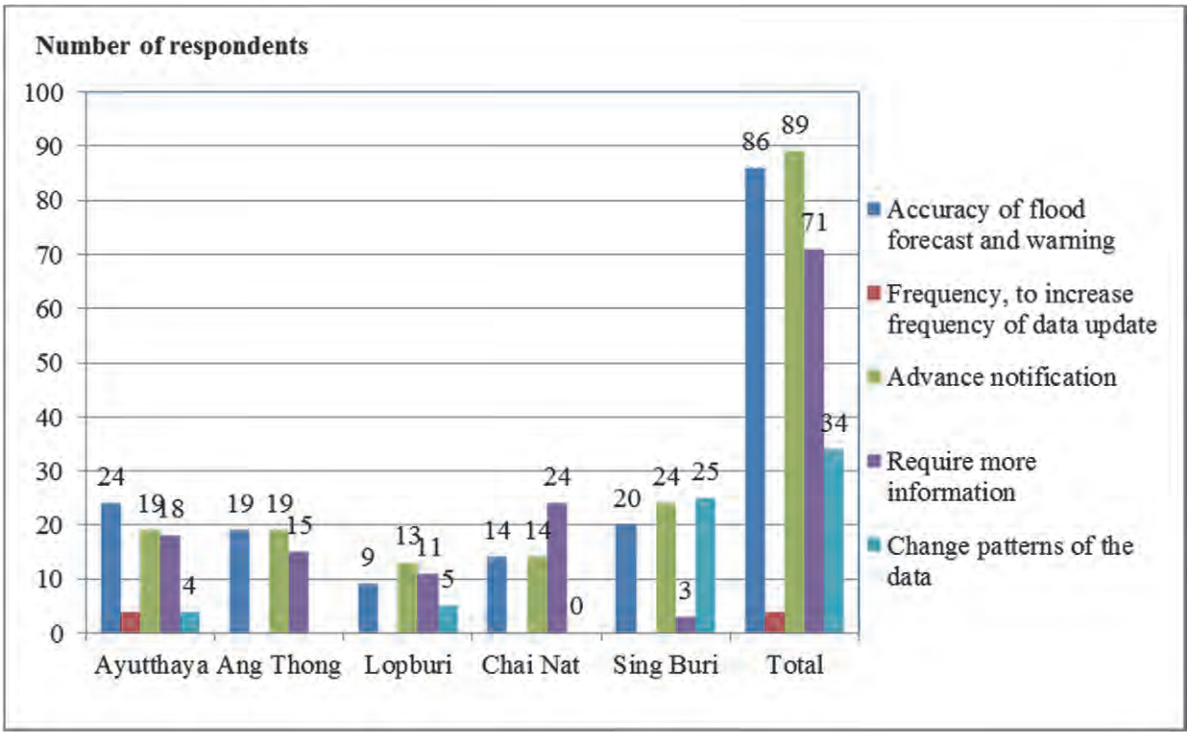


Figure 13-1 Farmer in 5 Provinces Survey: Suggestion of (Numbers of) respondent for information and waning system improvement, before the flood reaches the area

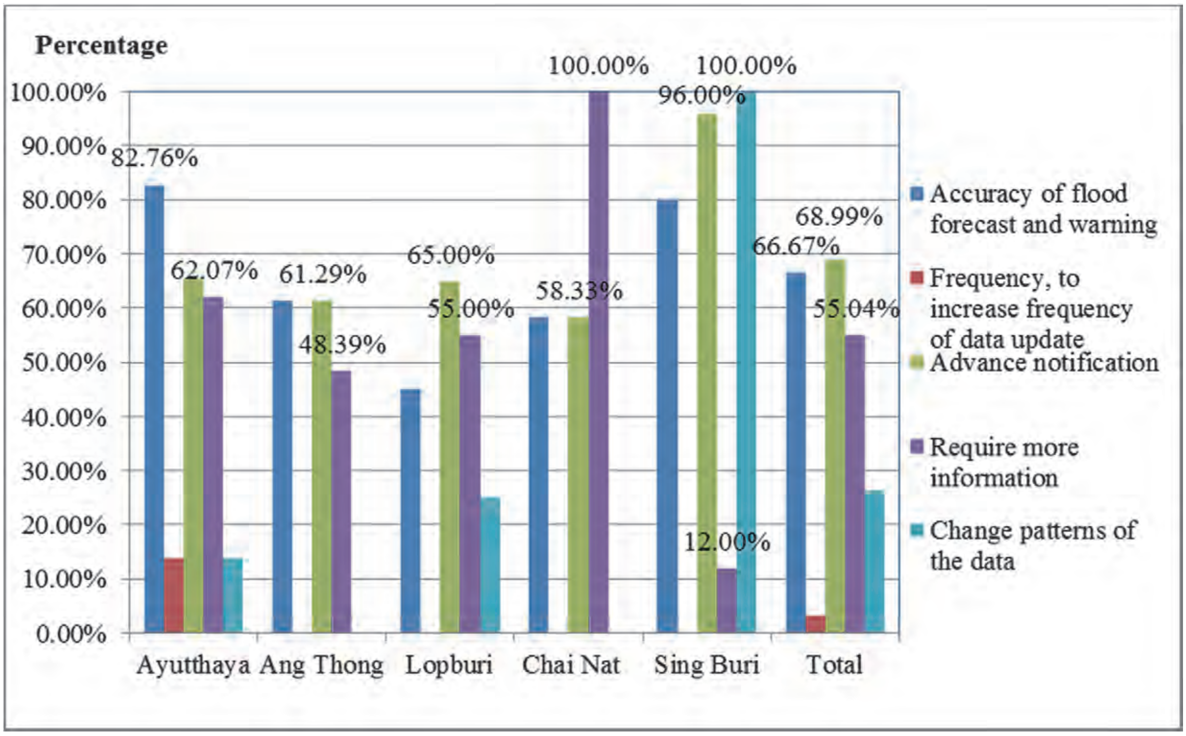


Figure 13-2 Farmer in 5 Provinces Survey: Suggestion of (Percentage of) respondent for information and waning system improvement, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 8-1, as the total number of each group of respondent*

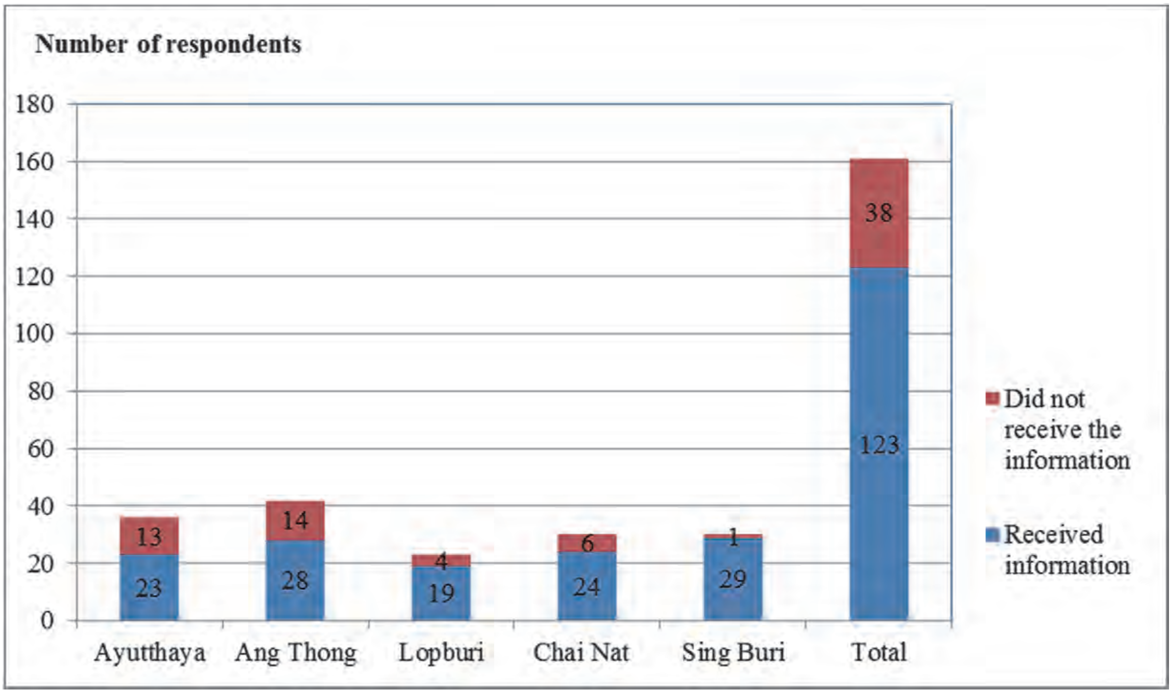


Figure 14-1 Farmer in 5 Provinces Survey: Number of respondents received the information and warning, during the flood reaching the area

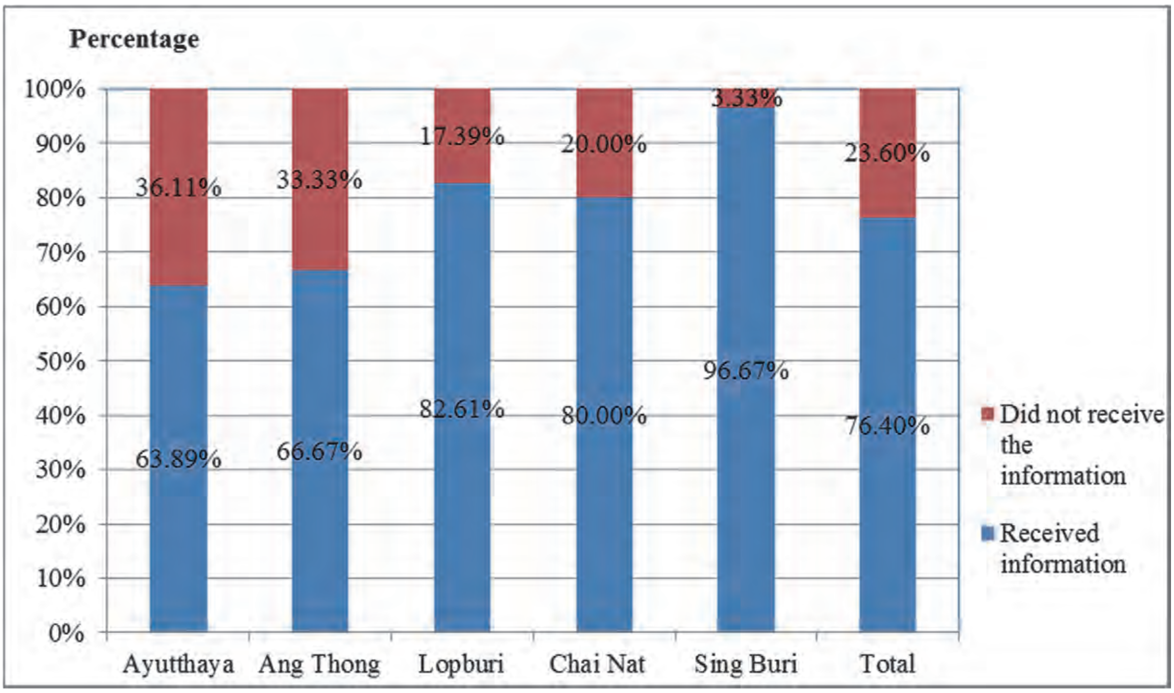


Figure 14-2 Farmer in 5 Provinces Survey: Percentage of respondents received the information and warning, during the flood reaching the area

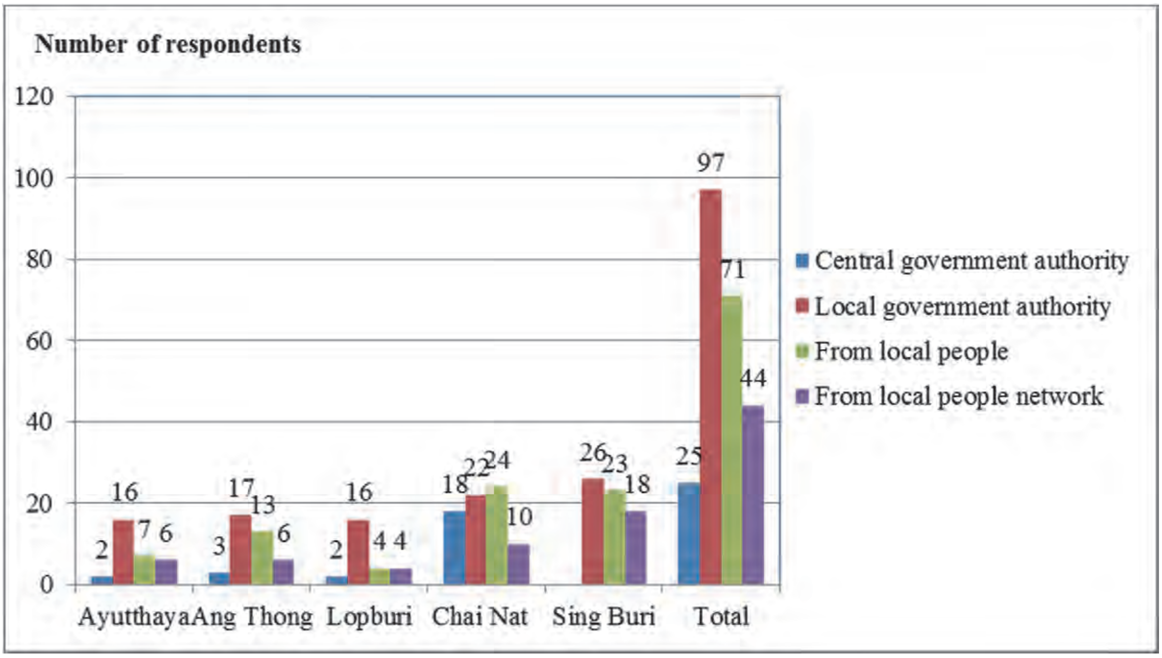


Figure 15-1 Farmer in 5 Provinces Survey: Number of respondents per source of inundation information and warning, during the flood reaching the area

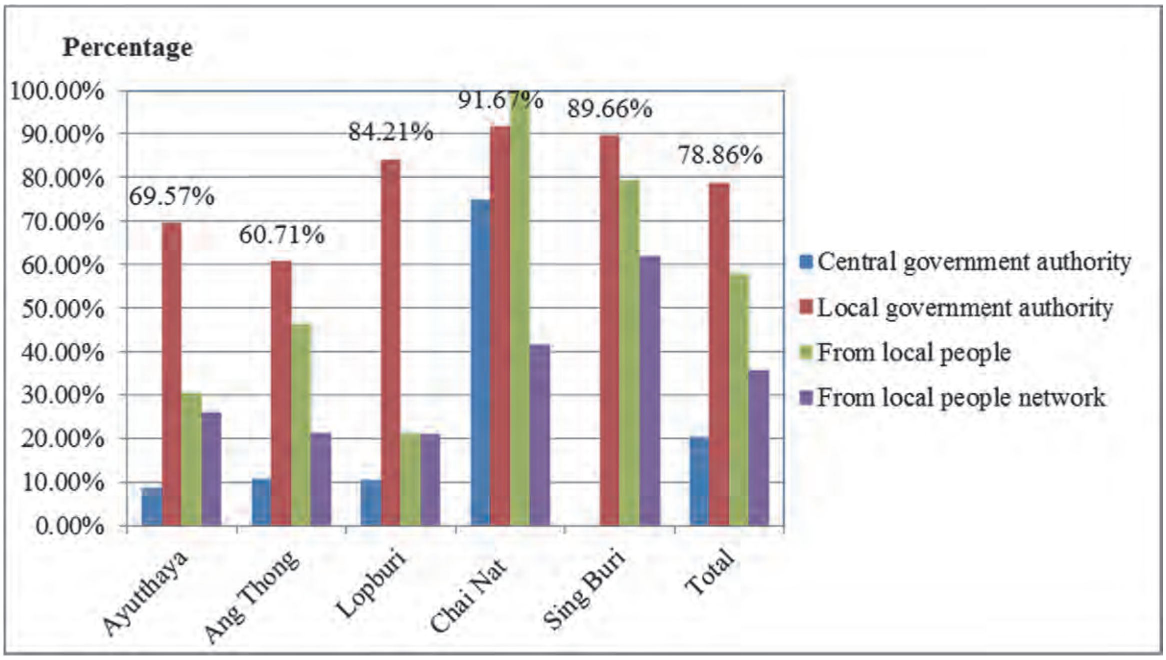


Figure 15-2 Farmer in 5 Provinces Survey: Percentage of respondents per source of inundation information and warning, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

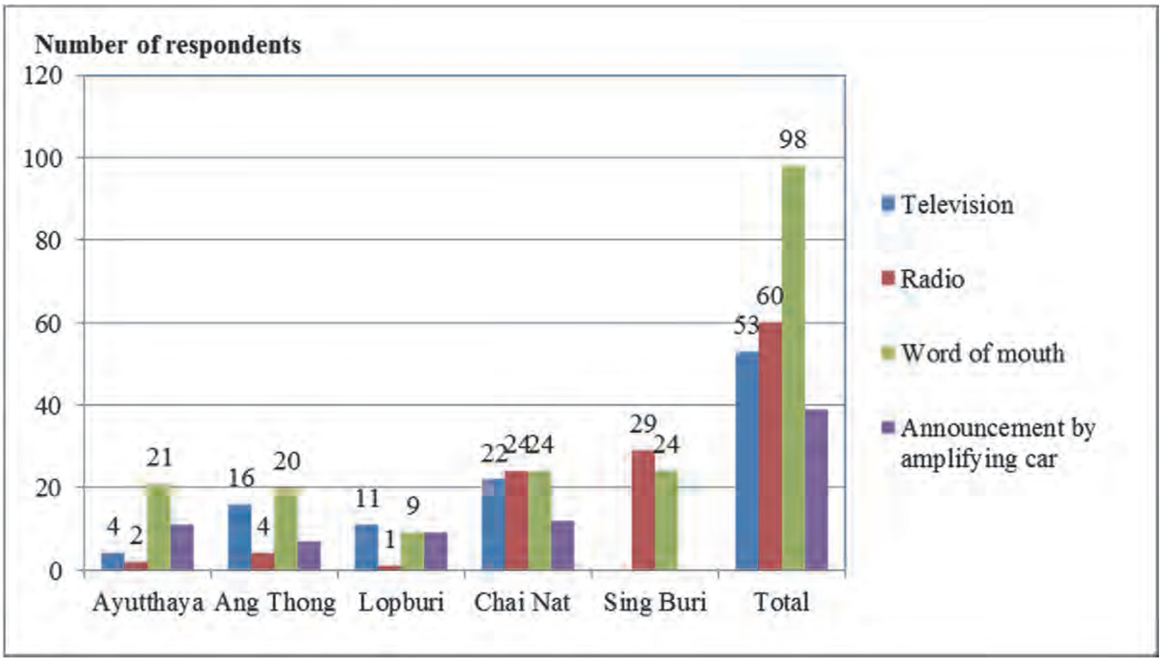


Figure 16-1 Farmer in 5 Provinces Survey: Number of respondents per Channel of inundation information and warning, during the flood reaching the area

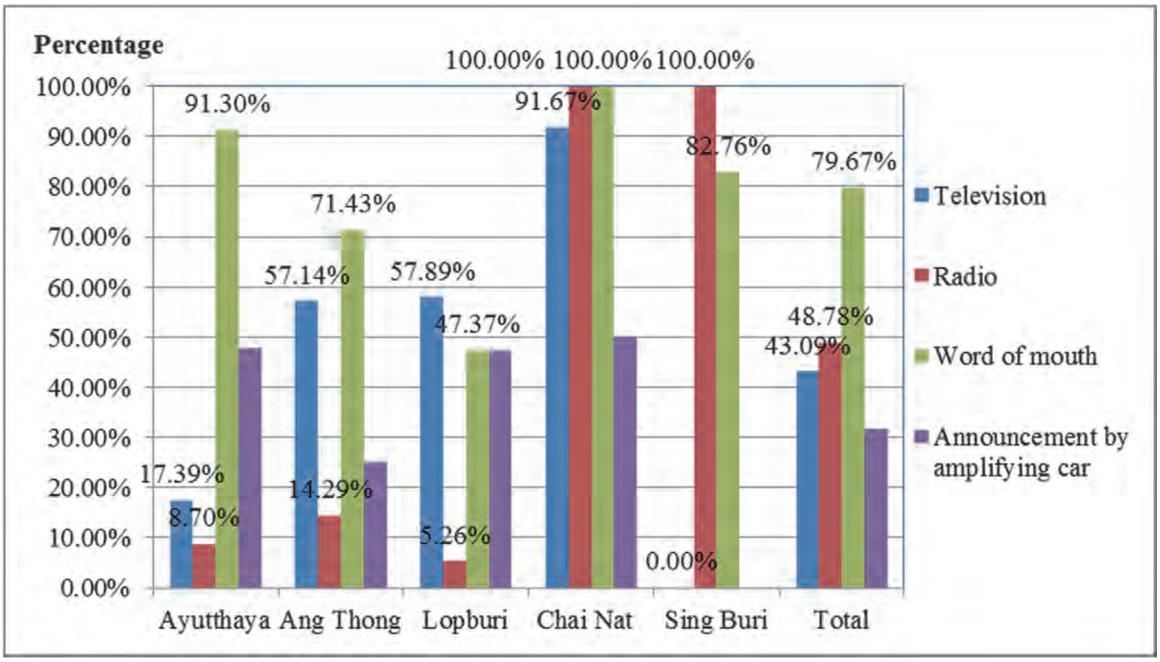


Figure 16-2 Farmer in 5 Provinces Survey: Percentage of respondents per Channel of inundation information and warning, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

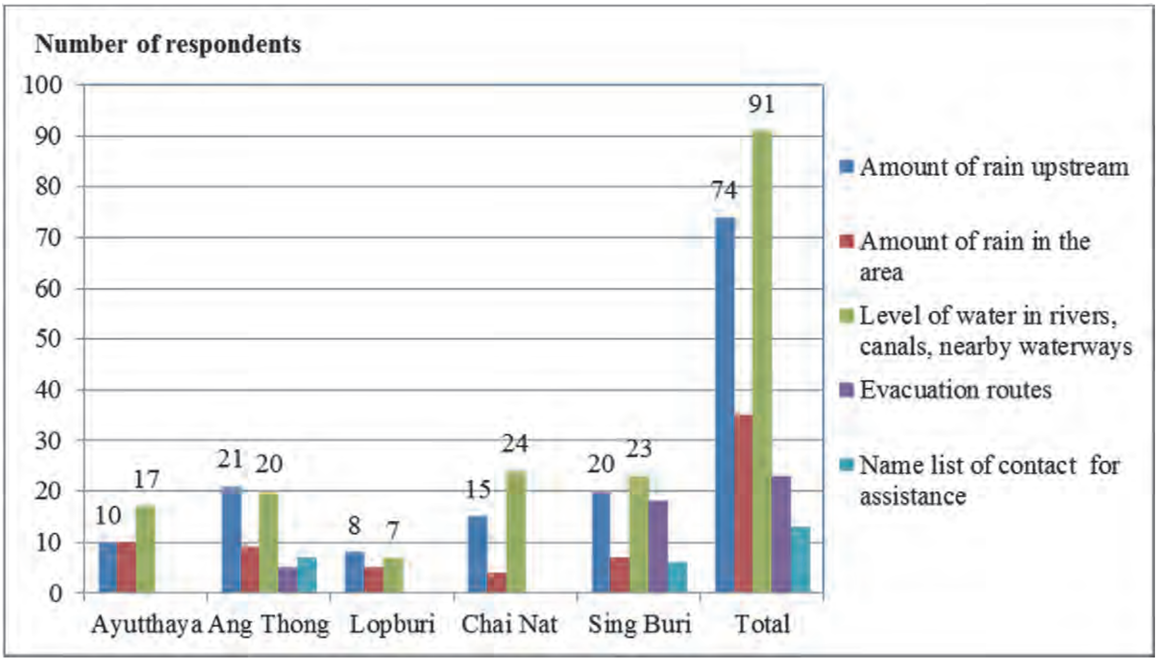


Figure 17-1 Farmer in 5 Provinces Survey: Number of respondents per Received Information, during the flood reaching the area

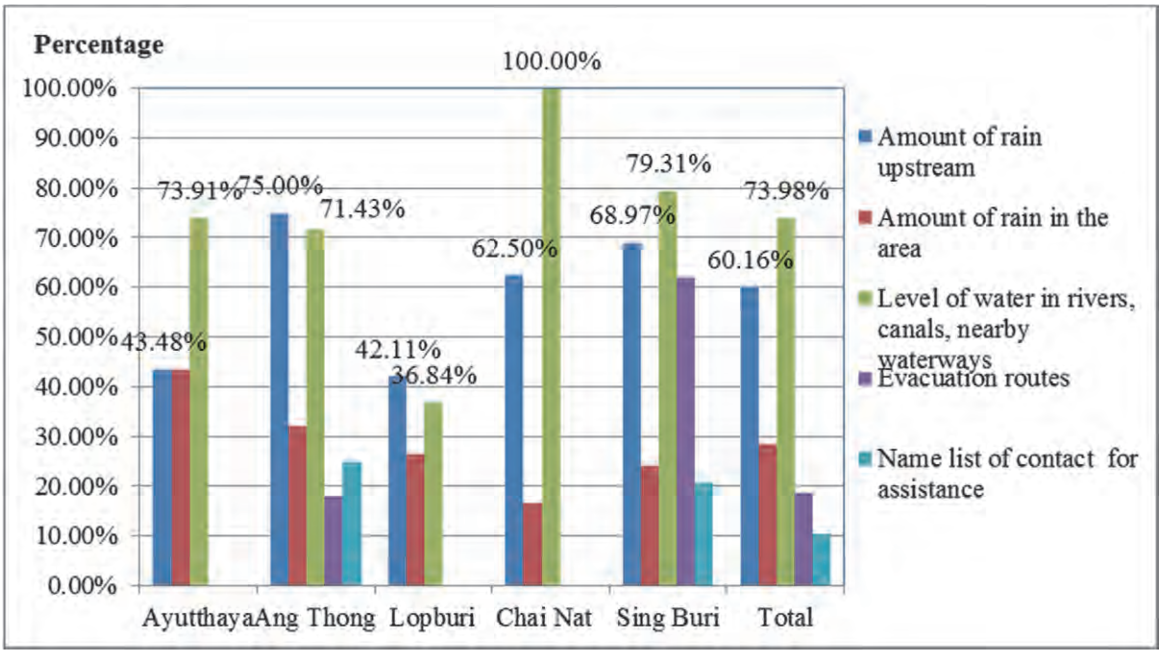


Figure 17-2 Farmer in 5 Provinces Survey: Percentage of respondents per Received Information, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

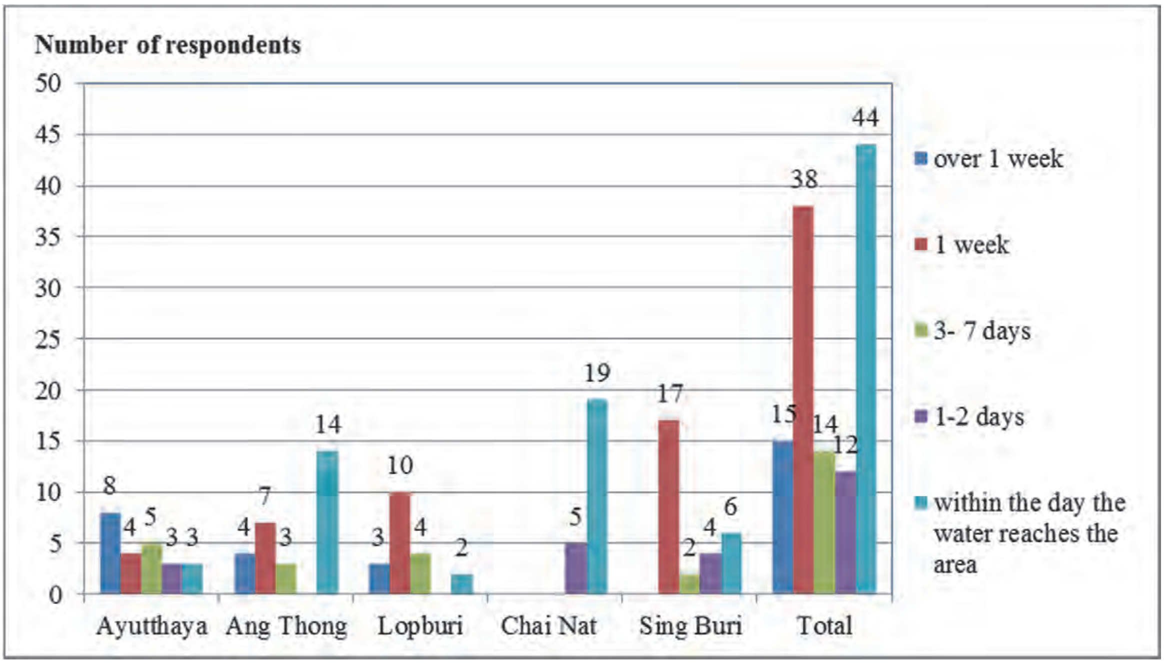


Figure 18-1 Farmer in 5 Provinces Survey: Time period that (Number of) respondents received the inundation information and warning, during the flood reaching the area

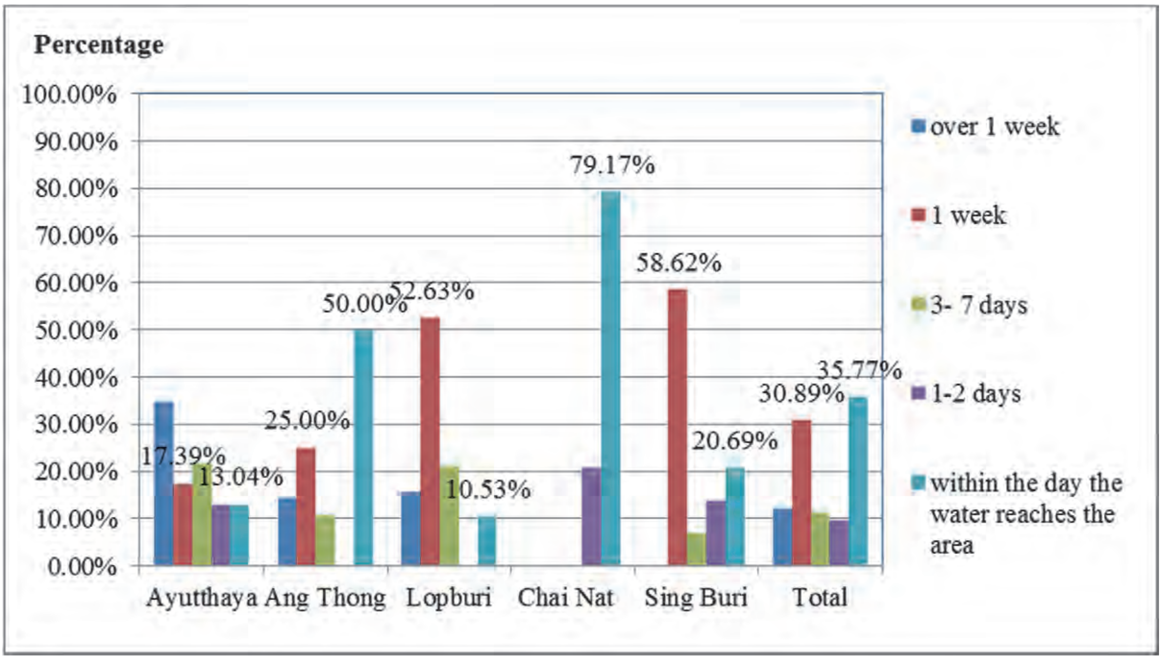


Figure 18-2 Farmer in 5 Provinces Survey: Time period that (Percentage of) respondent received the inundation information and warning, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

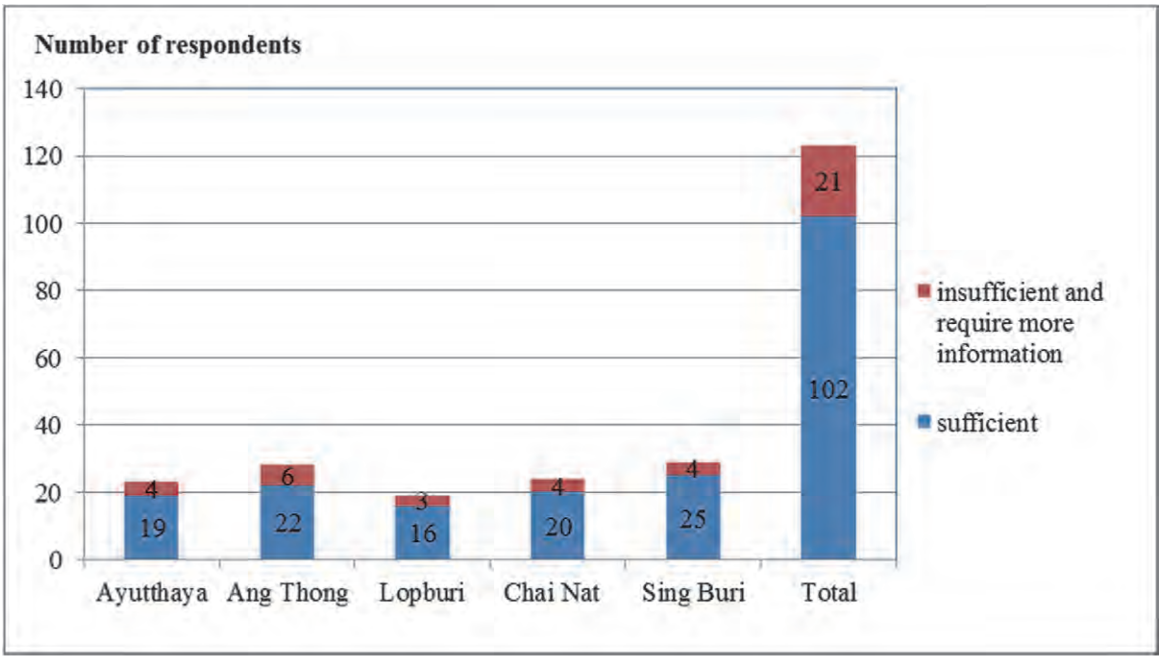


Figure 19-1 Farmer in 5 Provinces Survey: <u>Number of respondents</u> per the sufficiency of received information, during the flood reaching the area

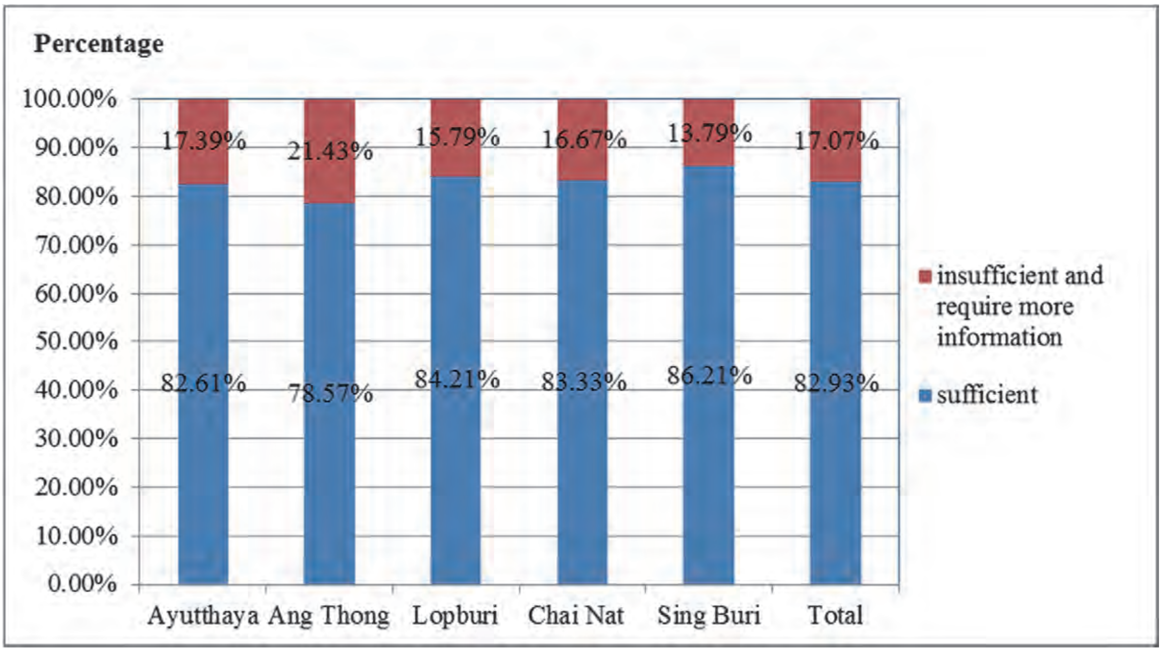


Figure 19-2 Farmer in 5 Provinces Survey: <u>Percentage of respondents</u> per the sufficiency of received information, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

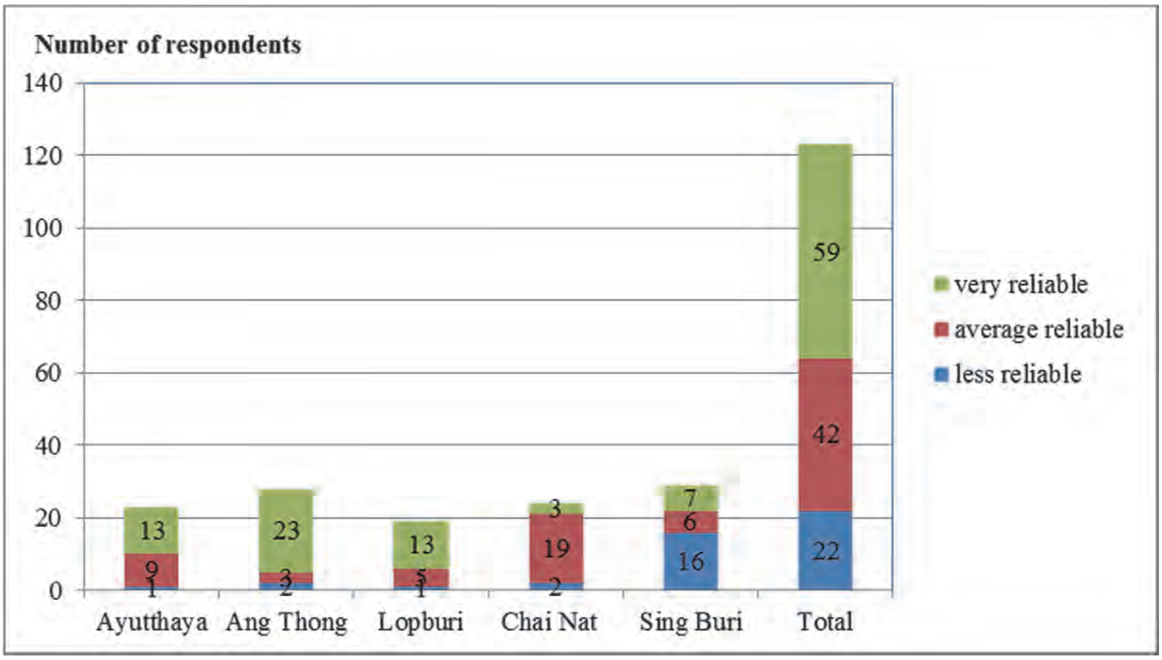


Figure 20-1 Farmer in 5 Provinces Survey: <u>Number of respondents</u> per reliability of received information and warning issuance, during the flood reaching the area

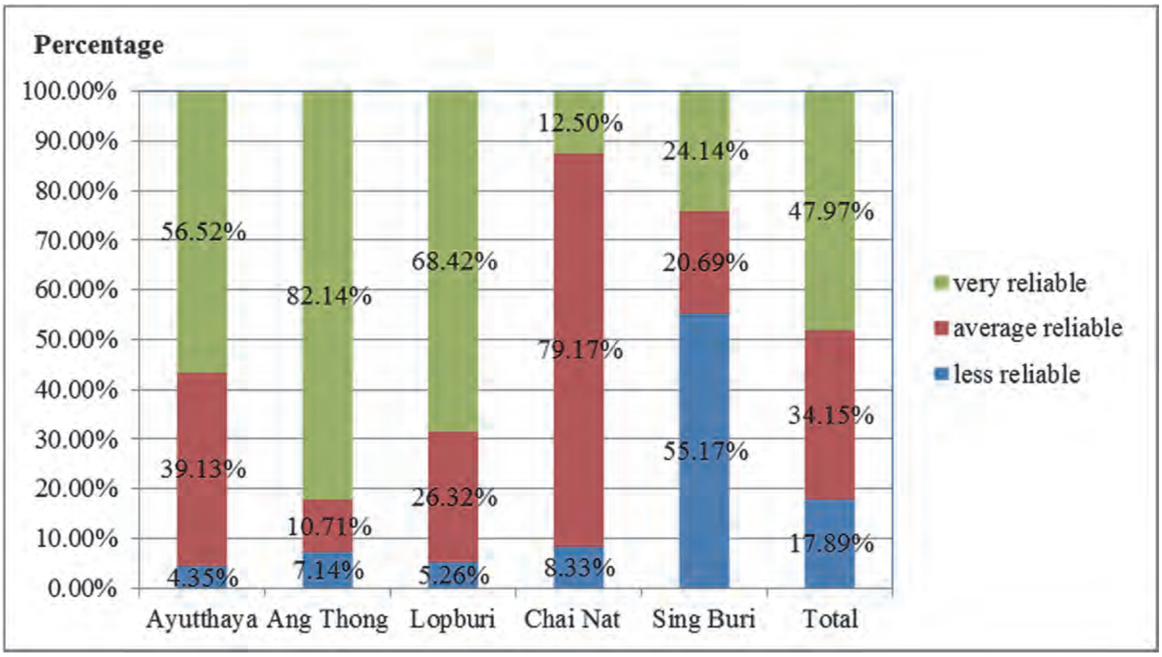


Figure 20-2 Farmer in 5 Provinces Survey: <u>Percentage of respondents</u> per reliability of received information and warning issuance, during the flood reaching the area

Note: *In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

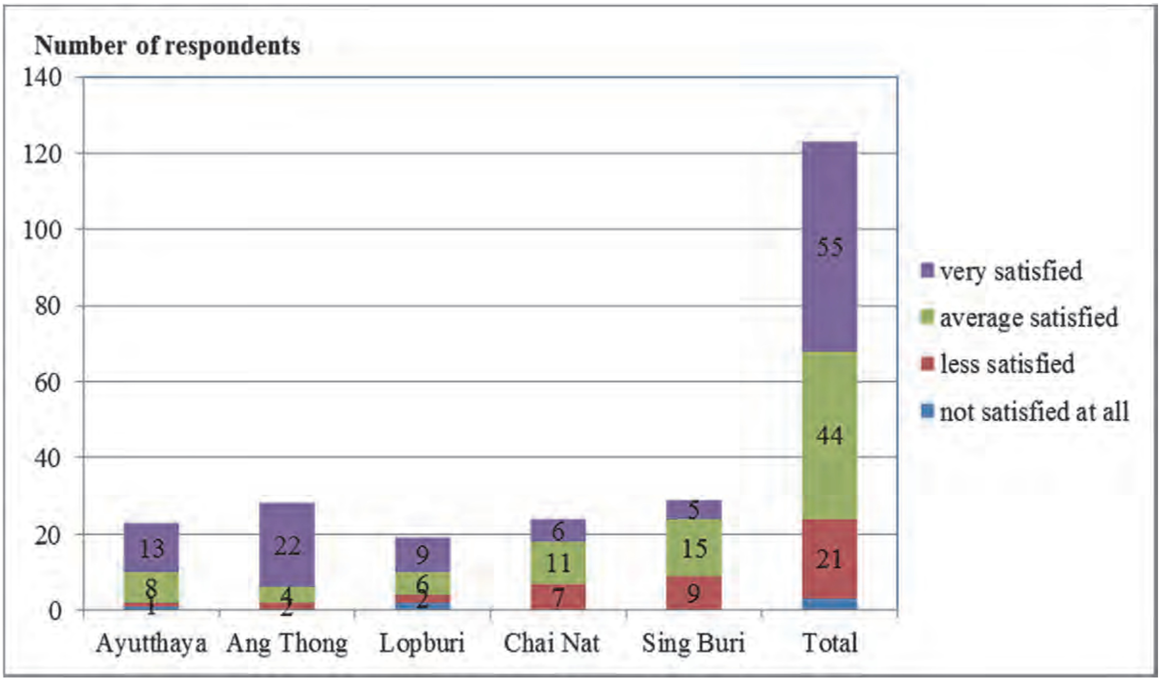


Figure 21-1 Farmer in 5 Provinces Survey: Number of respondents per satisfaction of received information and warning issuance, during the flood reaching the area

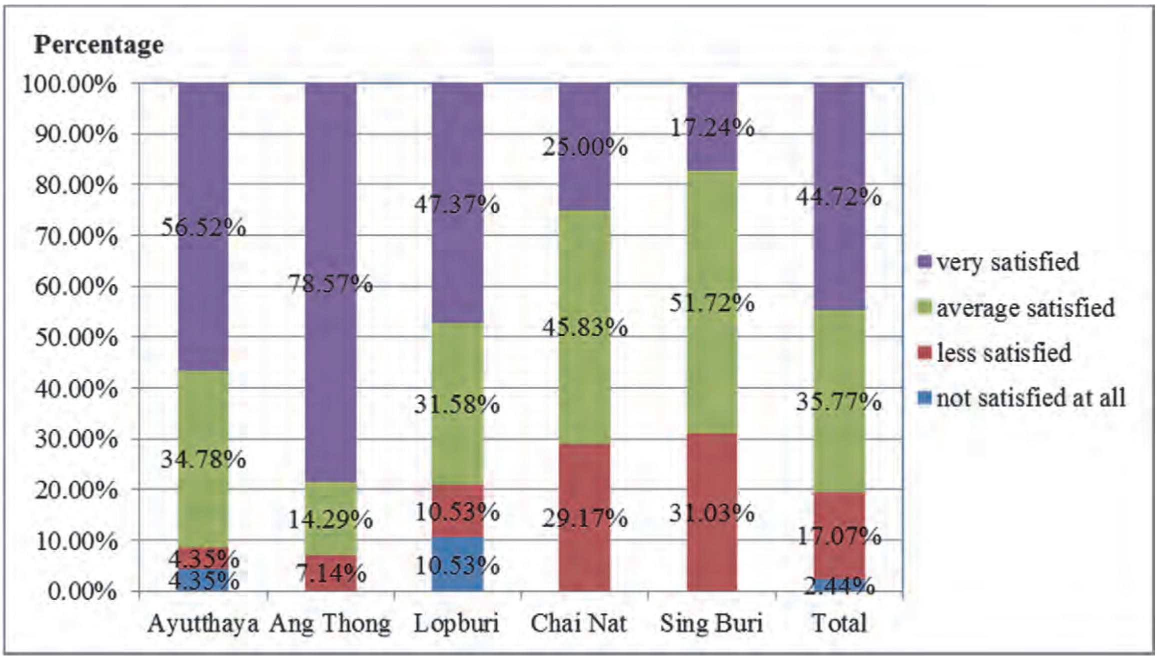


Figure 21-2 Farmer in 5 Provinces Survey: Percentage of respondents per satisfaction of received information and warning issuance, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

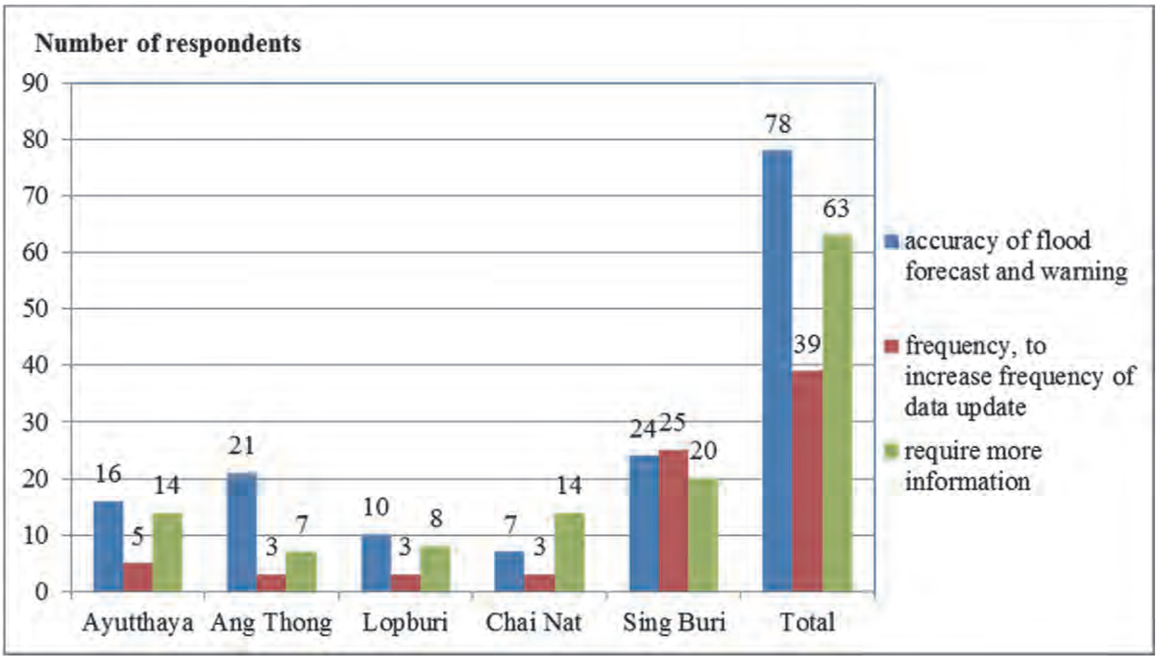


Figure 22-1 Farmer in 5 Provinces Survey: Suggestion of <u>(Numbers of) respondent</u> for information and warning system improvement, during the flood reaching the area

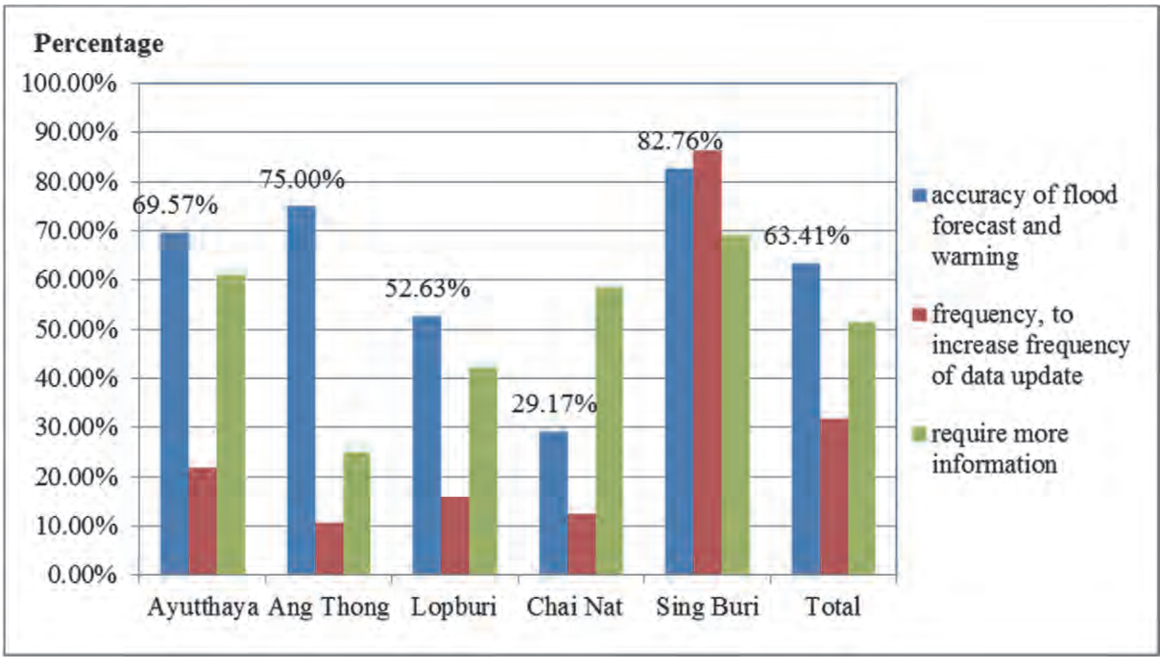


Figure 22-2 Farmer in 5 Provinces Survey: Suggestion of <u>(Percentage of) respondent</u> for information and warning system improvement, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 14-1, as the total number of each group of respondent*

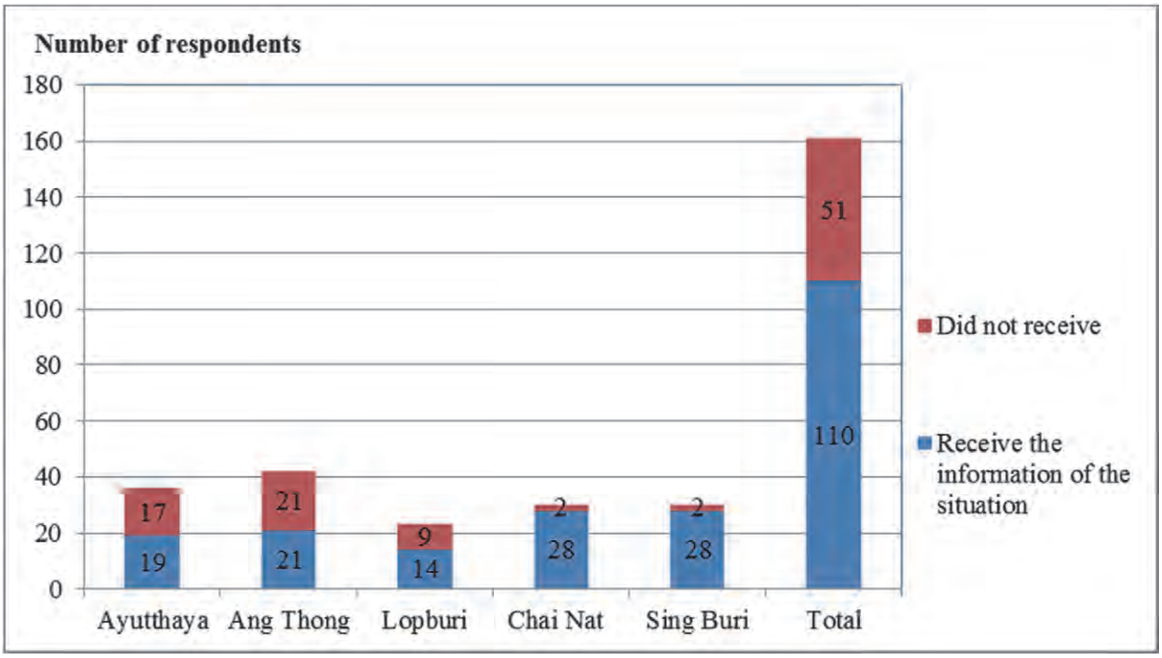


Figure 23-1 Farmer in 5 Provinces Survey: Number of respondents received the information and warning, during the recovery period

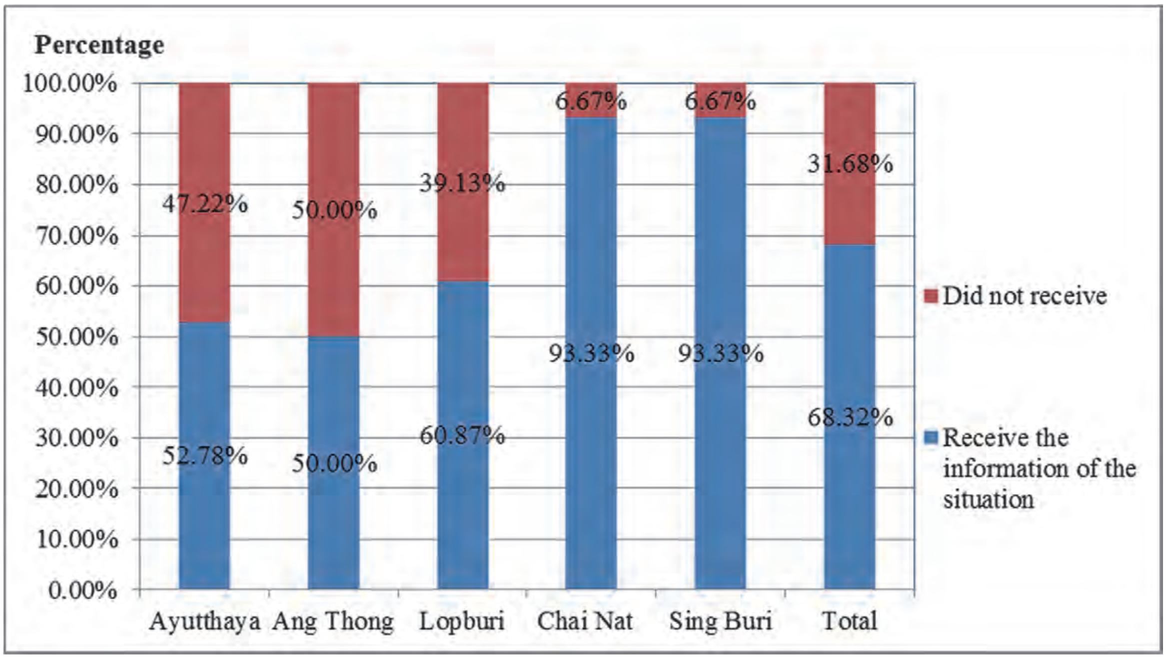


Figure 23-2 Farmer in 5 Provinces Survey: Percentage of respondents received the information and warning, during the recovery period

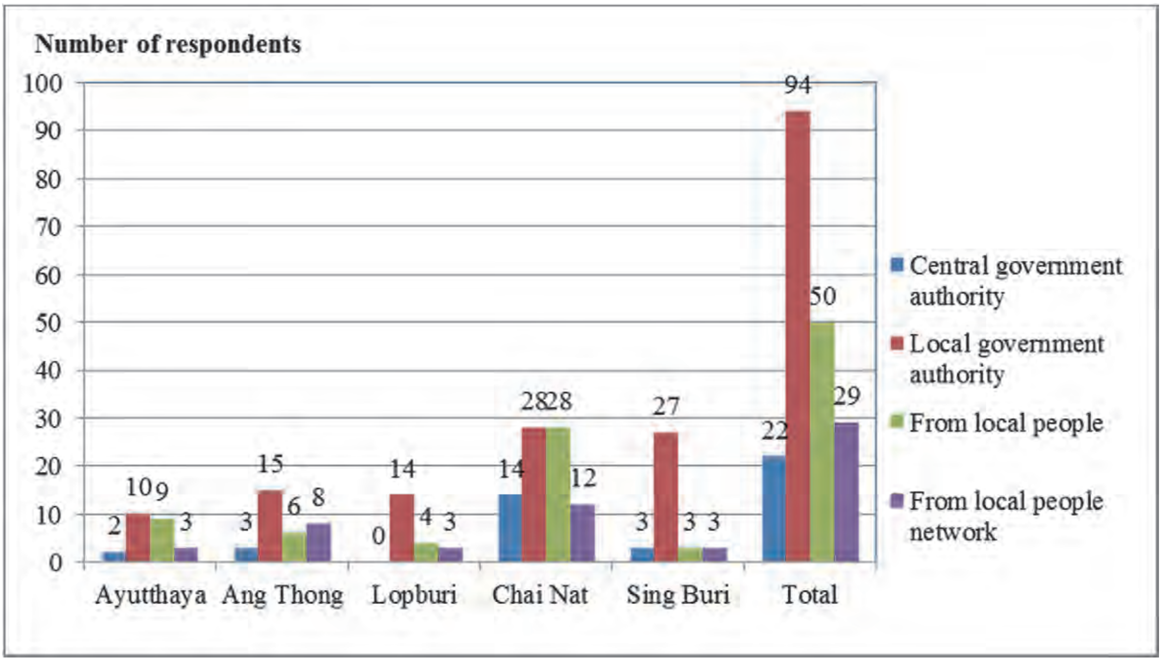


Figure 24-1 Farmer in 5 Provinces Survey: Number of respondents per source of inundation information and warning, during the recovery period

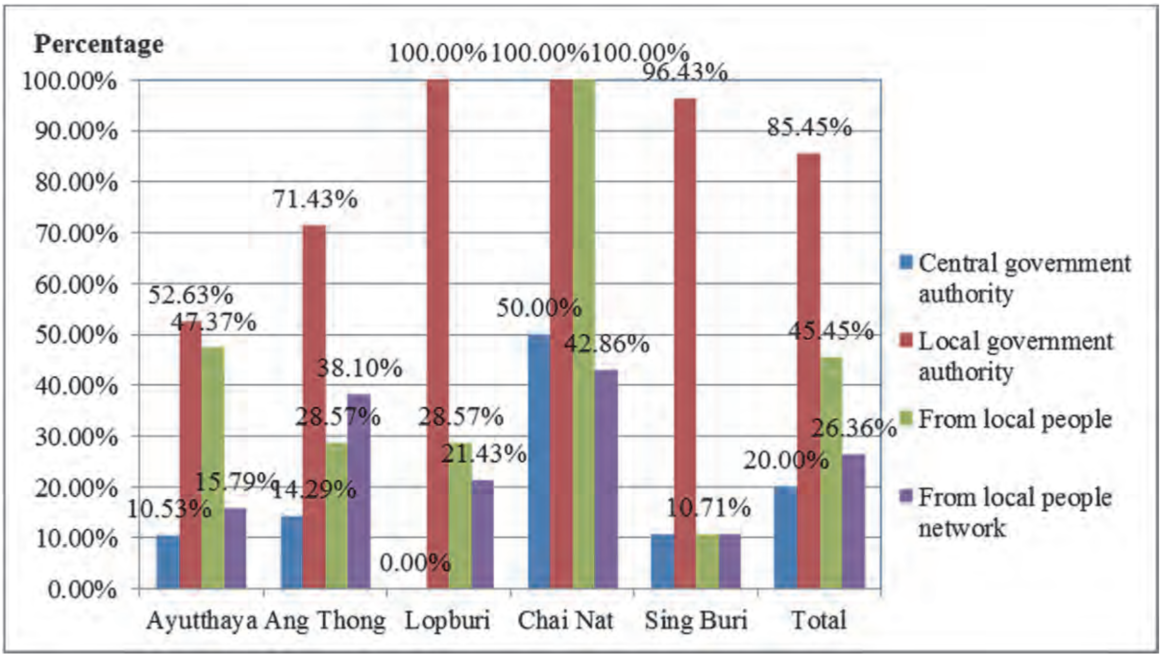


Figure 24-2 Farmer in 5 Provinces Survey: Percentage of respondents per source of inundation information and warning, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 23-1, as the total number of each group of respondent*

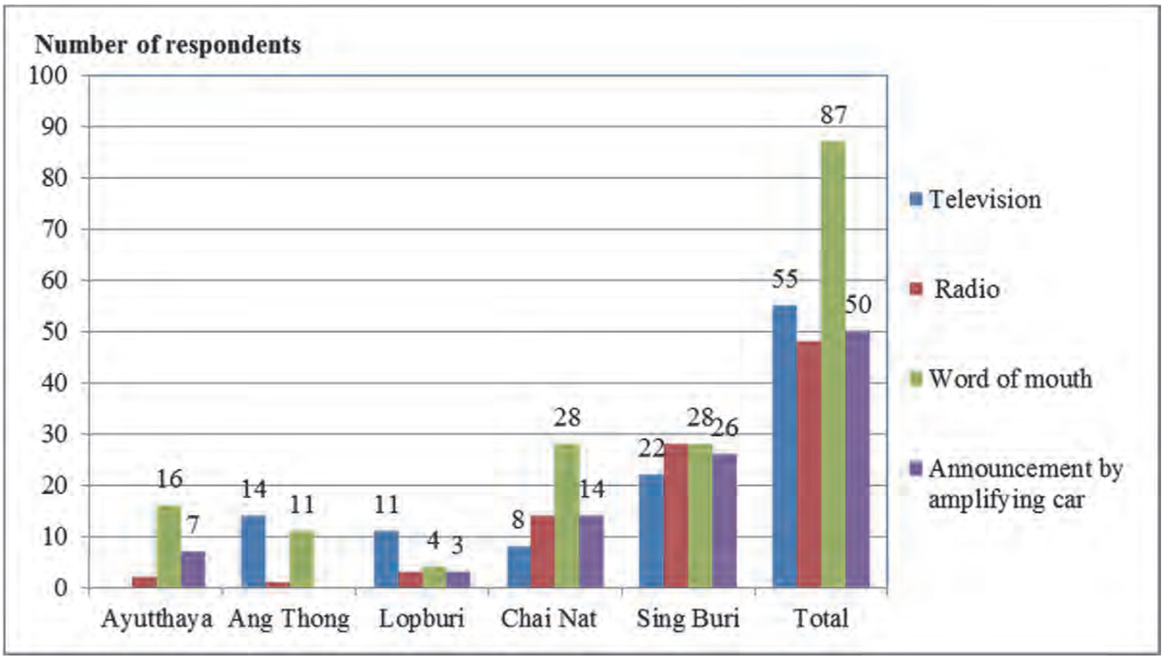


Figure 25-1 Farmer in 5 Provinces Survey: Number of respondents per Channel of inundation information and warning, during the recovery period

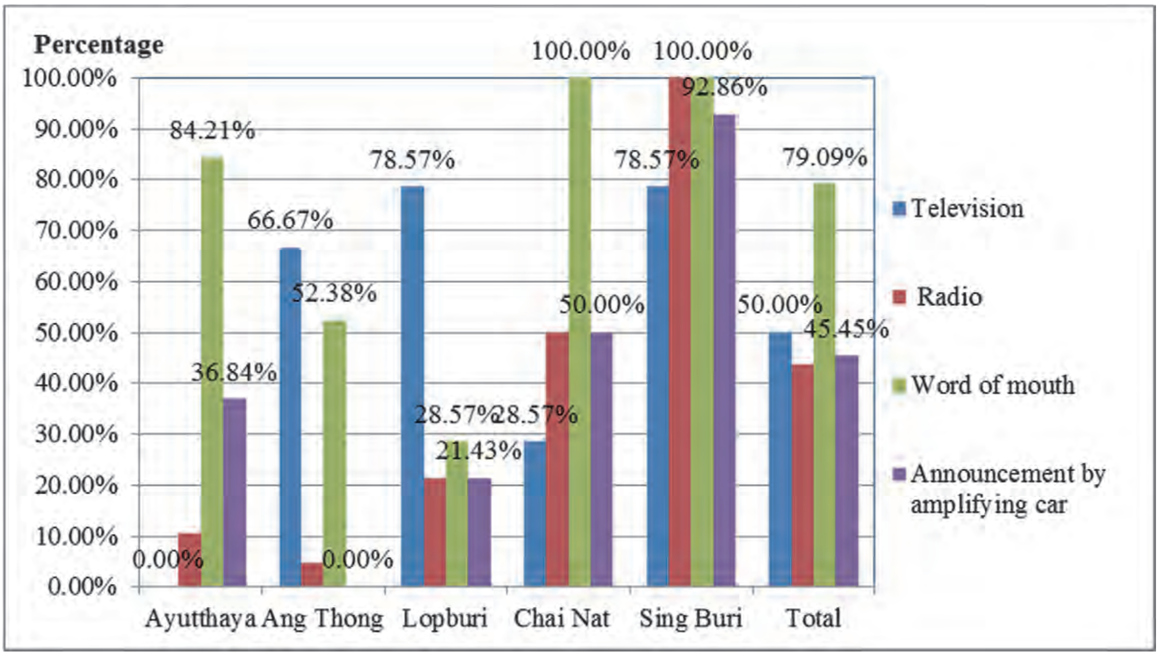


Figure 25-2 Farmer in 5 Provinces Survey: Percentage of respondents per Channel of inundation information and warning, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 23-1, as the total number of each group of respondent*

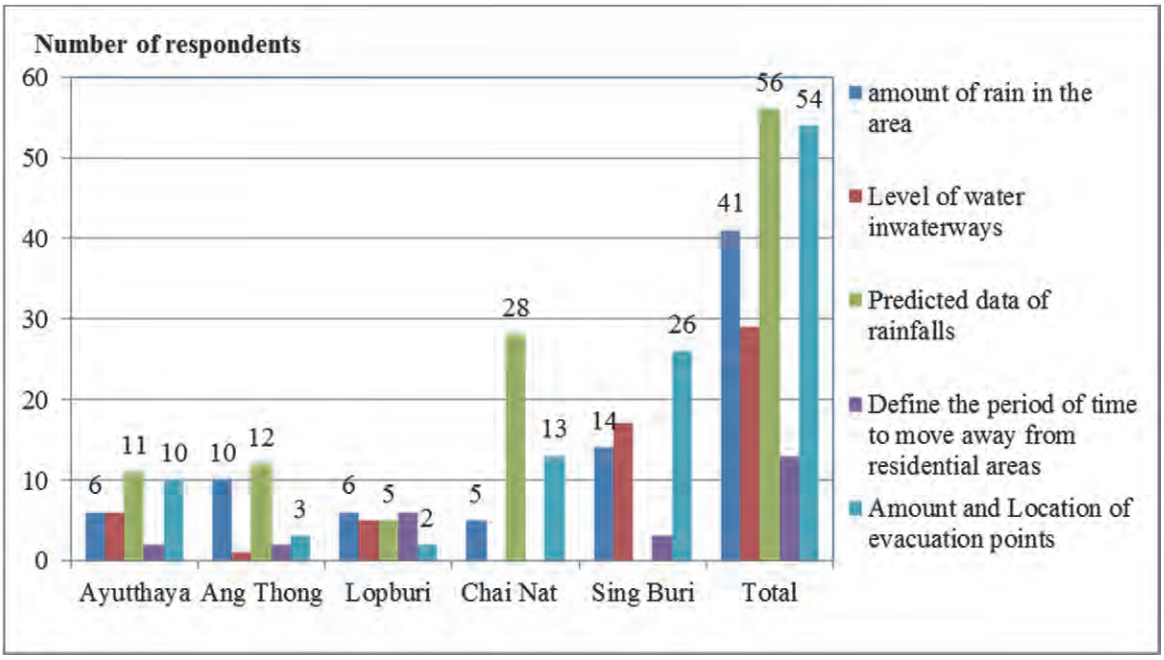


Figure 26-1 Farmer in 5 Provinces Survey: <u>Number of respondents</u> per Received Information, during the recovery period

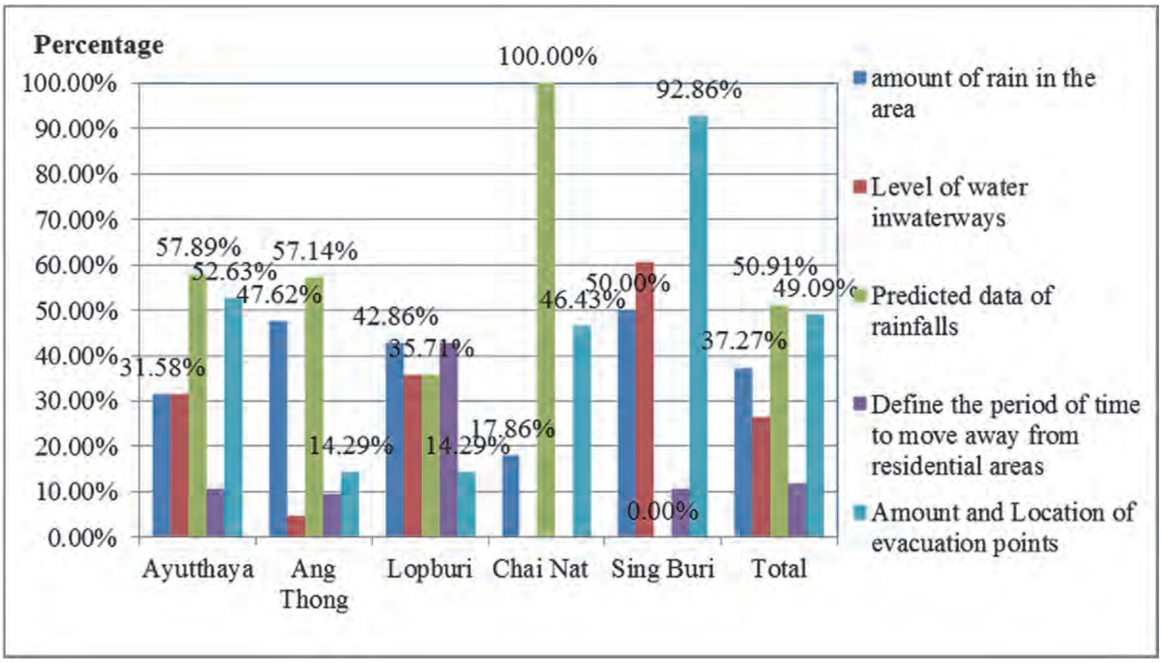


Figure 26-2 Farmer in 5 Provinces Survey: <u>Percentage of respondents</u> per Received Information, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 23-1, as the total number of each group of respondent*

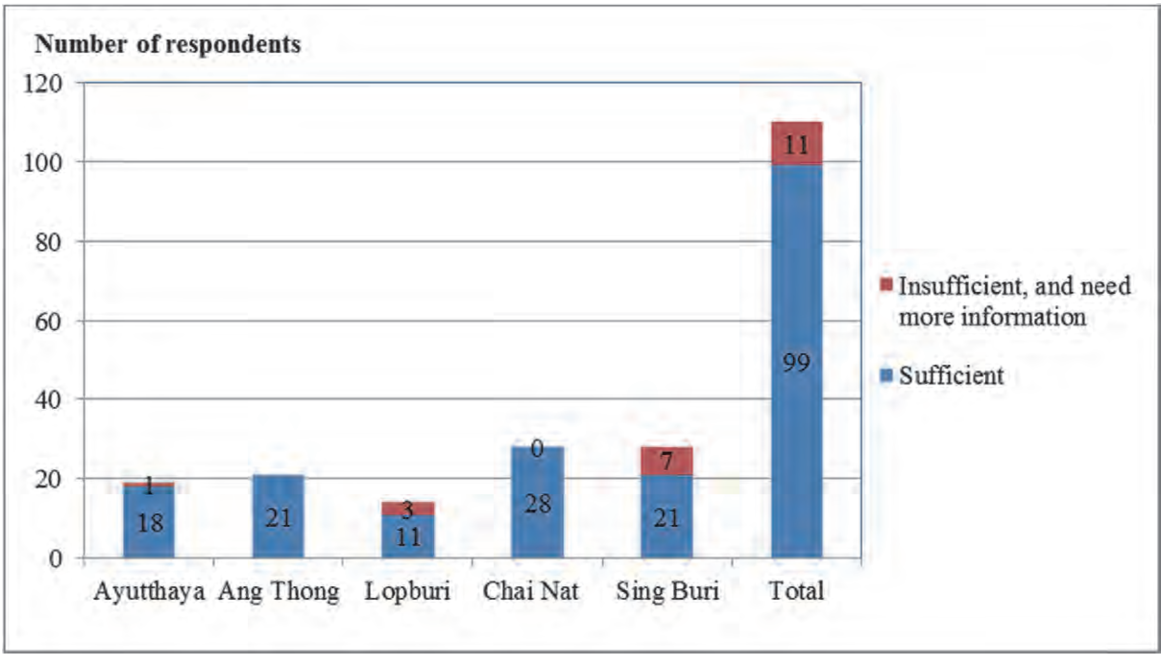


Figure 27-1 Farmer in 5 Provinces Survey: Number of respondents per the sufficiency of received information, during the recovery period

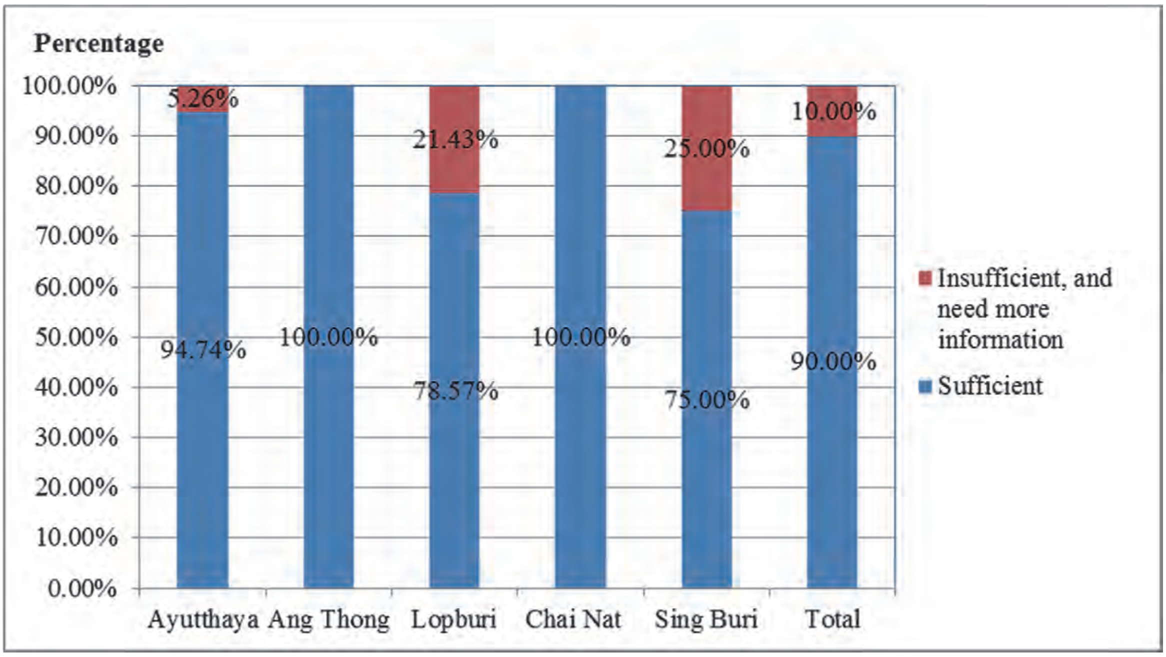


Figure 27-2 Farmer in 5 Provinces Survey: Percentage of respondents per the sufficiency of received information, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 23-1, as the total number of each group of respondent*

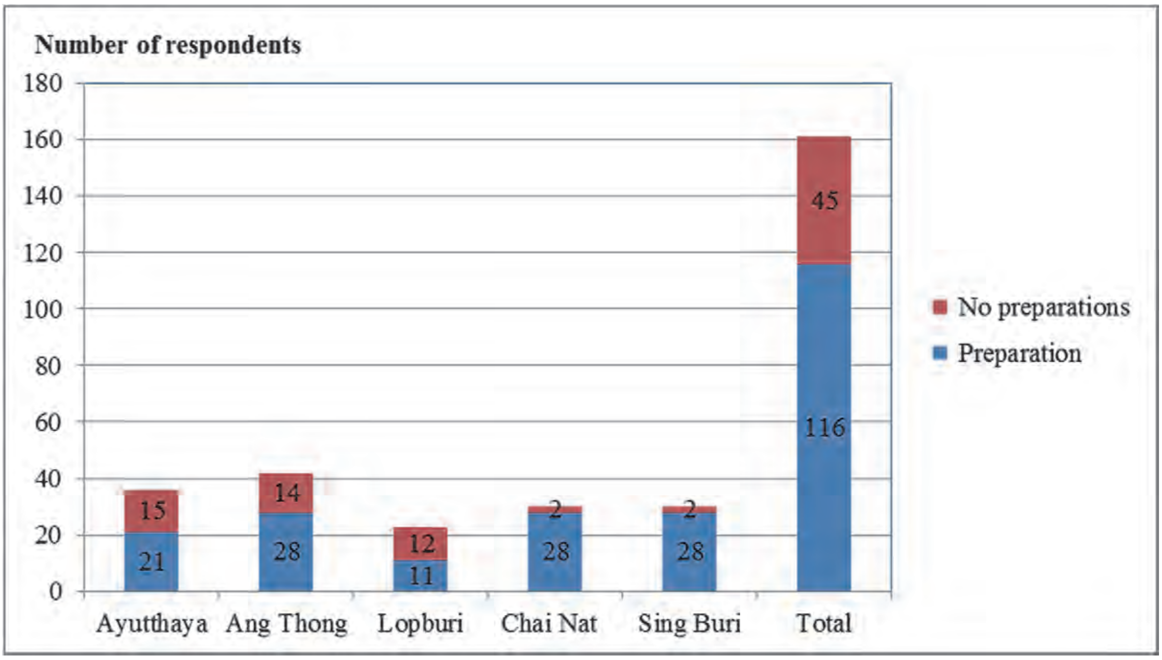


Figure 28-1 Farmer in 5 Provinces Survey: Number of respondents who prepared to handle the 2011 flood

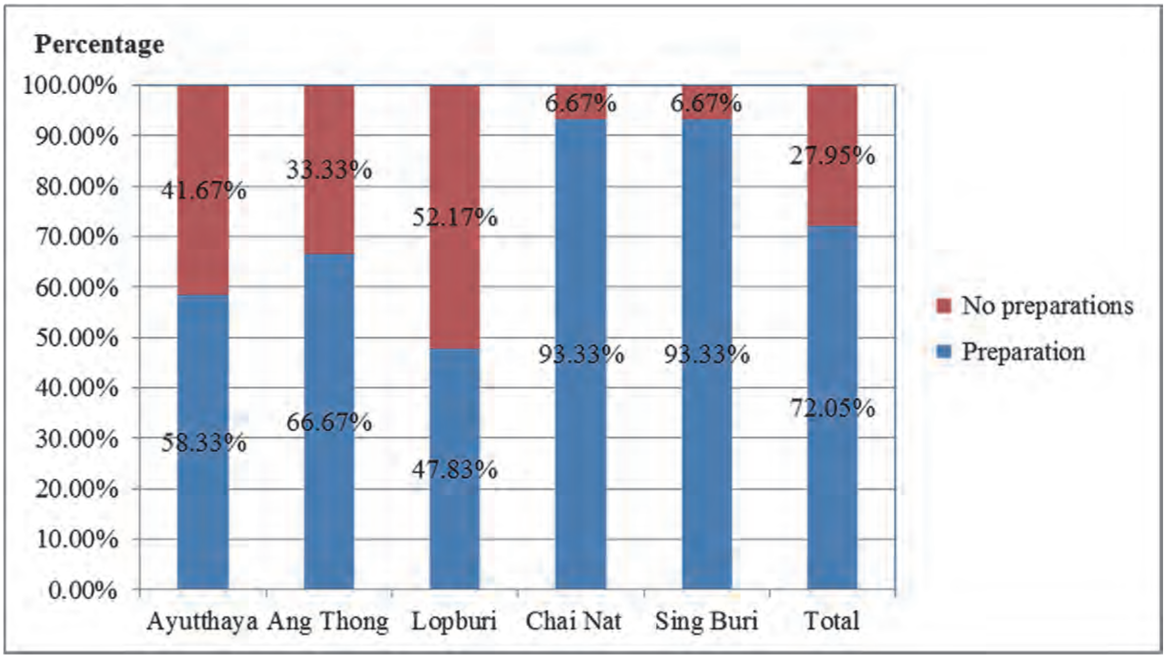


Figure 28-2 Farmer in 5 Provinces Survey: Percentage of respondents who prepared to handle the 2011 flood

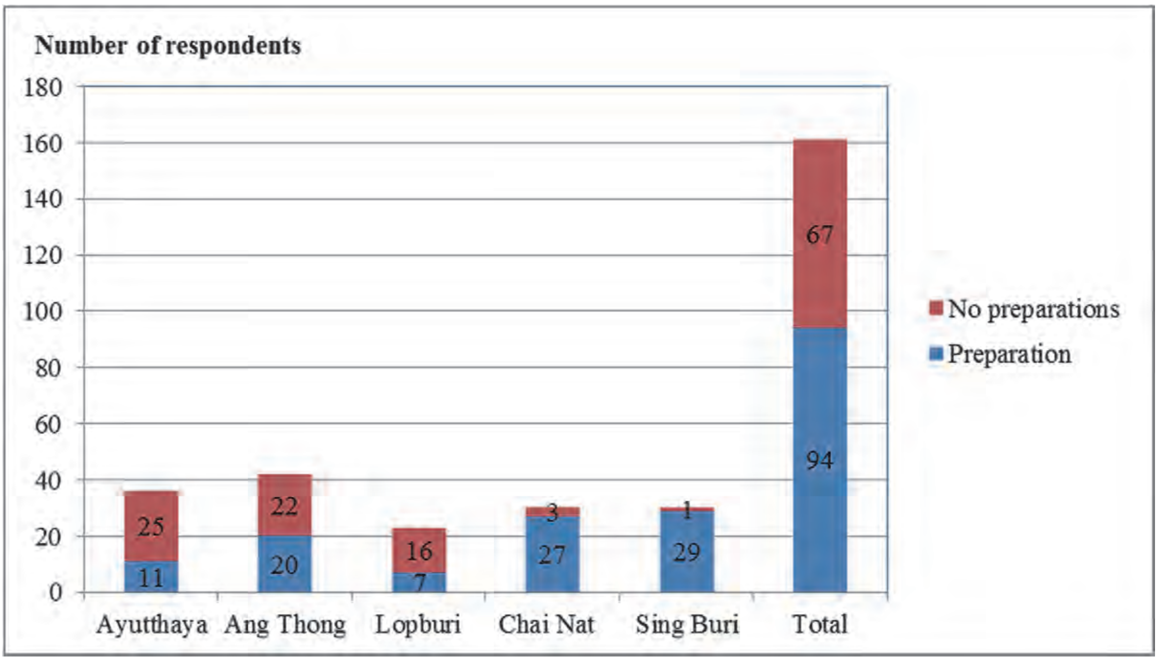


Figure 29-1 Farmer in 5 Provinces Survey: Number of respondents who prepared to handle the future flood

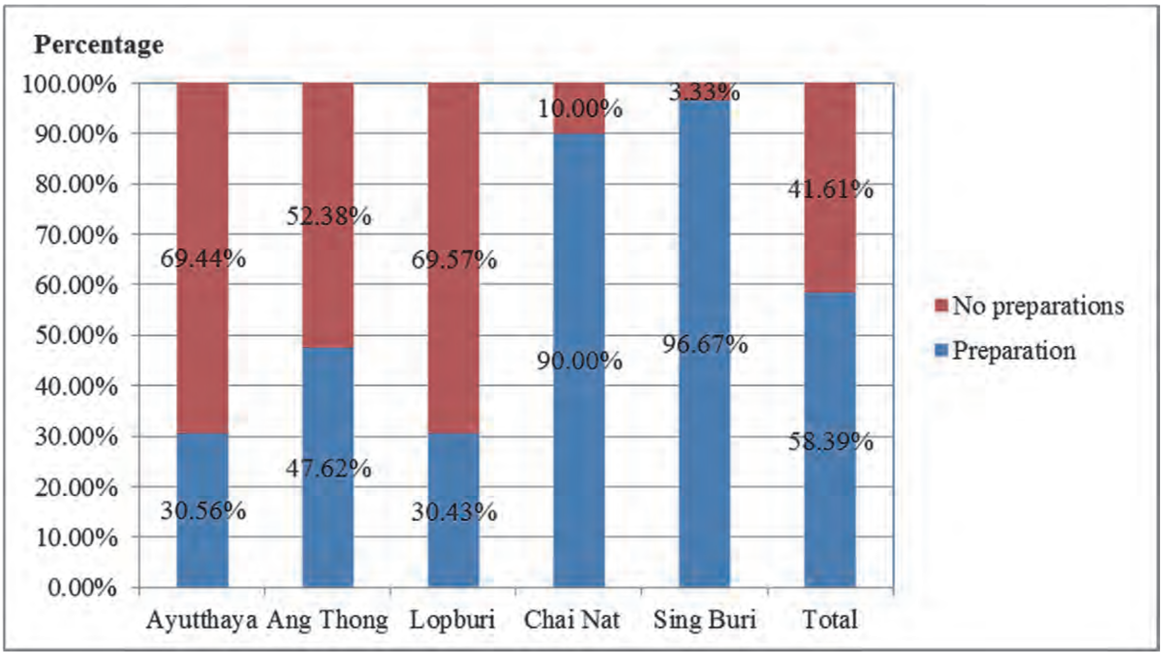


Figure 29-2 Farmer in 5 Provinces Survey: Percentage of respondents who prepared to handle the future flood

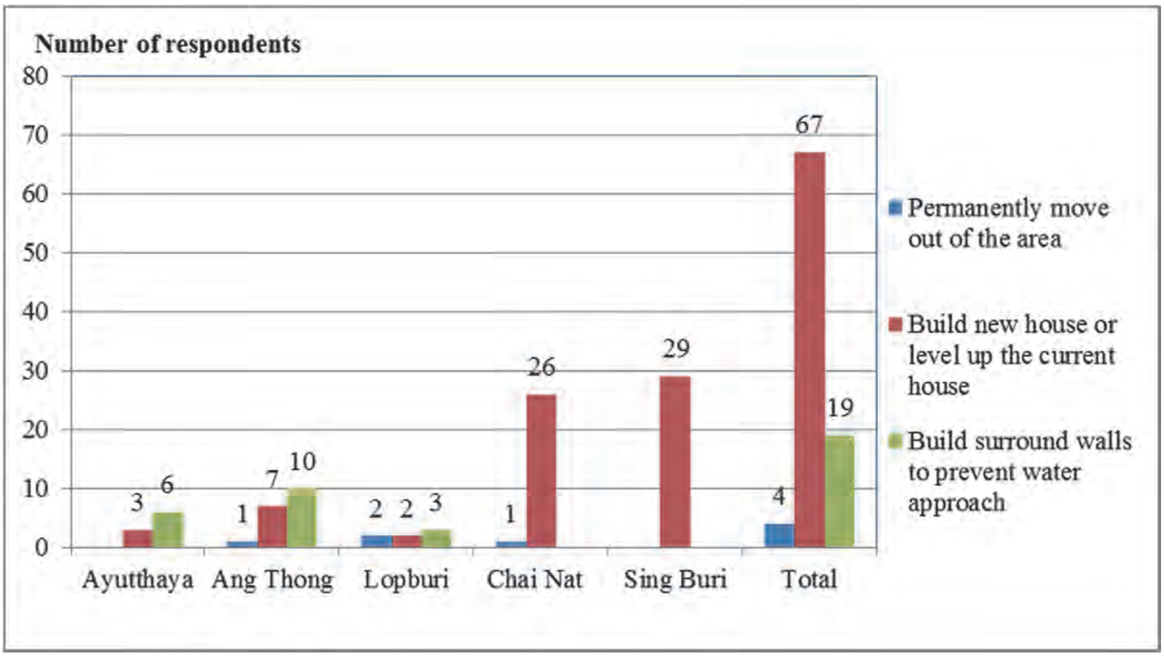


Figure 30-1 Farmer in 5 Provinces Survey: Measures that (Number of) respondents prepared to handle the future flood

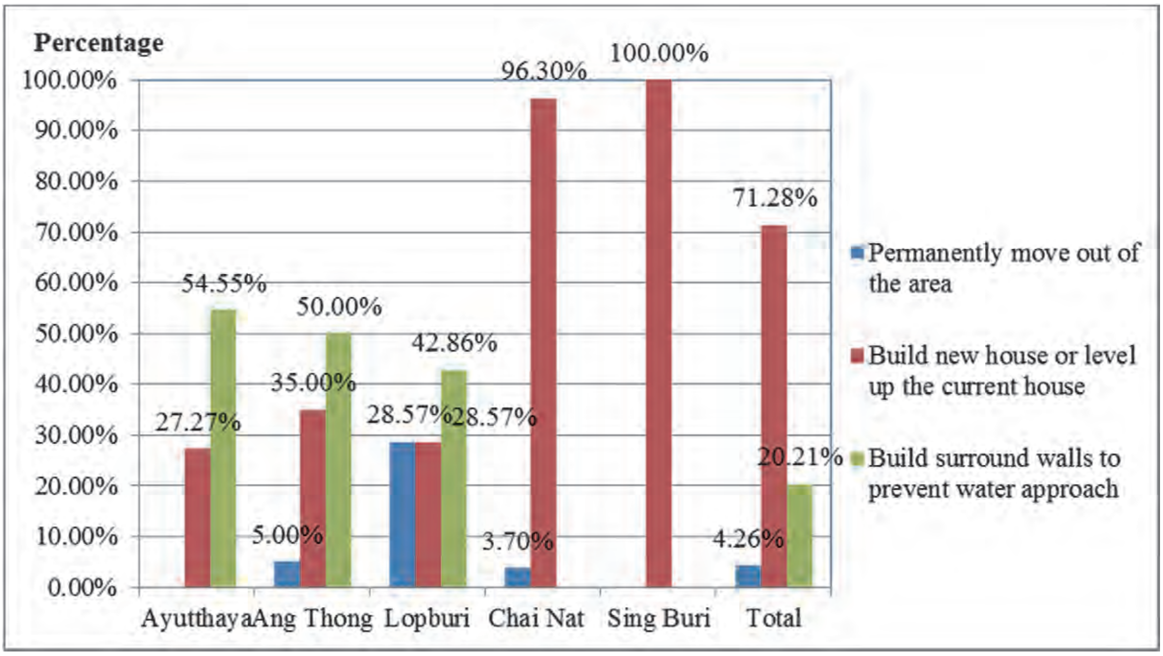


Figure 30-2 Farmer in 5 Provinces Survey: Measures that (Percentage of) respondents prepared to handle the future flood

**In percentage calculation, considered the number of respondents prepared to handle future flood, referred to the blue part in Figure 29-1, as the total number of each group of respondent*

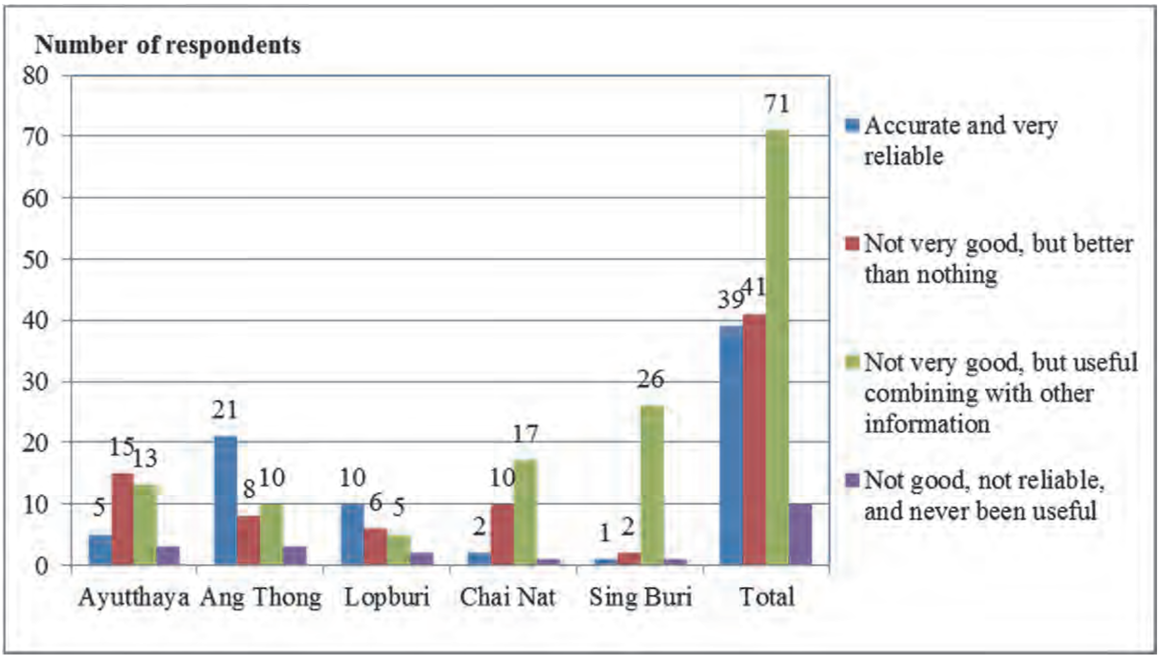


Figure 31-1 Farmer in 5 Provinces Survey: How (Number of) respondents feel about the exist flood forecasting and warning system

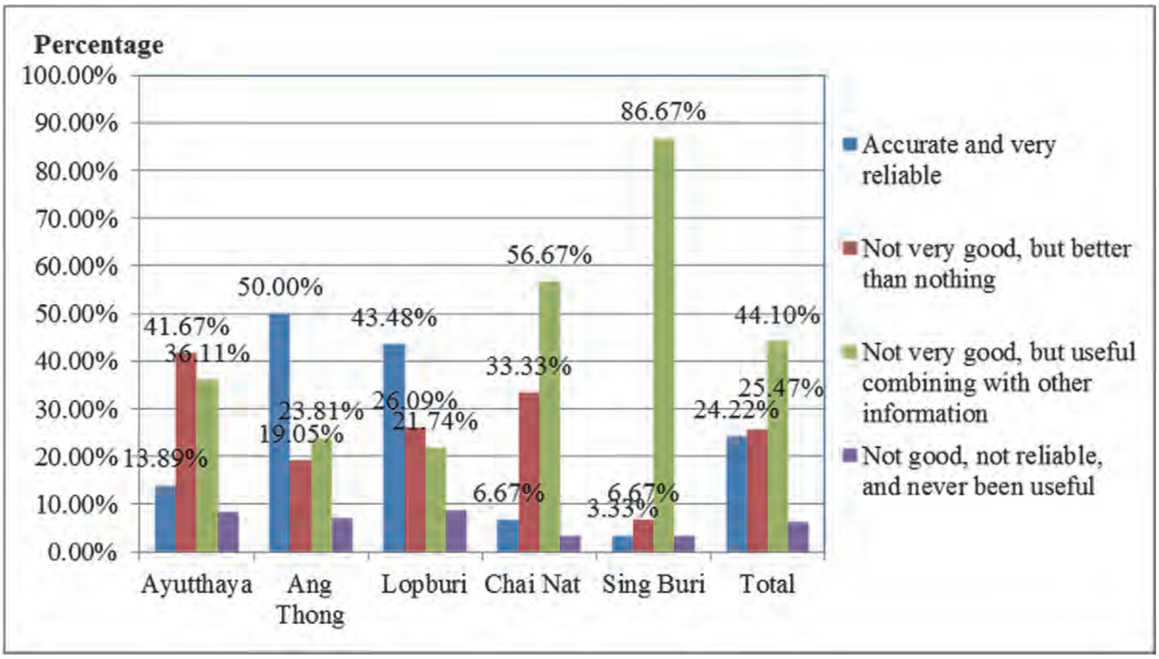


Figure 31-2 Farmer in 5 Provinces Survey: How (Percentage of) respondents feel about the exist flood forecasting and warning system

**In percentage calculation, considered all of the respondents, as the total number of respondent*

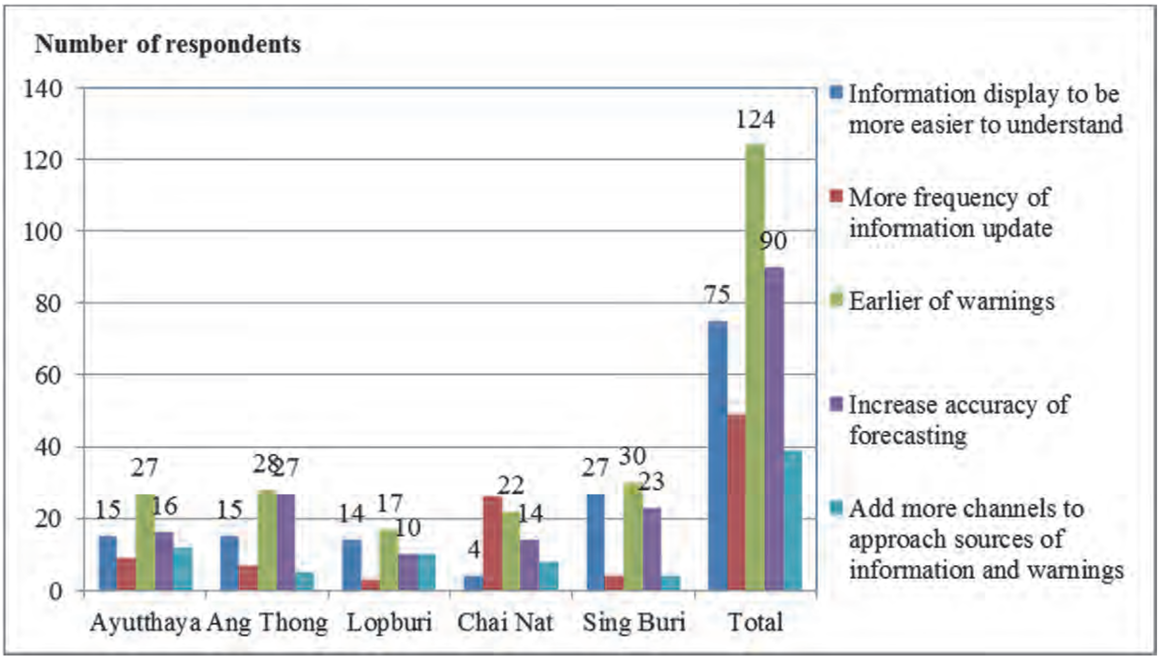


Figure 32-1 Farmer in 5 Provinces Survey: The Suggestion that <u>(Number of) respondents</u> gave, in order to improve the existing flood forecasting and warning system

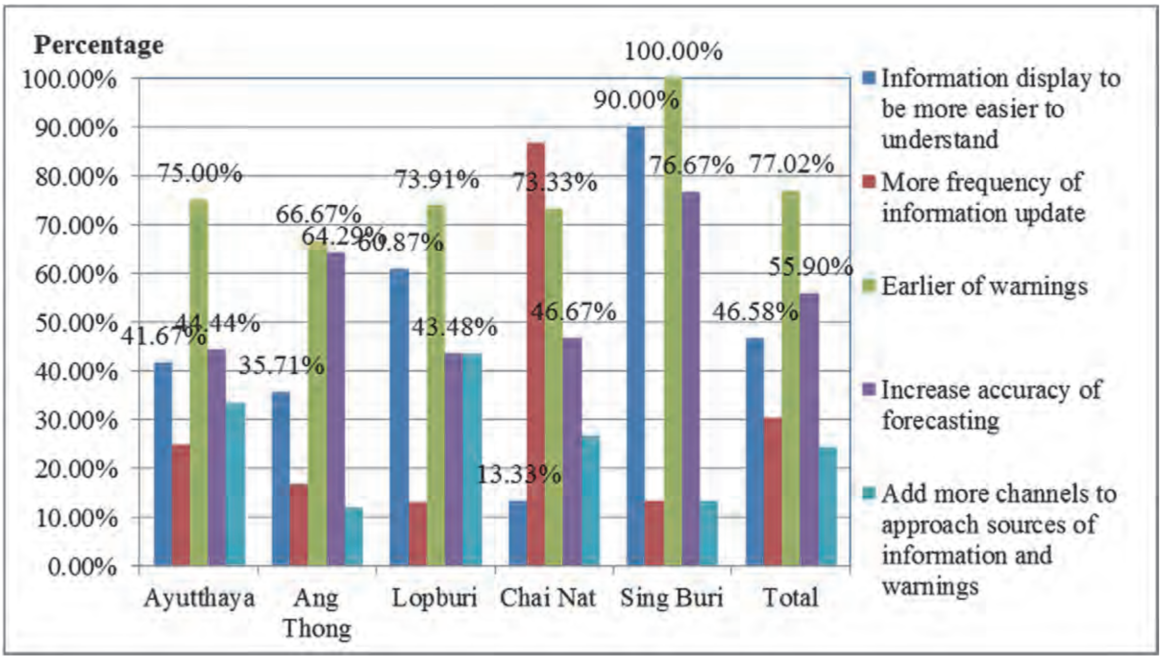


Figure 32-2 Farmer in 5 Provinces Survey: The Suggestion that <u>(Percentage of) respondents</u> gave, in order to improve the existing flood forecasting and warning system

**In percentage calculation, considered all of the respondents, as the total number of respondent*

5.2.2 City Residents Interview

In the study on flood forecasting and warning issuance, 139 city residents in 5 provinces of the lower reach of the Chao Phraya River Basin have been interviewed, as the result numerically reported in *Appendix C.*

According to the questionnaire survey, it was found that more than 79% of all respondents did receive the flood situation information and alarm, as the number and percentage shown in *Figure 33-1* and *33-2*, respectively. It was found that 76.09%, 73.33%, 93.33%, and 96.67 of the respondents, who received the information, in Ayutthaya, Lopburi, Chai Nat and Sing Buri, got the information, which mostly was announced by local authority, local people network and local people, as the result shown in number and percentage in *Figure 34-1* and *33-2.*

Besides, the result of sources of announcement has been supported by the channel of information announcement, in which most of the people, 76.74% of the respondents, who received the information, got the verbal information through word of mouth, as the result shown in *Figure 35-1, 35-2*. Other channels of communications are television, announcement by amplifying car, and by radio. The information they got were the water level in rivers and nearby waterways, the rain in the upstream area and within the area, and some of the respondents also got the information of name list of contact person or agency in the case of emergency, as the result shown in *Figure 36-1* and *36-2,* in which mostly daily updated in the form of narration.

According to the adequacy of the received information, more than 83% of the respondents, who received the information, said that the received information was sufficient and useful for making decision and/or taking alleviation action. Besides, 45.05% of them indicated that the reliability of the information was average and 47.75% mentioned that the information was very reliable, as the result shown in *Figure 37-1* and *37-2*. More than 89% of all respondents who received the information mentioned that the received information was average to very useful, in which 46.85% felt averagely satisfied and 27.03% felt very much satisfied on the system.

However, in order to improve the flood warning system, 59.46% of the respondents who received the information suggested improving the accuracy of the flood forecast and warning system, 55.86% needed to get 1 month advance warning, while 47.75% required more information such as the suggestion to deal with the situation and the evacuation location, as the result shown in *Figure 38-1* and 38-2.

During the flood period, more than 80% of respondents received the flood warning, as the number and percentage of respondents shown in *Figure 39-1* and *39-2*, respectively. The main sources of daily information seem to be local people, local government authority and local people network, as the result shown in *Figure-40-1* and *40-2*. It seems that the most effective ways to make the communications are word to mouth, radio, television and amplifying car, as shown in *Figure 41-1* and *41-2,* in which the distributed information were water level in waterways, name list of contact persons / officials / agencies to contact for assistance, the rainfall in the upstream area and within the area, as the result shown in *Figure 42-1* and *42-2*. However, it is very interesting that 10 respondents in Ayutthaya and 6 respondents in Ang Thong wanted the information of sea level as they described the problem of water retaining so long was the high sea level. In addition, 10 people needed information of evacuation camp, evacuation routes and agency that they can contact for assistant. It indicates the uncertainty of the information and warning issuance since some of the respondents got the information, but some people did not received the same information.

Figure 43-1 and *43-2* show the period of time that the respondents received information and warning. 38.39% of the respondents, who got the information, received the flood warning within the day the water reached the area, while 22.32% got informed 1-2 days before the water reached their places. For them it was rather hard to take immediate evacuation.

Nevertheless, more than 80% of the respondents who received the information said that the information received during the flood was sufficient for making decision, as the result shown in *Figure 44-1, 44-2*, in which 50.89% felt that the flood information and warning were very reliable, and 41.96% felt that it was average reliable, as the result shown in *Figure 45-1* and *45-2*. It could be implied that that most of the people satisfied on the existing flood forecast and warning system, as the number and percentage shown in *Figure 46-1* and *46-2*, respectively.

However, in order to improve the system, the respondents mentioned that they need more information, especially whatever related with evacuation. Besides, the accuracy of the system is also important and should be improved, *Figure 47-1, 47-2.*

During the recovery period, more than 70% of the respondents received the information, as the survey result in *Figure48-1* and *84-2*, in which 82.69% of the them got the information from local agency authority, 59.62% and 39.42% got the warning from local people and from local people network, respectively, as shown in *Figure 49-1, 49-2.* The most effective channels for warning issuance seems to be word of mouth, announcement by amplifying car while radio and television played minor roles in information distribution, as the survey result shown in *Figure 50-1, 50-2.*

The result in *Figure 51-1* and *51-2* show that 55 people; i.e.52.88% of the respondents who received the information, daily received the information of the amount and location of evacuation points, 50.96% and 25.96% got the predicted data of rainfalls and the level of water in waterways, respectively. However, during the recovery period, there was no extra rainfall that may cause more severity, thus the respondents seems not so interested in the rainfall data. More than 96% of the respondents said that the information they received was sufficient for making decision and more than 80% felt satisfaction towards flood forecast and warning system, as the result shown in *Figure 52-1, 52-2*. However, 56.73% of the respondents who received the information suggested that improving the accuracy of the system will increase more confidence.

It could be summarized in the whole picture that the respondents in the upper part of the lower reach of the Chao Phraya River Basin, that is Sing Buri and Chai Nat spent higher attention on flood forecasting and warning issuance than the other 3 provinces lower, as the result in *Figure 53-1, 53-2*, which show the number of people prepared to handle the flood. It seems that the people upstream was not familiar with the flood and did not want to be inundated, while some of the people in lower part, especially who had no flood experience, believed that their places would not be inundated.

The similar trend can be seen in *Figure 54-1* and *54-2*, when the respondents were asked about the preparation to handle the future flooding; 93.33% and 100% of respondents in Sing Buri and Chai Nat decided to build new house and some of them permanently move out of the area, while 65.22%, 50% and 26.67% of the respondents in Ayutthaya, Ang Thong and

Lopburi do not prepare for the future flooding, as the number of respondent shown in *Figure 55-1, 55-2,* since most of them think that the great flood might never happen again.

Figure *56-1, 56-2* present how the respondents feel about the existing forecasting and warning systems. More than 38% of the respondents said that although the system is not very good, but it is useful combining with other information such as what they got from friends, from TV, from social network, while about 32% felt that although the system is not very good, but better than nothing. The respondents suggested that the forecasting and warning systems should be improved by earlier of warnings, increasing the accuracy of forecasting, more frequency of information updating and displaying information in the pattern that is easier to understand, as the questionnaire result shown in *Figure 57-1, 57-2.*

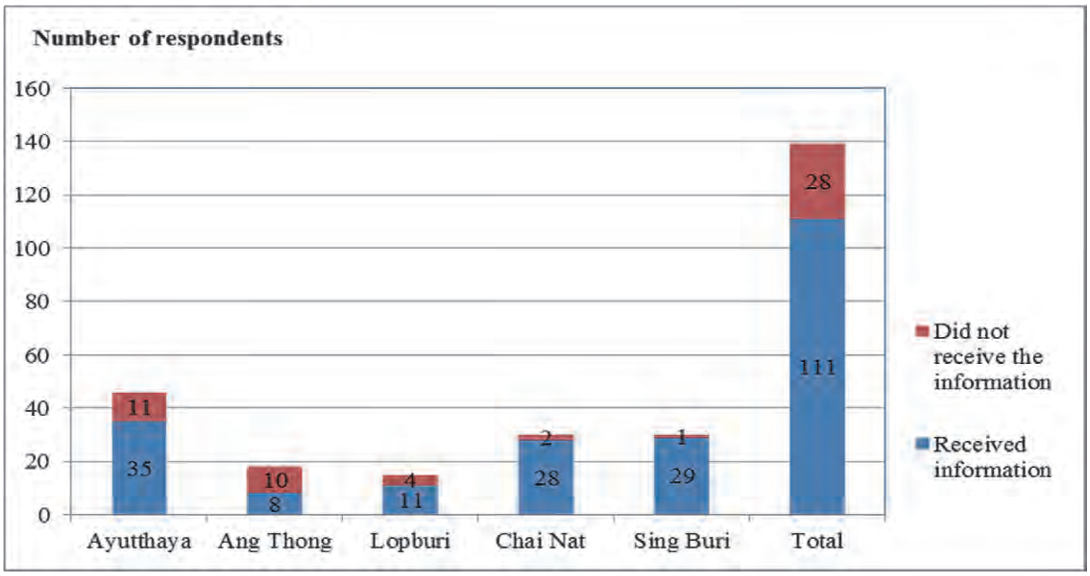


Figure 33-1 City Residents in 5 Provinces Survey: Number of respondents received the information and warning, before the flood reaches the area

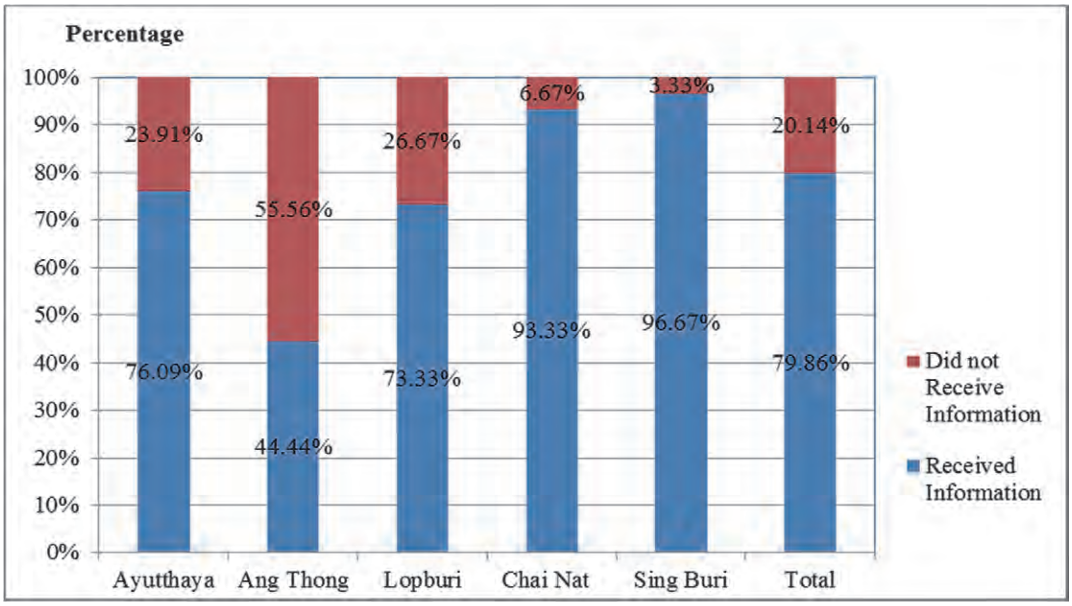


Figure 33-2 City Residents in 5 Provinces Survey: Percentage of respondents received the information and warning, before the flood reaches the area

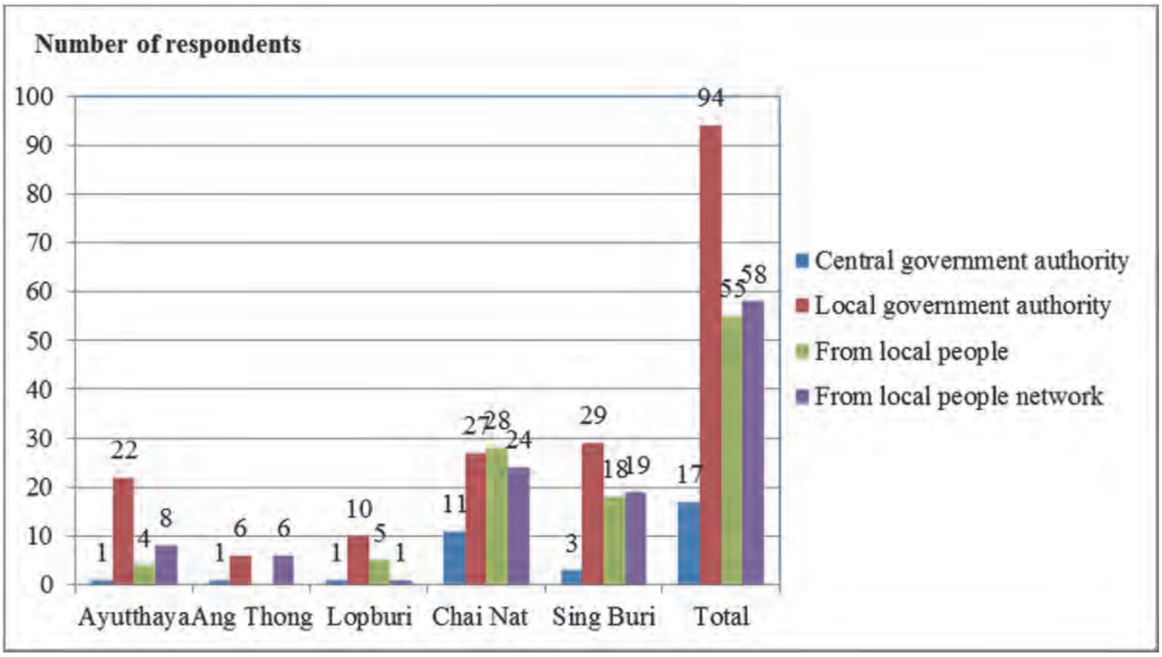


Figure 34-1 City Residents in 5 Provinces Survey: <u>Number of respondents</u> per source of inundation information and warning, before the flood reaches the area

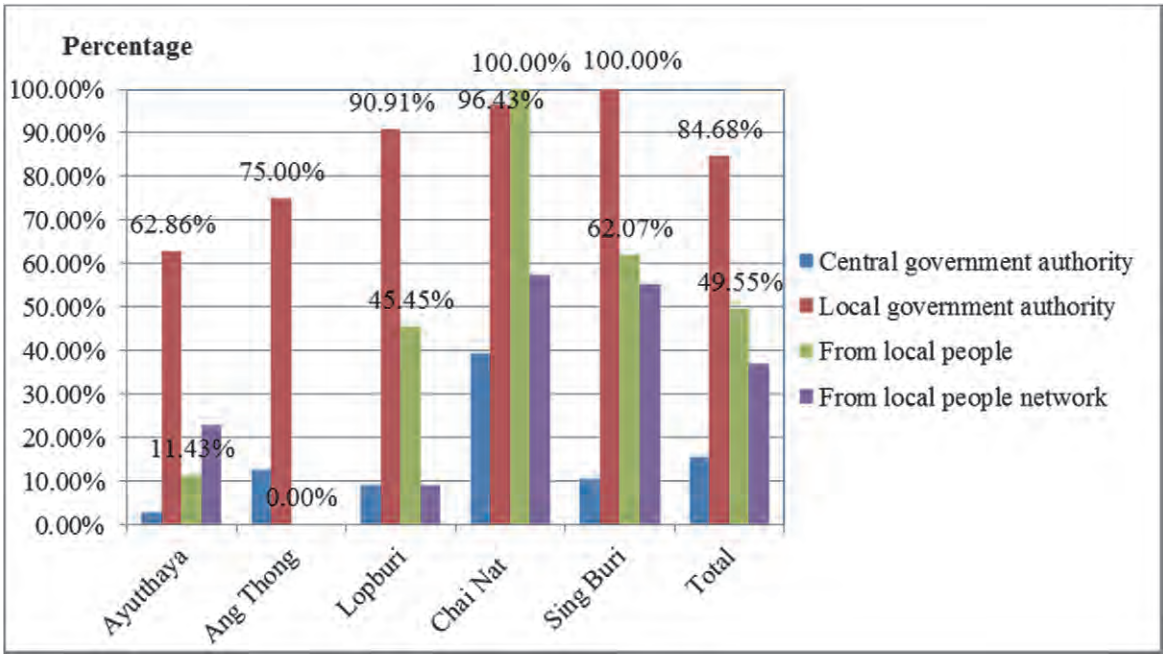


Figure 34-2 City Residents in 5 Provinces Survey: <u>Percentage of respondents</u> per source of inundation information and warning, before the flood reaches the area

** In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 33-1, as the total number of each group of respondent*

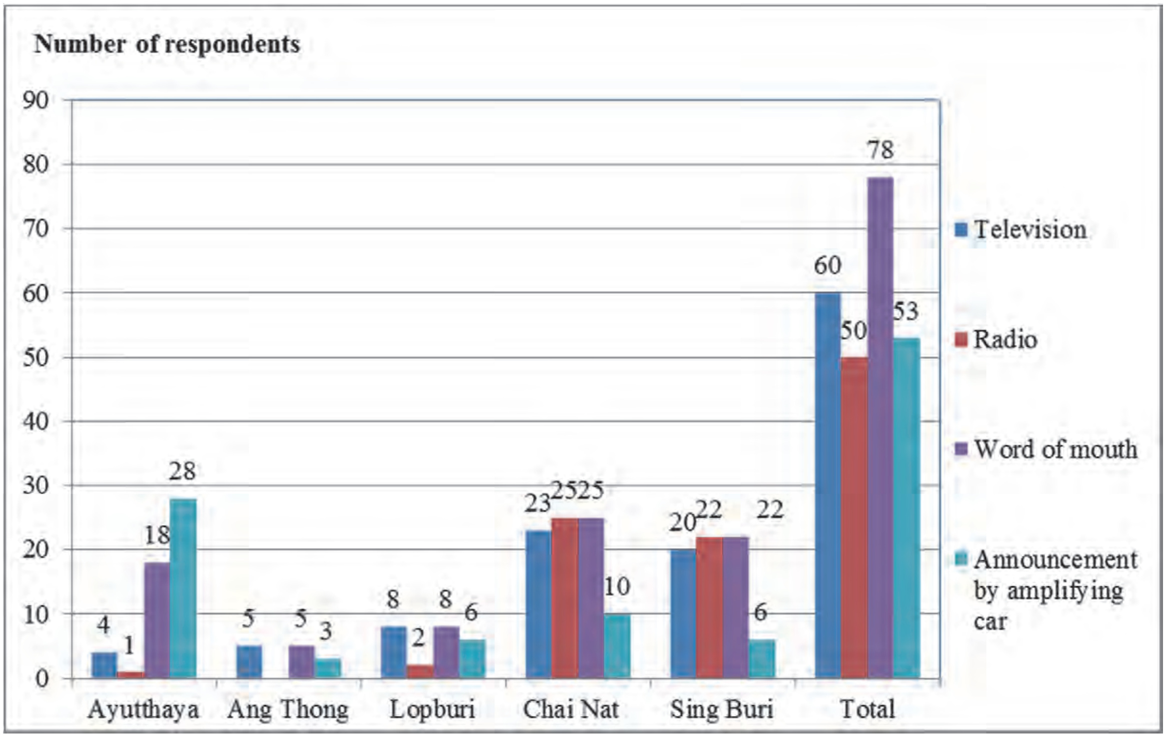


Figure 35-1 City Residents in 5 Provinces Survey: Number of respondents per Channel of inundation information and warning, before the flood reaches the area

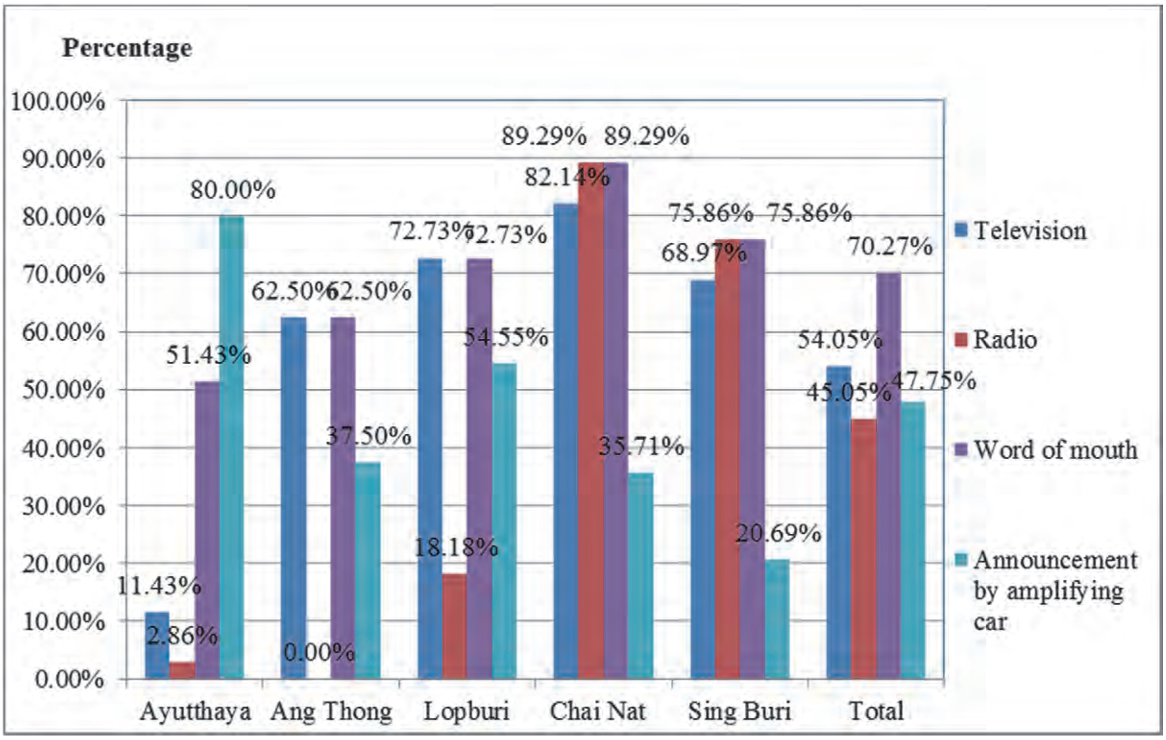


Figure 35-2 City Residents in 5 Provinces Survey: Percentage of respondents per Channel of inundation information and warning, before the flood reaches the area

***In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 33-1, as the total number of each group of respondent**

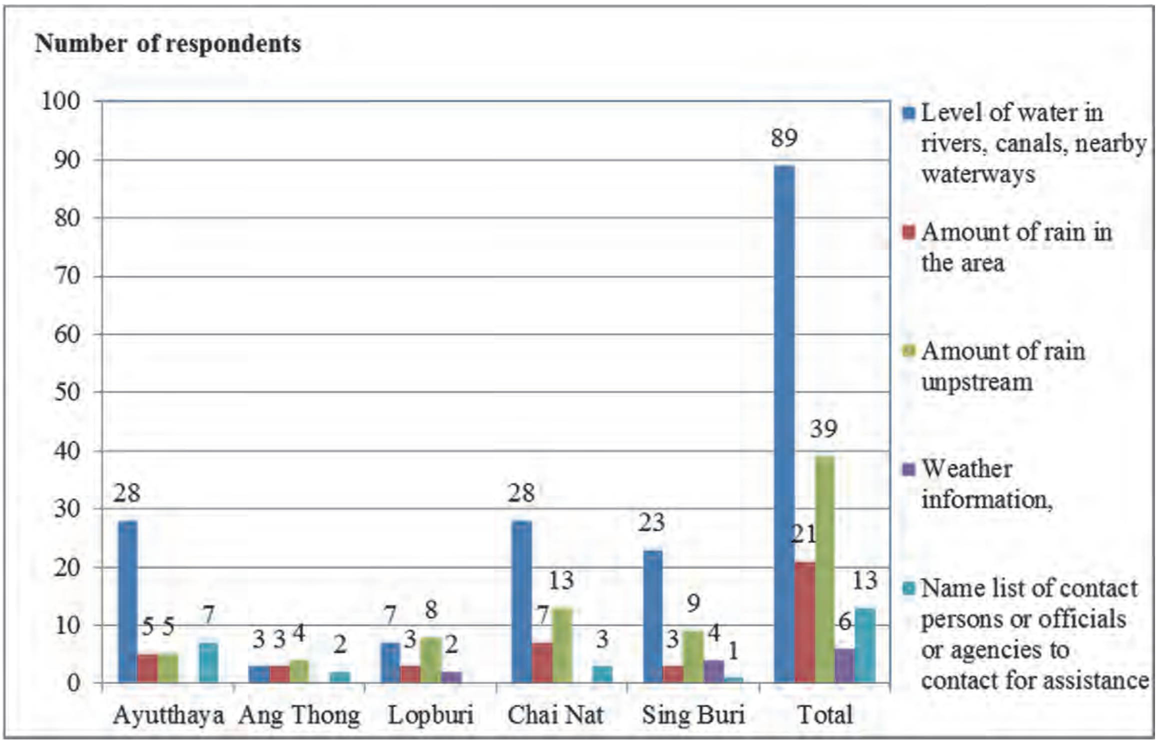


Figure 36-1 City Residents in 5 Provinces Survey: <u>Number of respondents</u> per Received Information, before the flood reaches the area

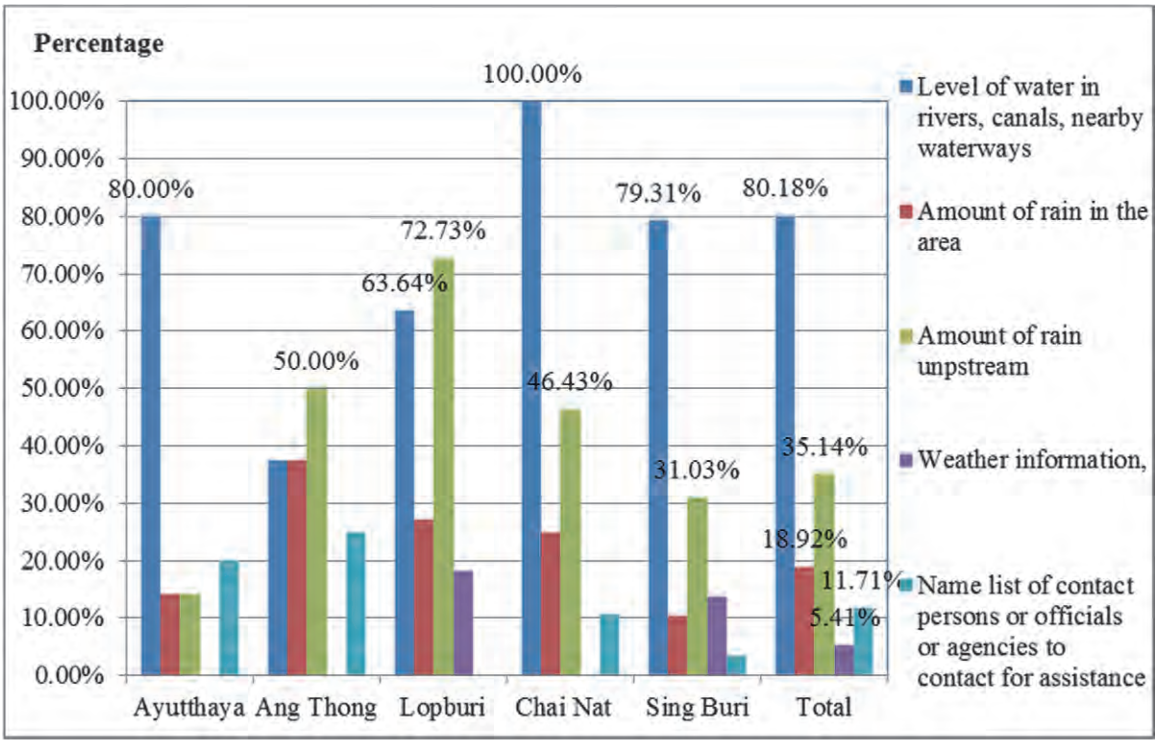


Figure 36-2 City Residents in 5 Provinces Survey: <u>Percentage of respondents</u> per Received Information, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 33-1, as the total number of each group of respondent*

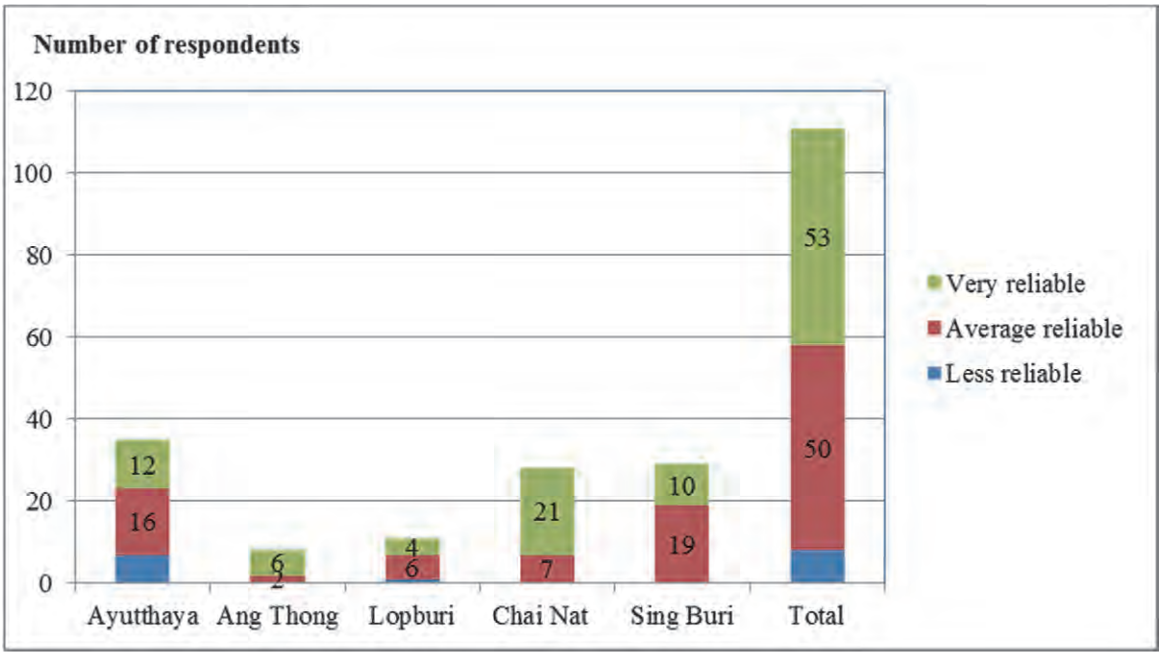


Figure 37-1 City Residents in 5 Provinces Survey: <u>Number of respondents</u> per reliability of received information and warning issuance, before the flood reaches the area

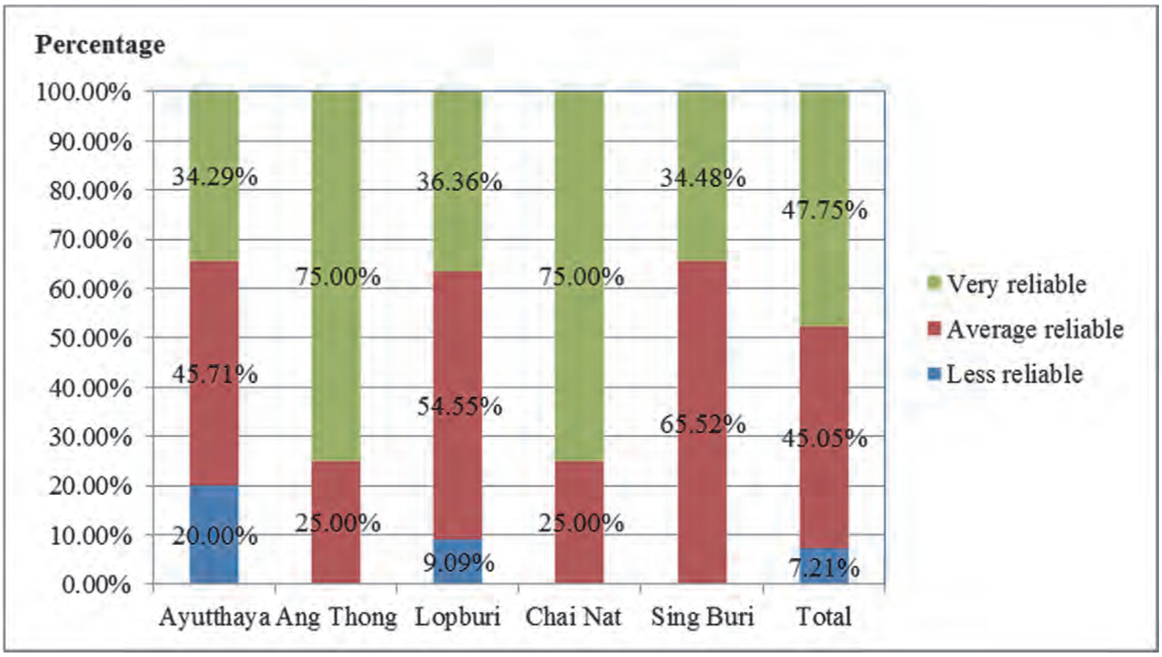


Figure 37-2 City Residents in 5 Provinces Survey: <u>Percentage of respondents</u> per reliability of received information and warning issuance, before the flood reaches the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 33-1, as the total number of each group of respondent*

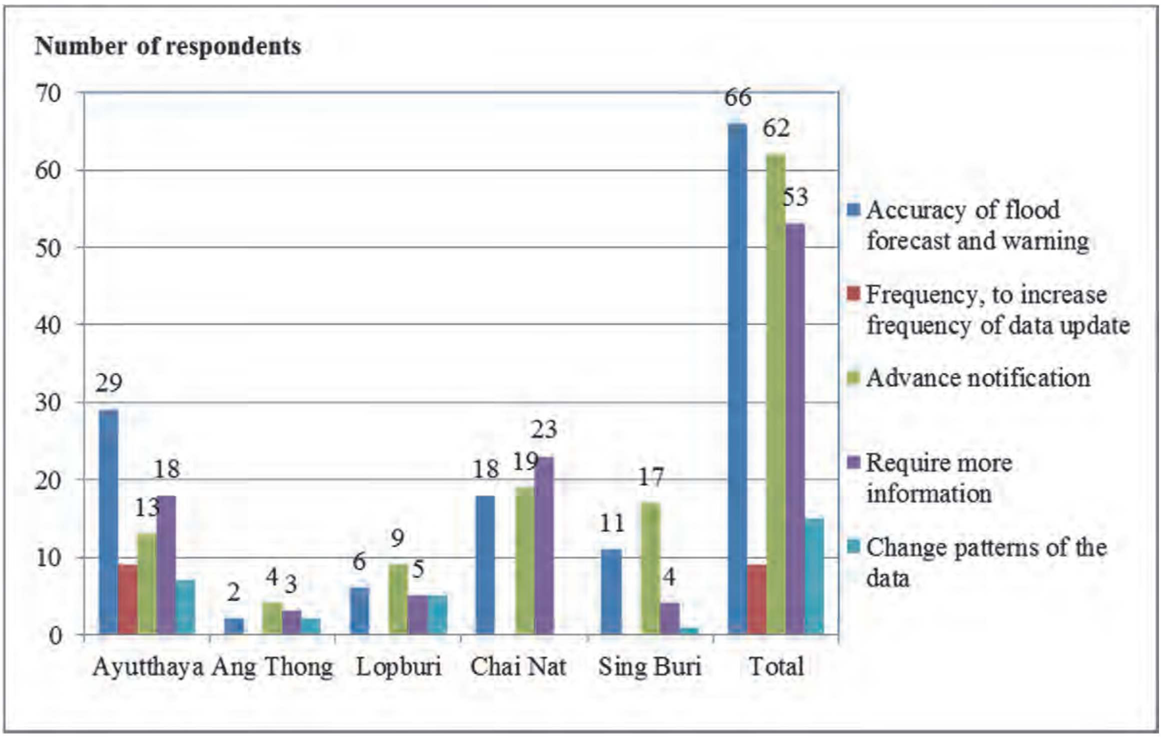


Figure 38-1 City Residents in 5 Provinces Survey: Suggestion of (Numbers of) respondent for information and waning system improvement, before the flood reaches the area

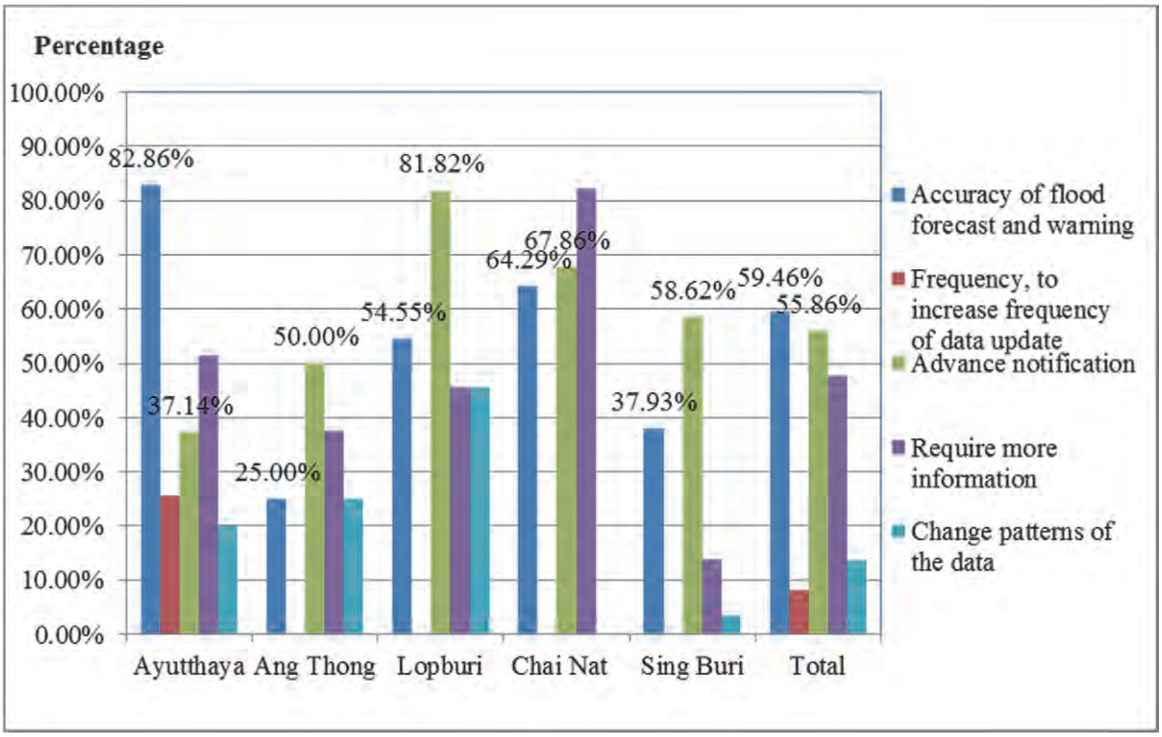


Figure 38-2 City Residents in 5 Provinces Survey: Suggestion of (Percentage of) respondent for information and waning system improvement, before the flood reaches the area

Note: **In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 33-1, as the total number of each group of respondent*

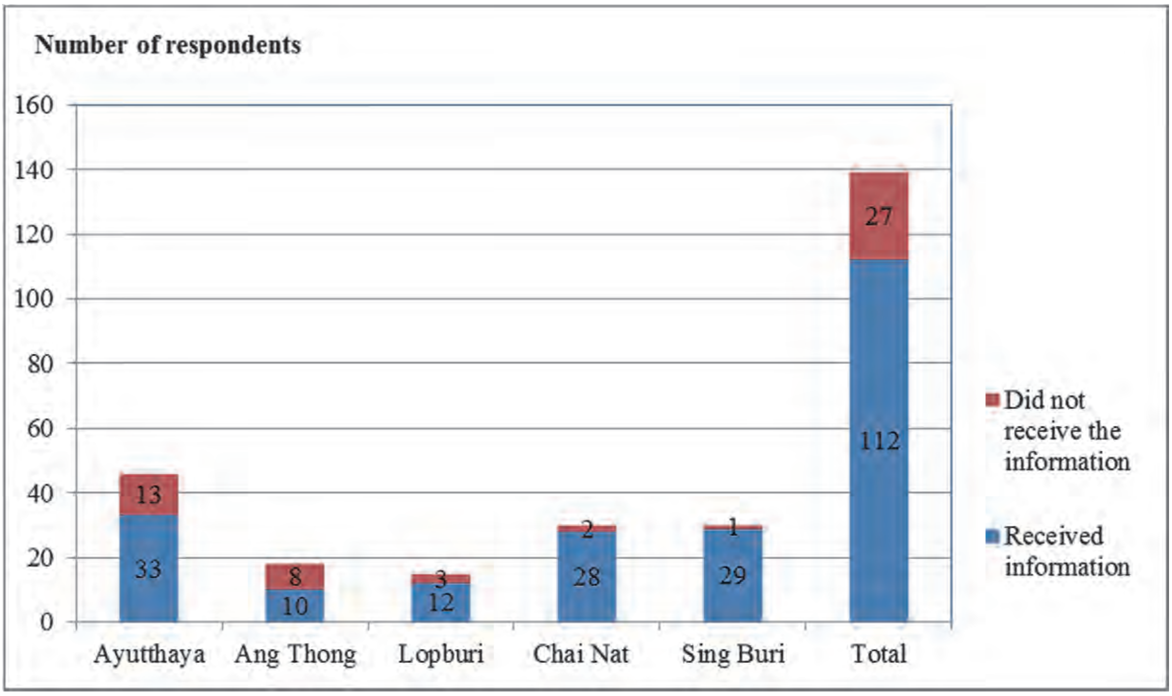


Figure 39-1 City Residents in 5 Provinces Survey: <u>Number of respondents</u> received the information and warning, during the flood reaching the area

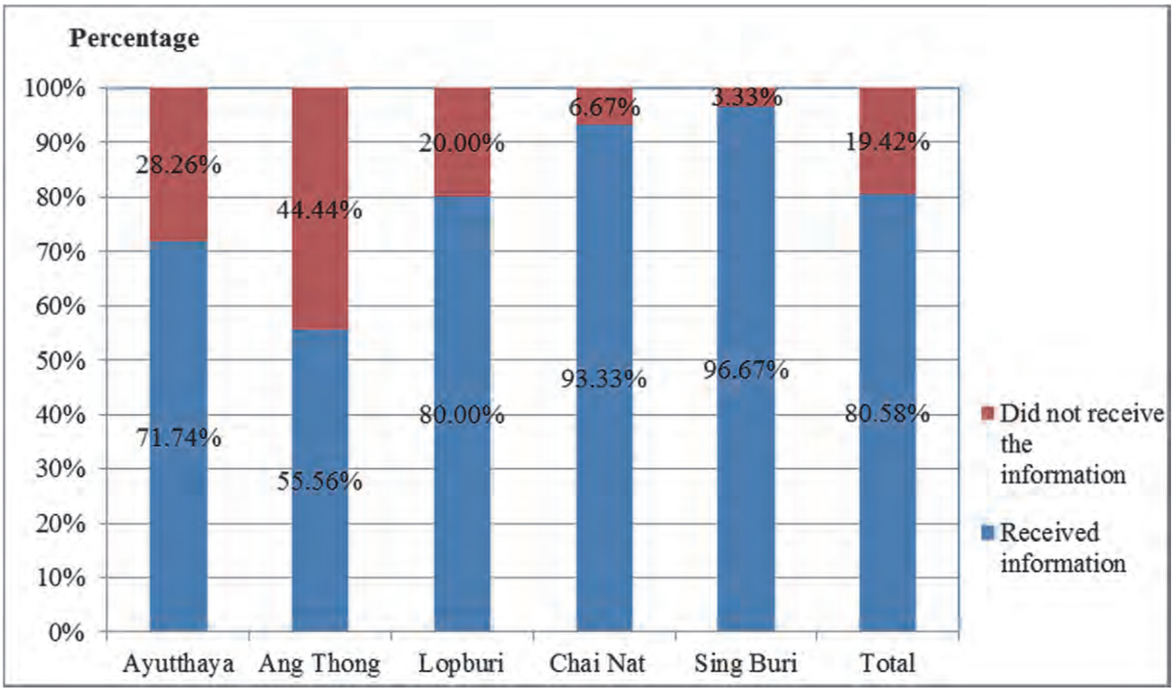


Figure 39-2 City Residents in 5 Provinces Survey: <u>Percentage of respondents</u> received the information and warning, during the flood reaching the area

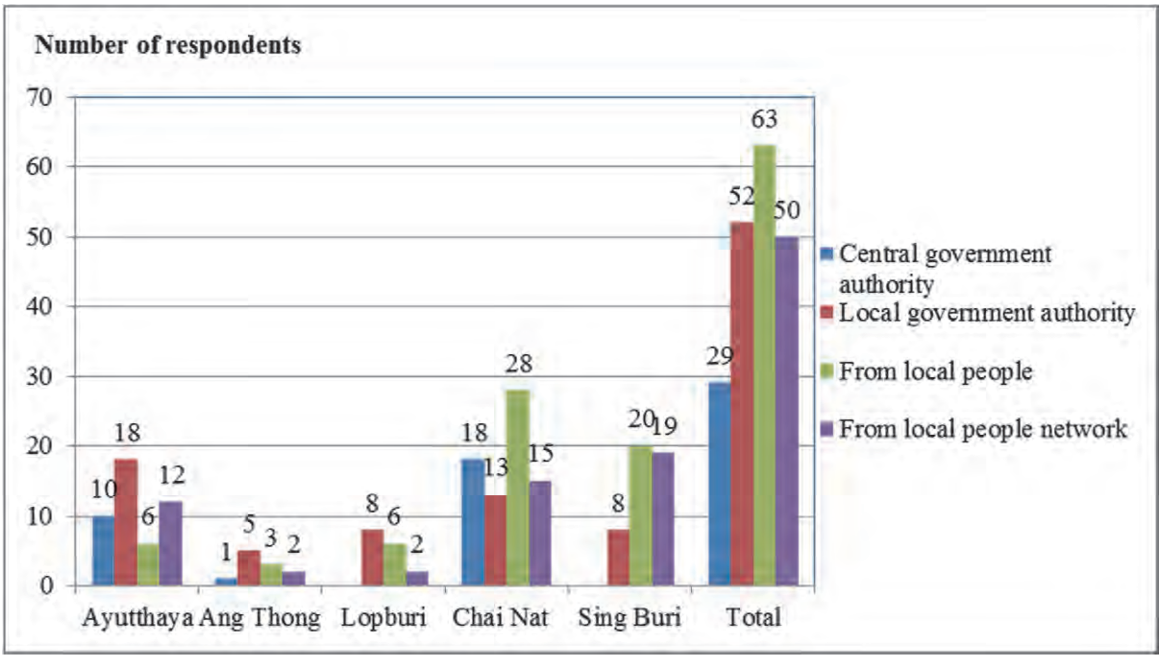


Figure 40-1 City Residents in 5 Provinces Survey: Number of respondents per source of inundation information and warning, during the flood reaching the area

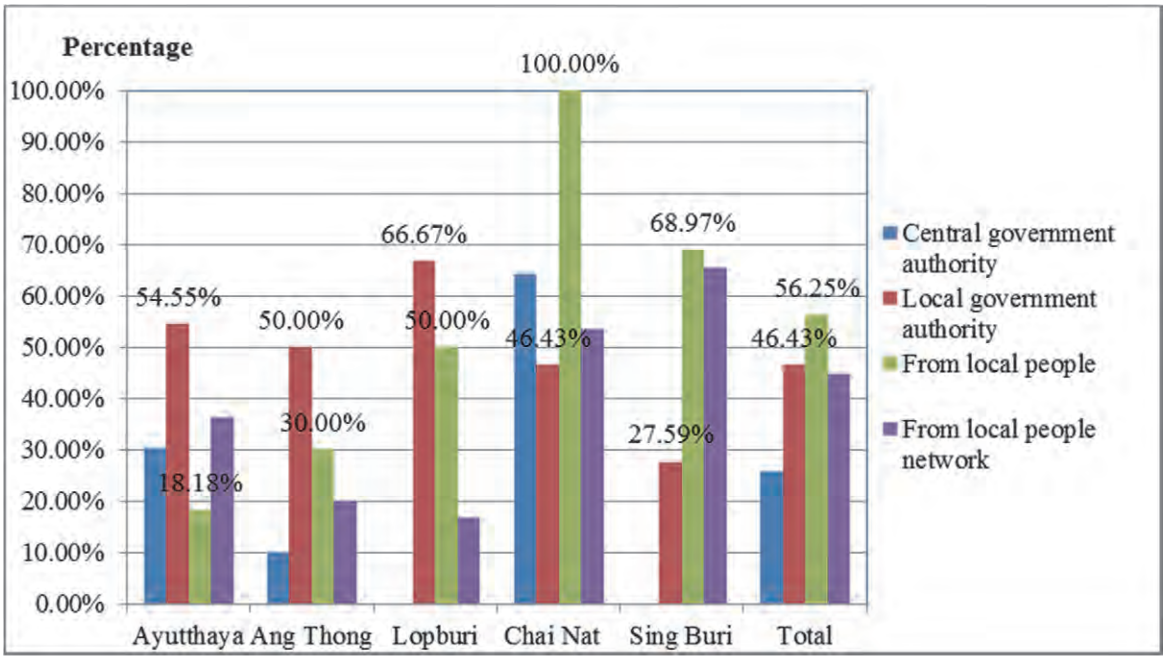


Figure 40-2 City Residents in 5 Provinces Survey: Percentage of respondents per source of inundation information and warning, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

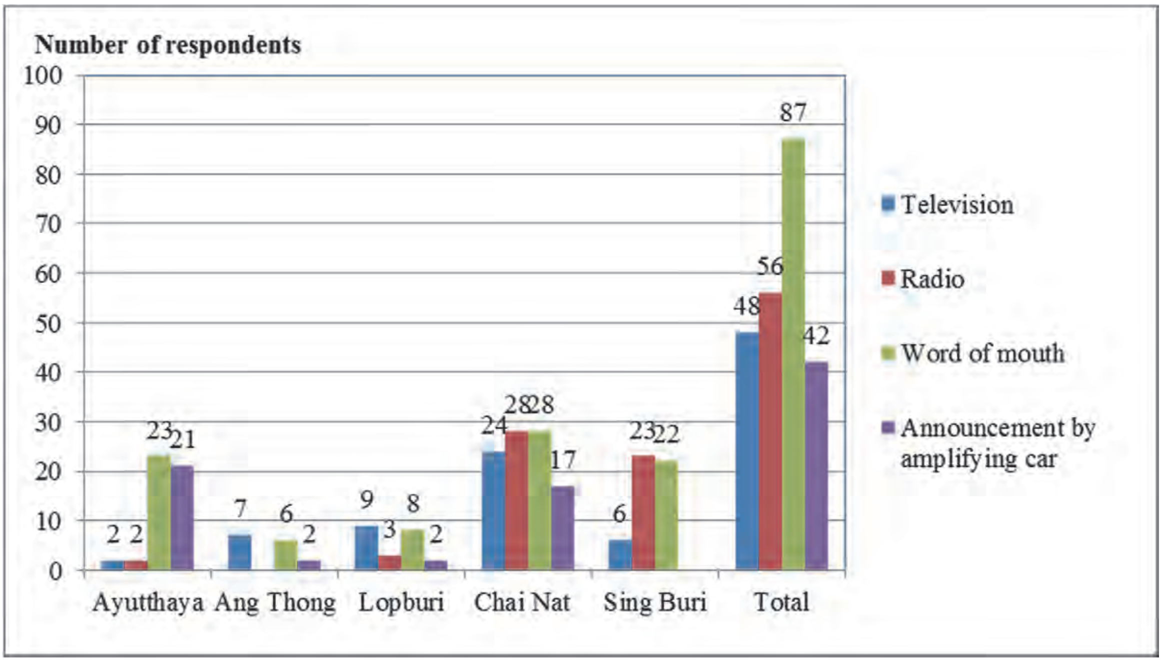


Figure 41-1 City Residents in 5 Provinces Survey: Number of respondents per Channel of inundation information and warning, during the flood reaching the area

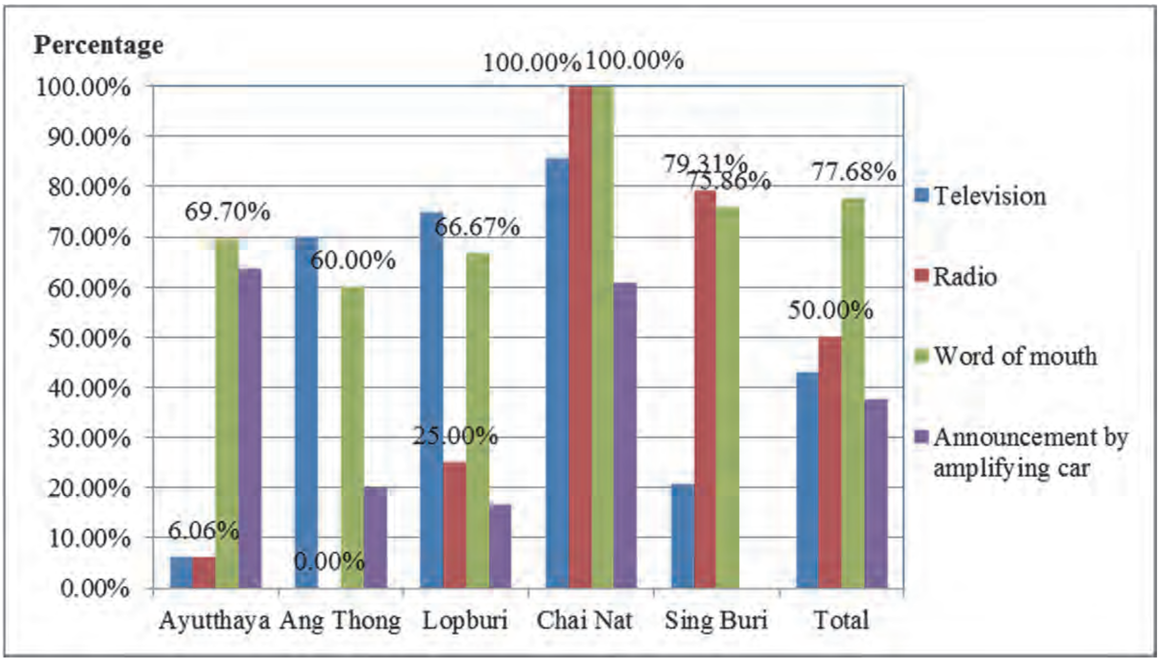


Figure 41-2 City Residents in 5 Provinces Survey: Percentage of respondents per Channel of inundation information and warning, during the flood reaching the area

***In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

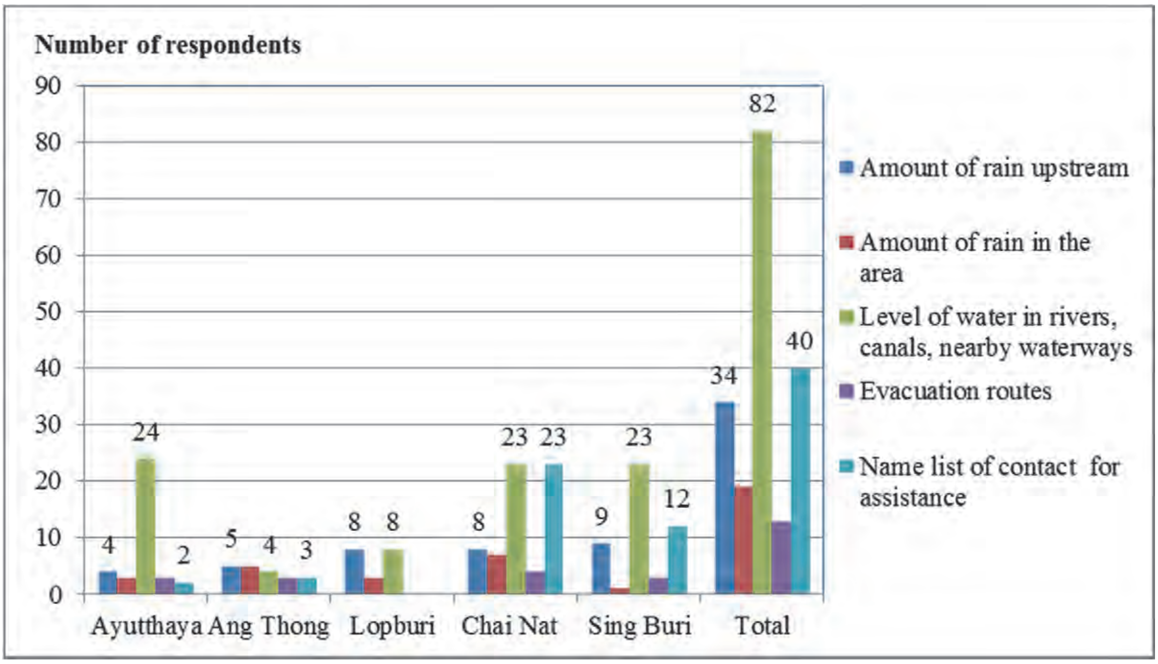


Figure 42-1 City Residents in 5 Provinces Survey: Number of respondents per Received Information, during the flood reaching the area

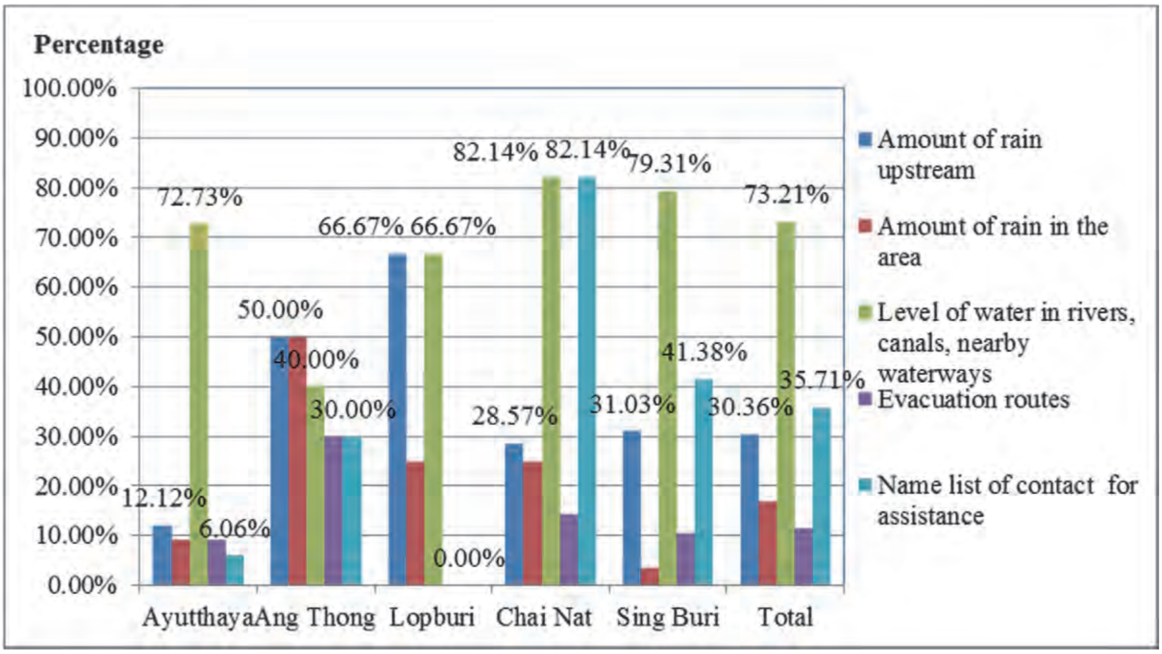


Figure 42-2 City Residents in 5 Provinces Survey: Percentage of respondents per Received Information, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

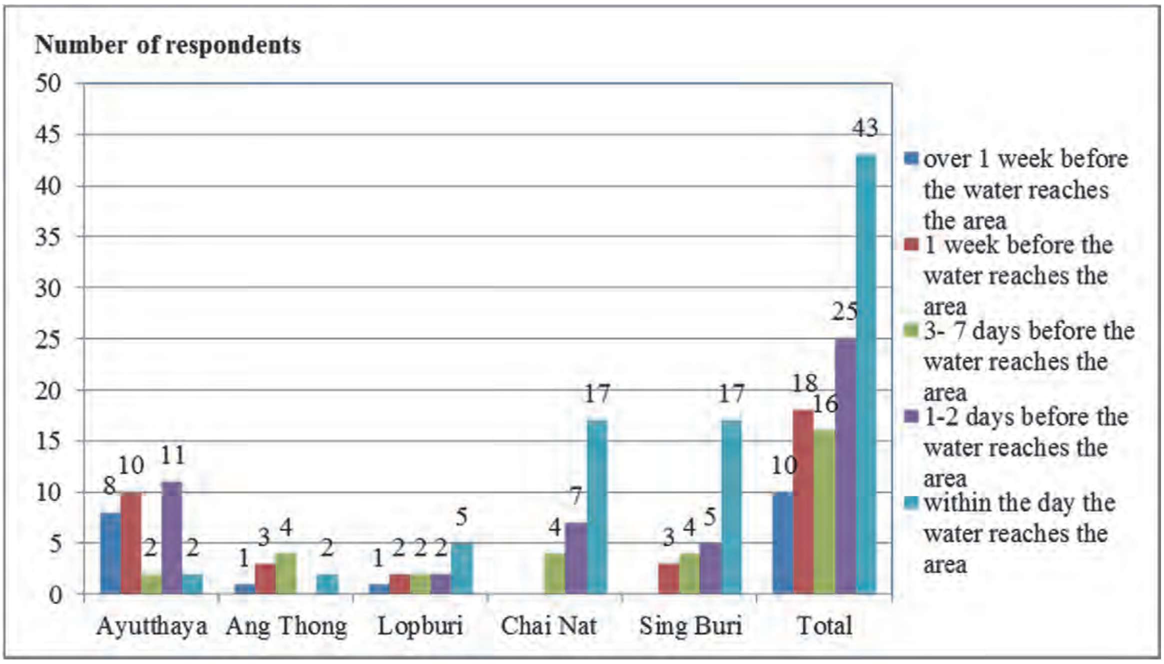


Figure 43-1 City Residents in 5 Provinces Survey: Time period that (Number of) respondents received the inundation information and warning, during the flood reaching the area

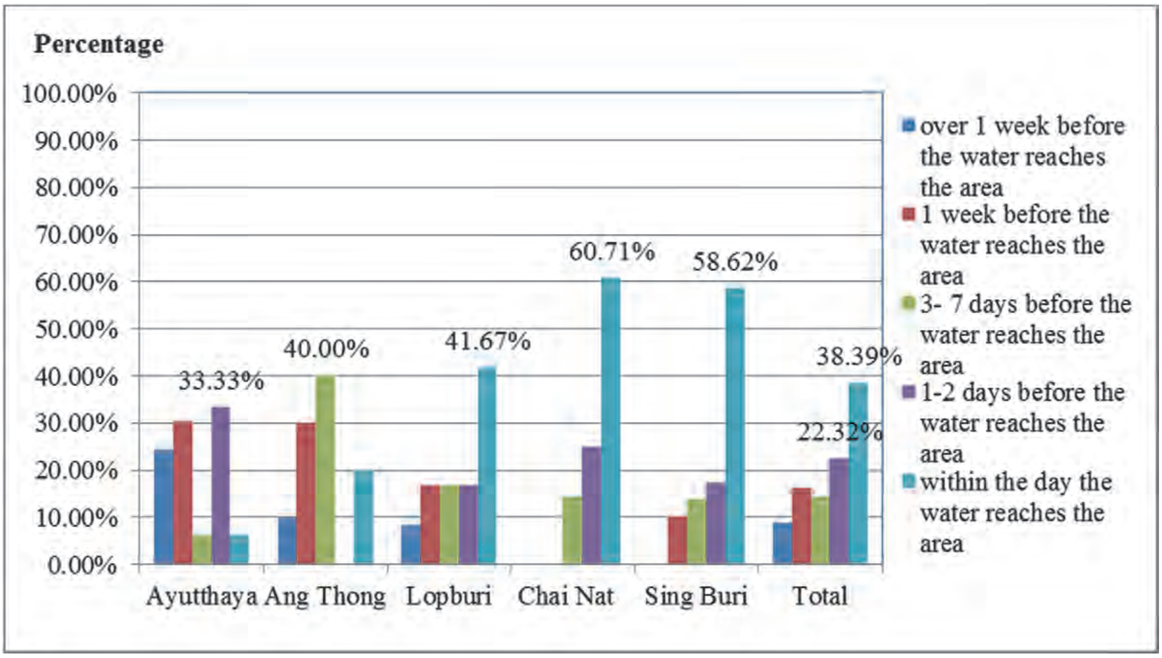


Figure 43-2 City Residents in 5 Provinces Survey: Time period that (Percentage of) respondent received the inundation information and warning, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

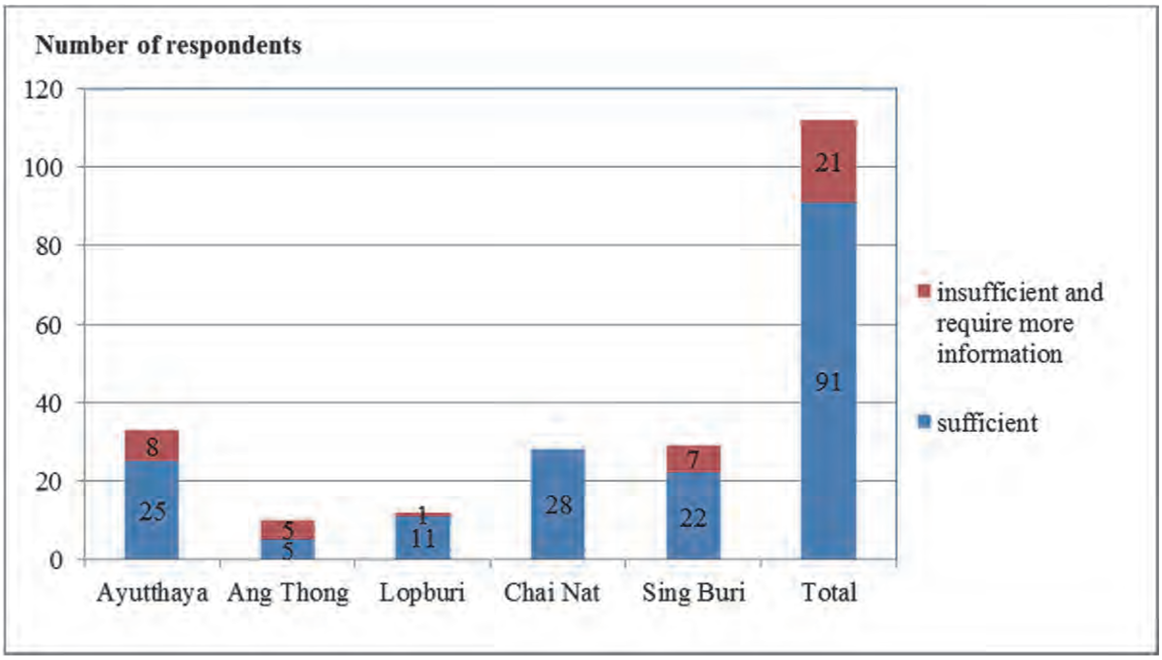


Figure 44-1 City Residents in 5 Provinces Survey: Number of respondents per the sufficiency of received information, during the flood reaching the area

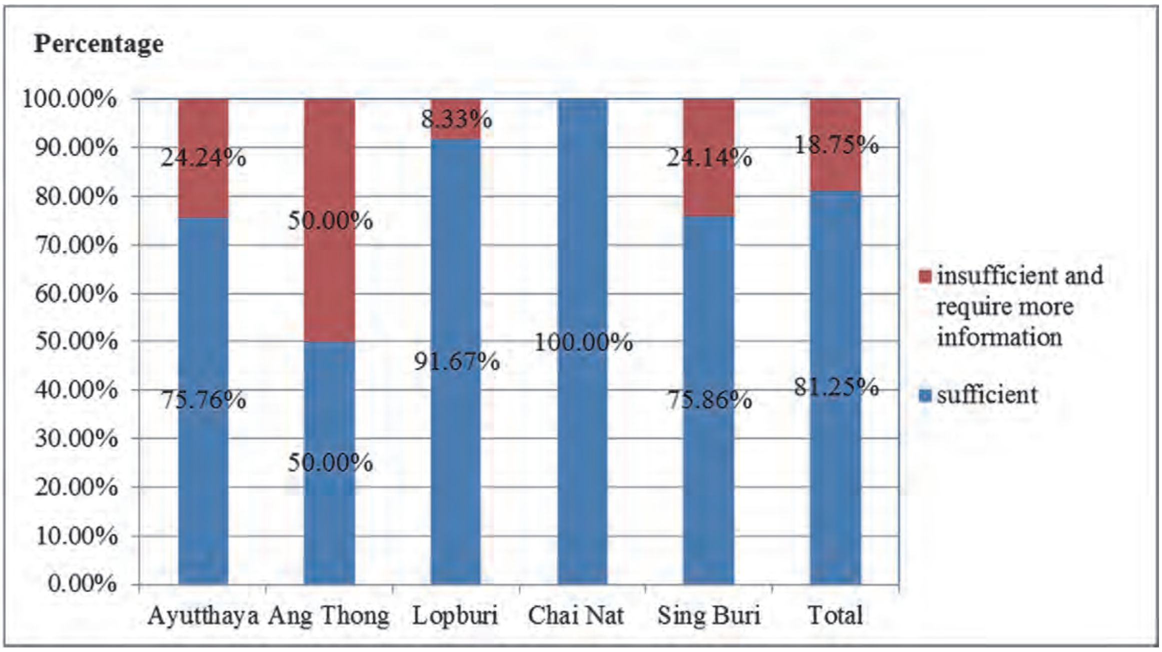


Figure 44-2 City Residents in 5 Provinces Survey: Percentage of respondents per the sufficiency of received information, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

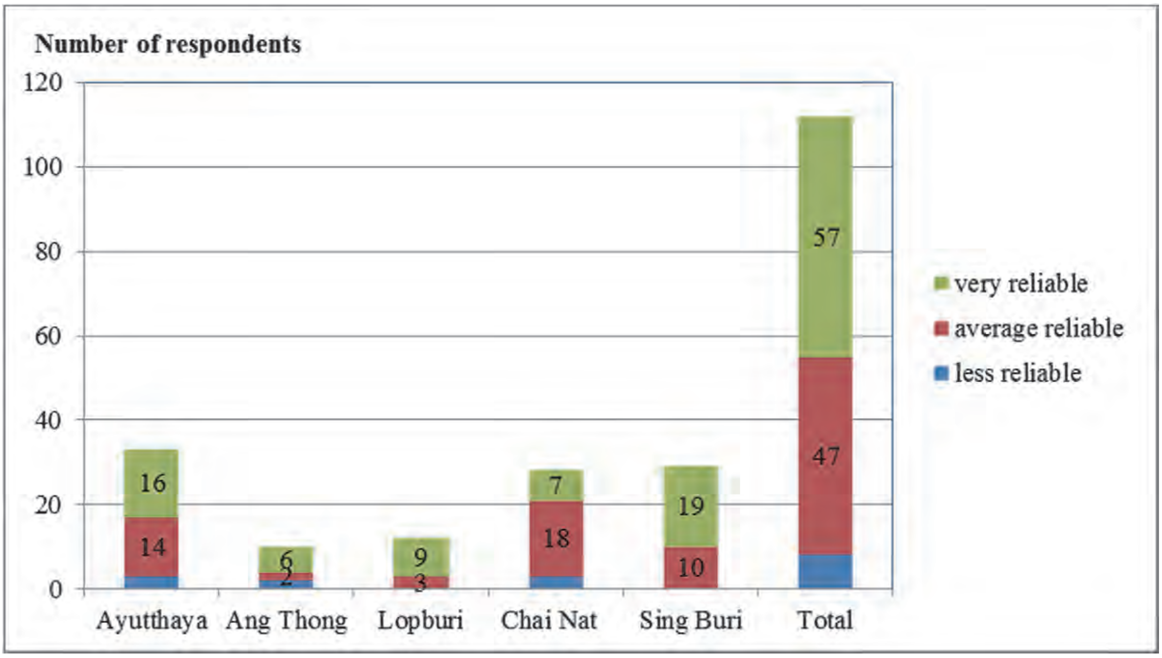


Figure 45-1 City Residents in 5 Provinces Survey: Number of respondents per reliability of received information and warning issuance, during the flood reaching the area

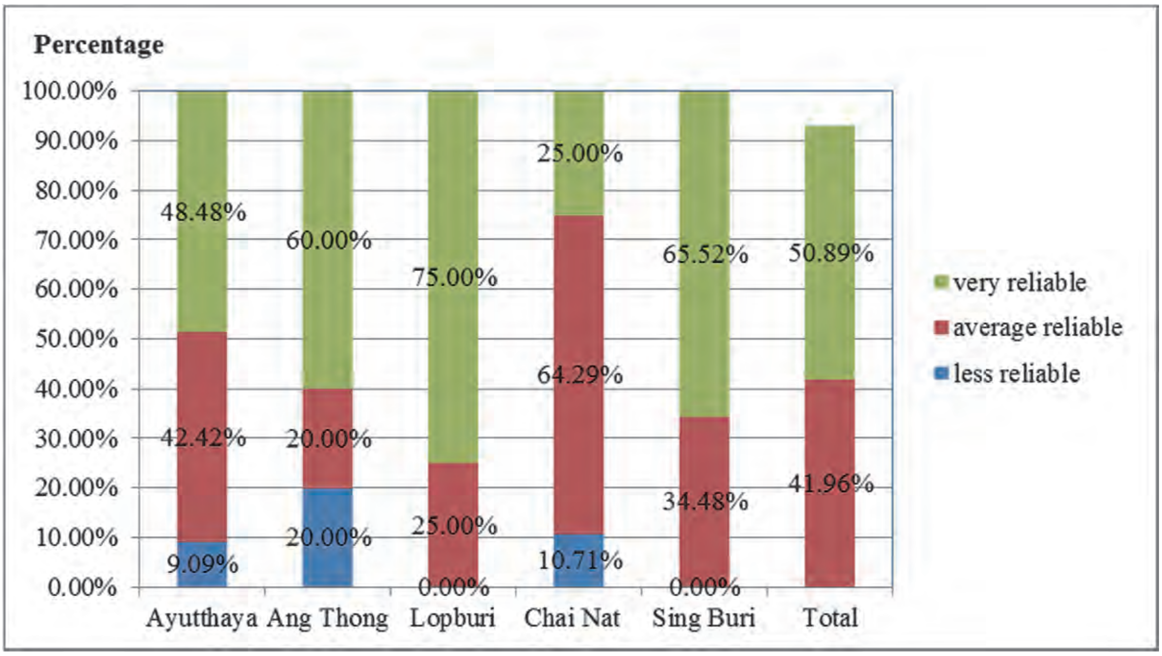


Figure 45-2 City Residents in 5 Provinces Survey: Percentage of respondents per reliability of received information and warning issuance, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

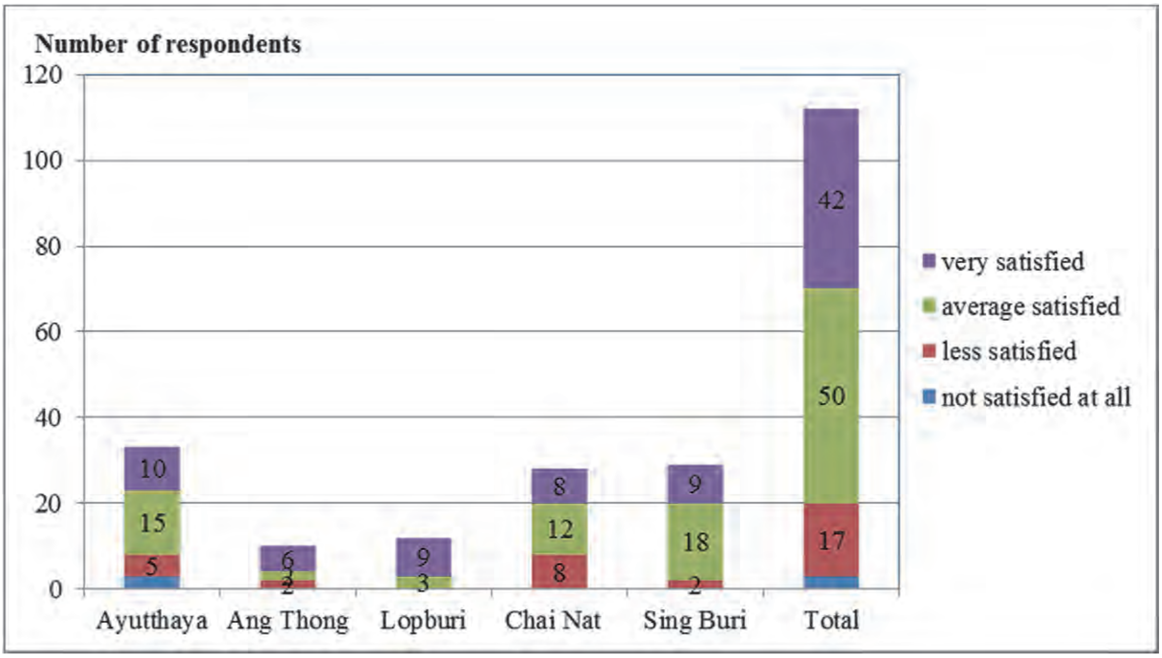


Figure 46-1 City Residents in 5 Provinces Survey: Number of respondents per satisfaction of received information and warning issuance, during the flood reaching the area

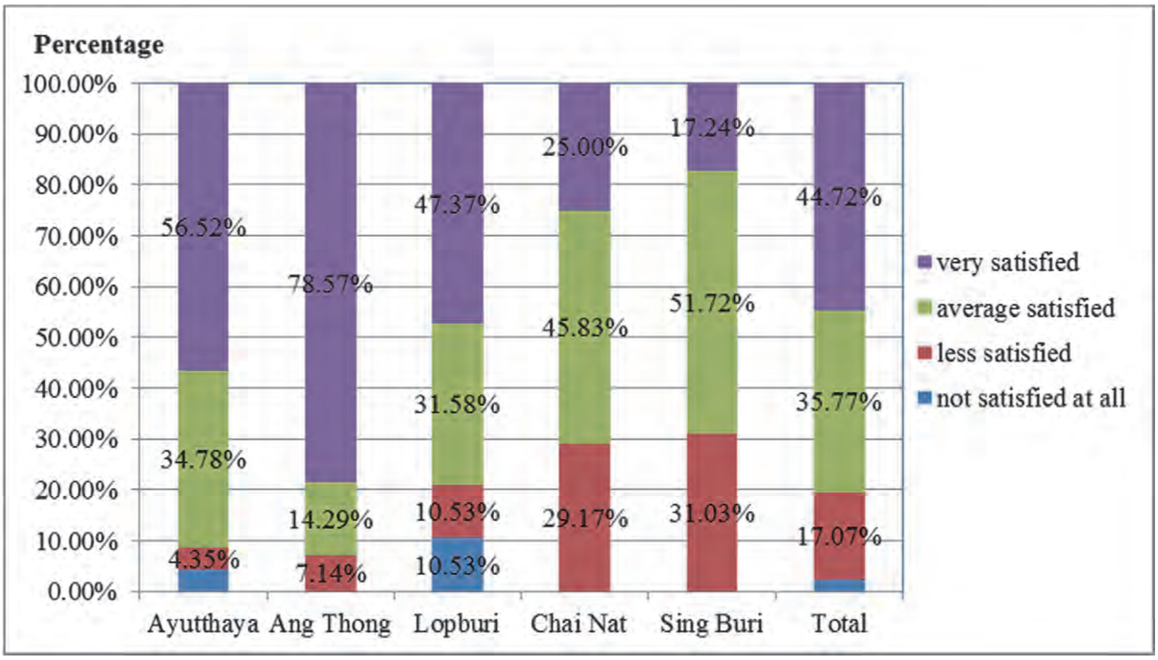


Figure 46-2 City Residents in 5 Provinces Survey: Percentage of respondents per satisfaction of received information and warning issuance, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

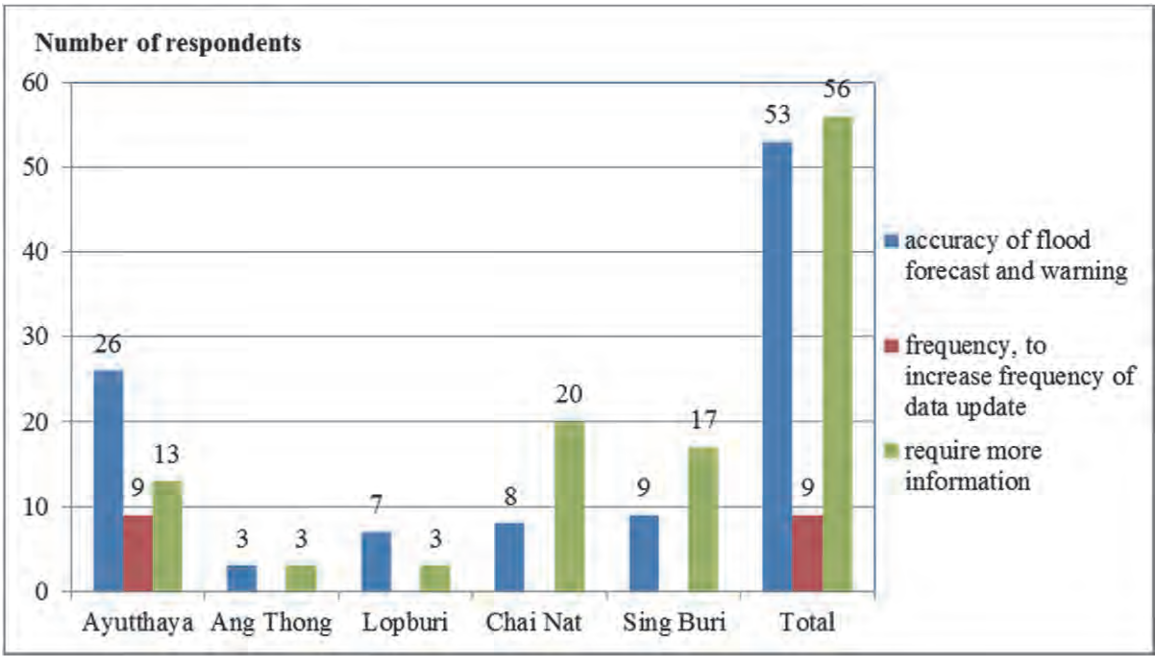


Figure 47-1 City Residents in 5 Provinces Survey: Suggestion of (Numbers of) respondent for information and warning system improvement, during the flood reaching the area

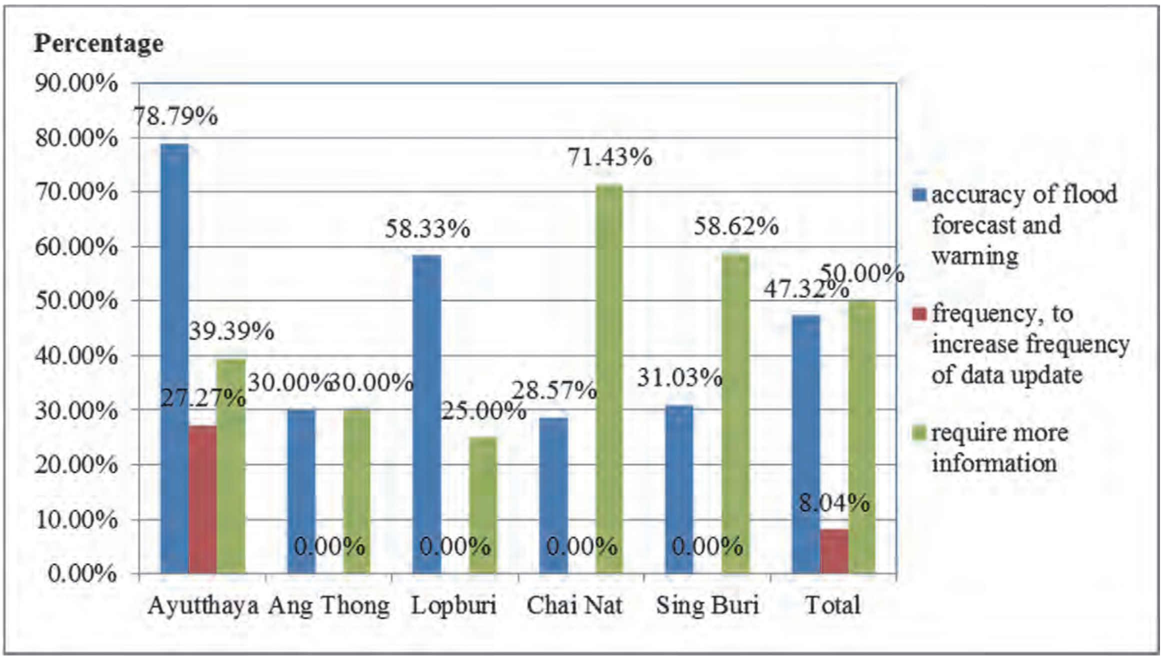


Figure 47-2 City Residents in 5 Provinces Survey: Suggestion of (Percentage of) respondent for information and warning system improvement, during the flood reaching the area

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 39-1, as the total number of each group of respondent*

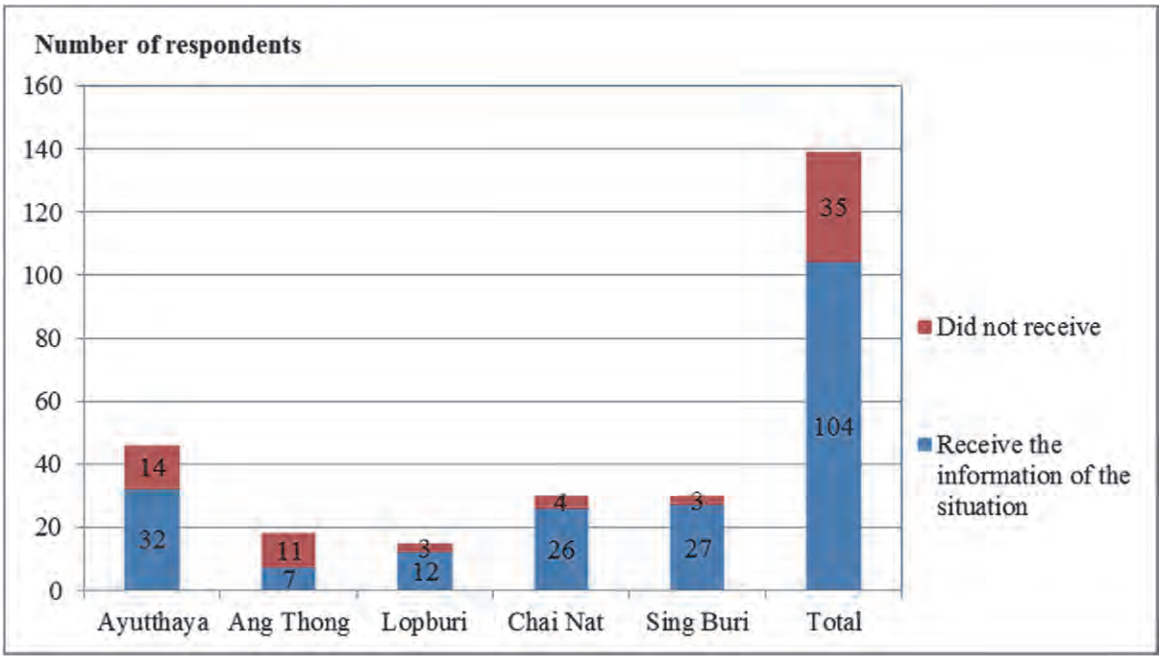


Figure 48-1 City Residents in 5 Provinces Survey: Number of respondents received the information and warning, during the recovery period

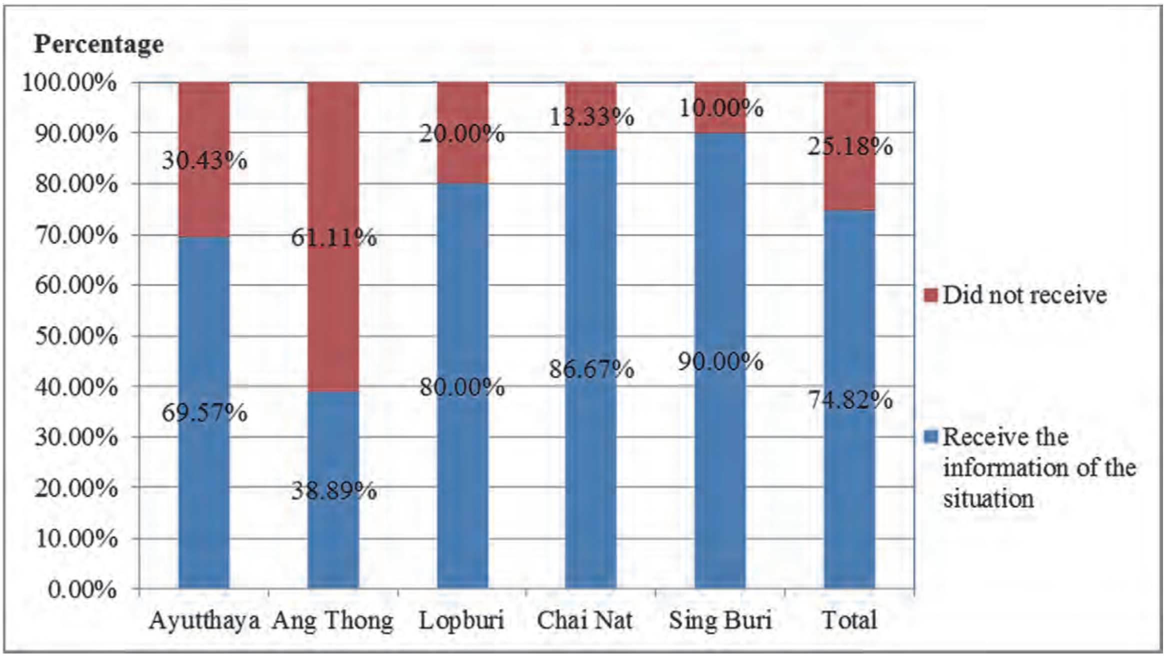


Figure 48-2 City Residents in 5 Provinces Survey: Percentage of respondents received the information and warning, during the recovery period

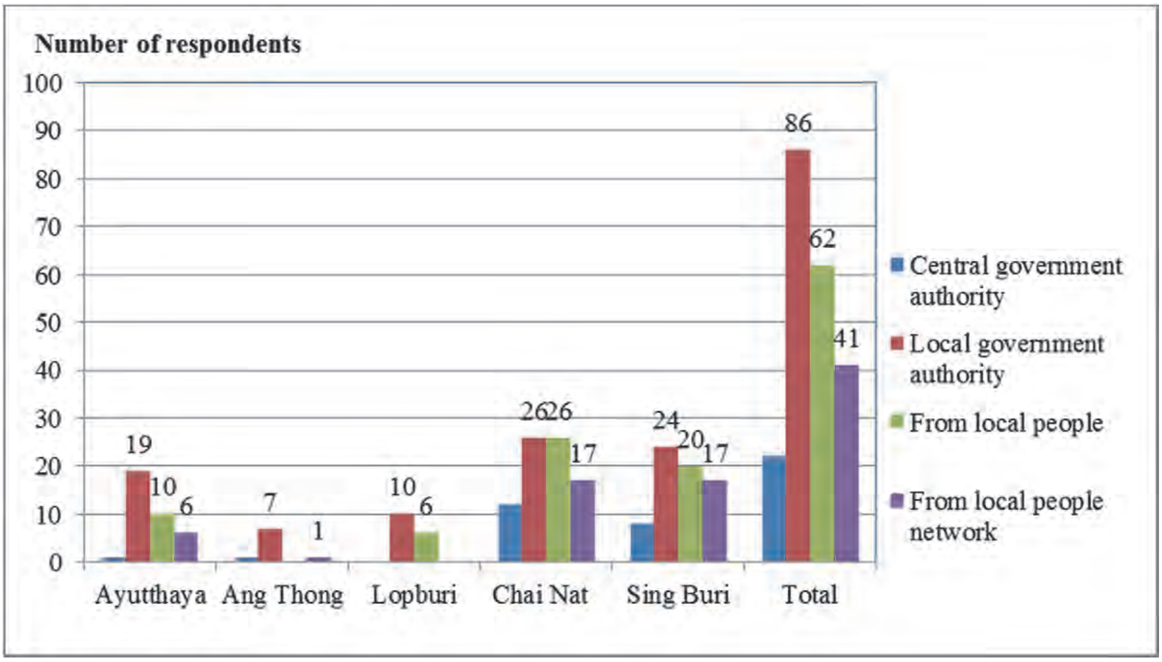


Figure 49-1 City Residents in 5 Provinces Survey: Number of respondents per source of inundation information and warning, during the recovery period

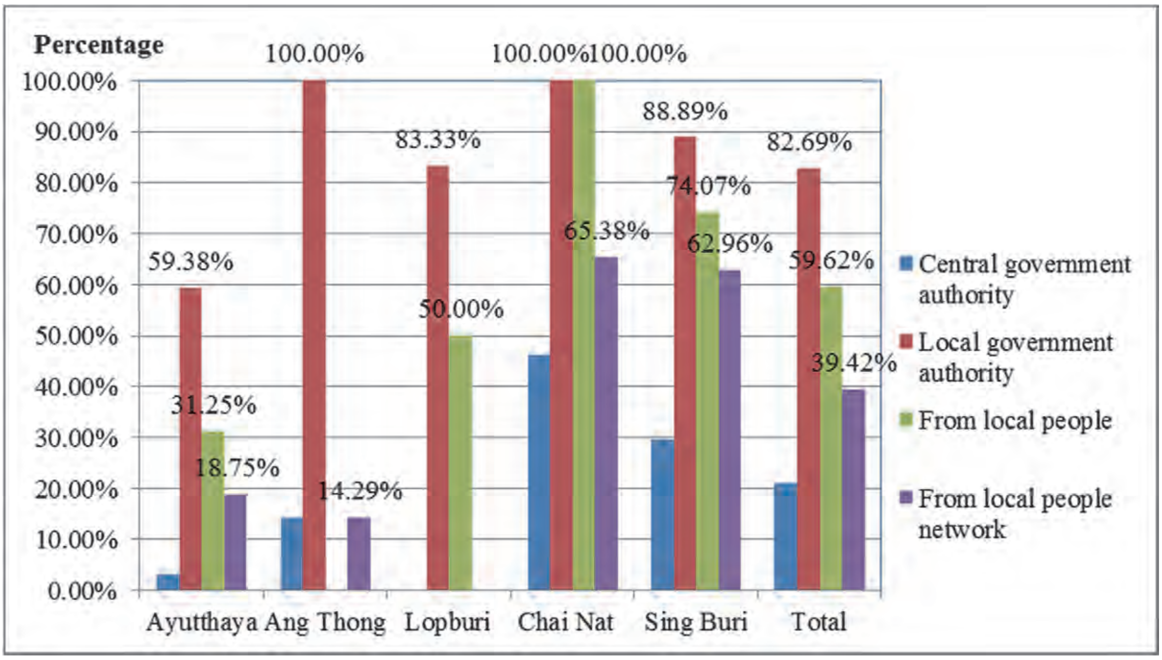


Figure 49-2 City Residents in 5 Provinces Survey: Percentage of respondents per source of inundation information and warning, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 48-1, as the total number of each group of respondent*

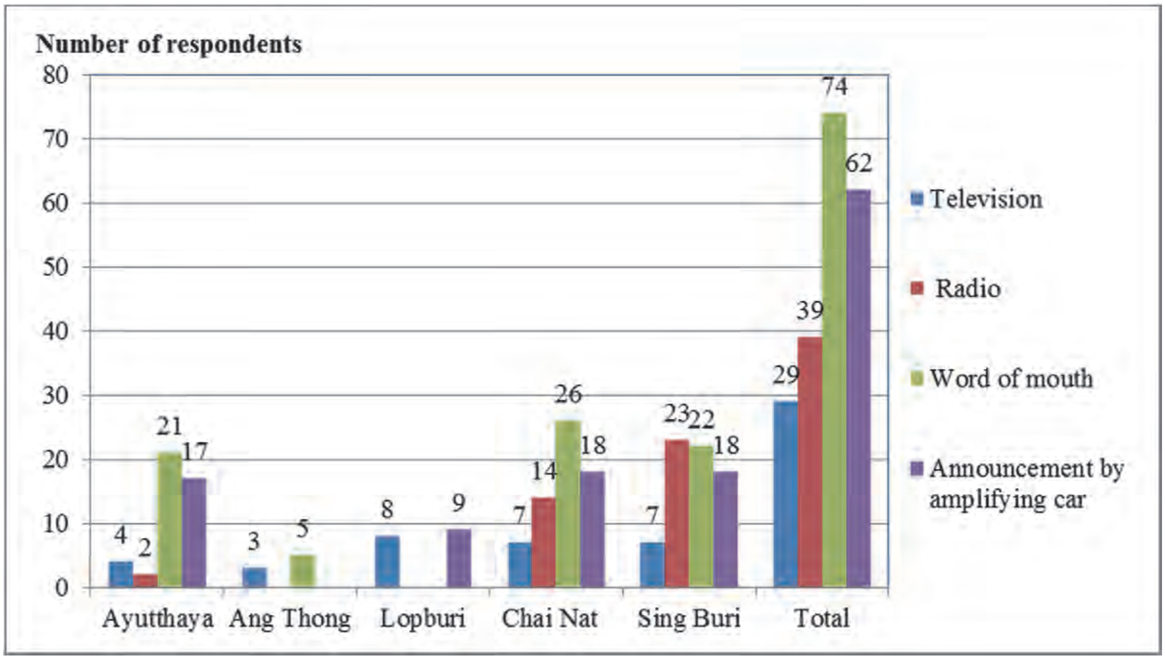


Figure 50-1 City Residents in 5 Provinces Survey: <u>Number of respondents</u> per Channel of inundation information and warning, during the recovery period

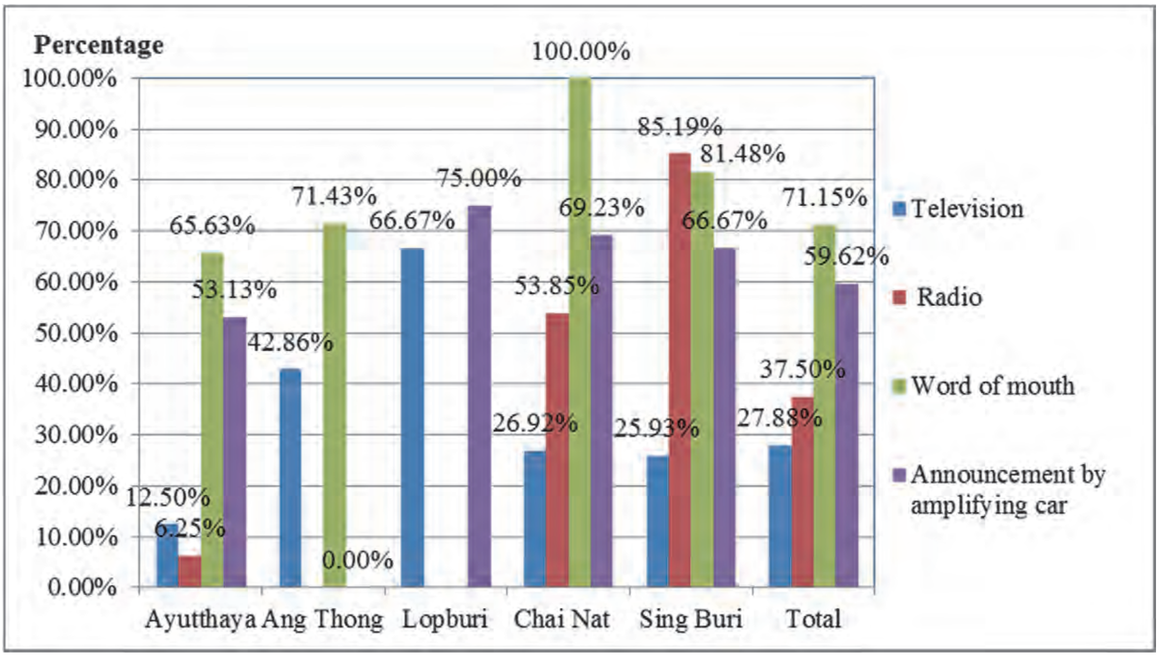


Figure 50-2 City Residents in 5 Provinces Survey: <u>Percentage of respondents</u> per Channel of inundation information and warning, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 48-1, as the total number of each group of respondent*

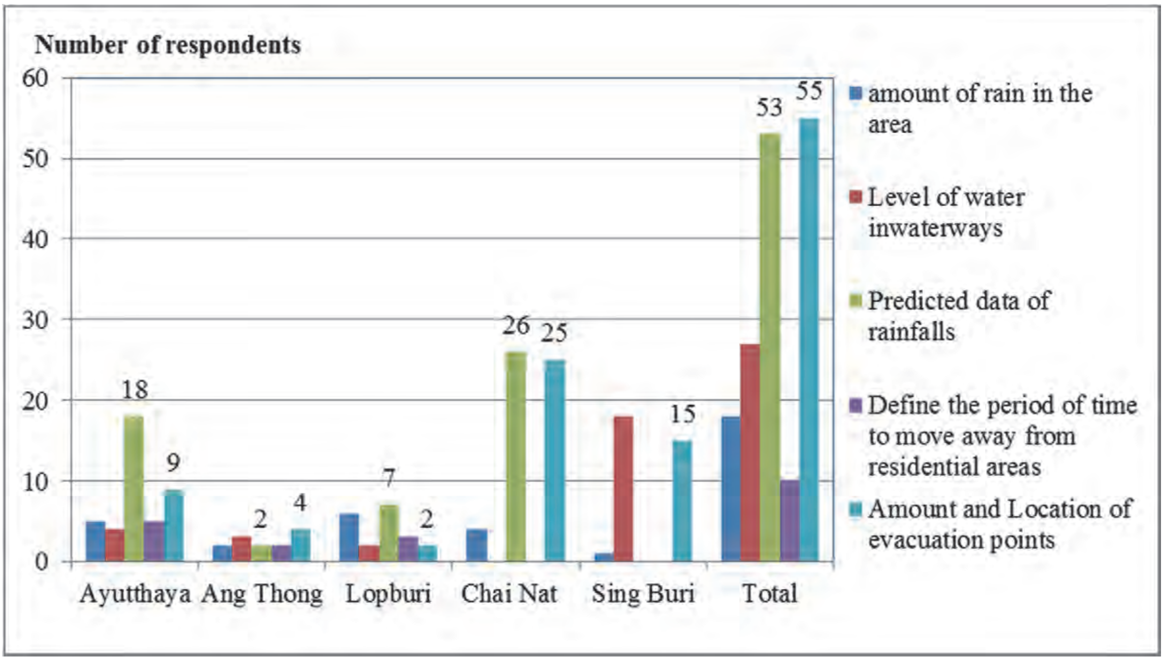


Figure 51-1 City Residents in 5 Provinces Survey: Number of respondents per Received Information, during the recovery period

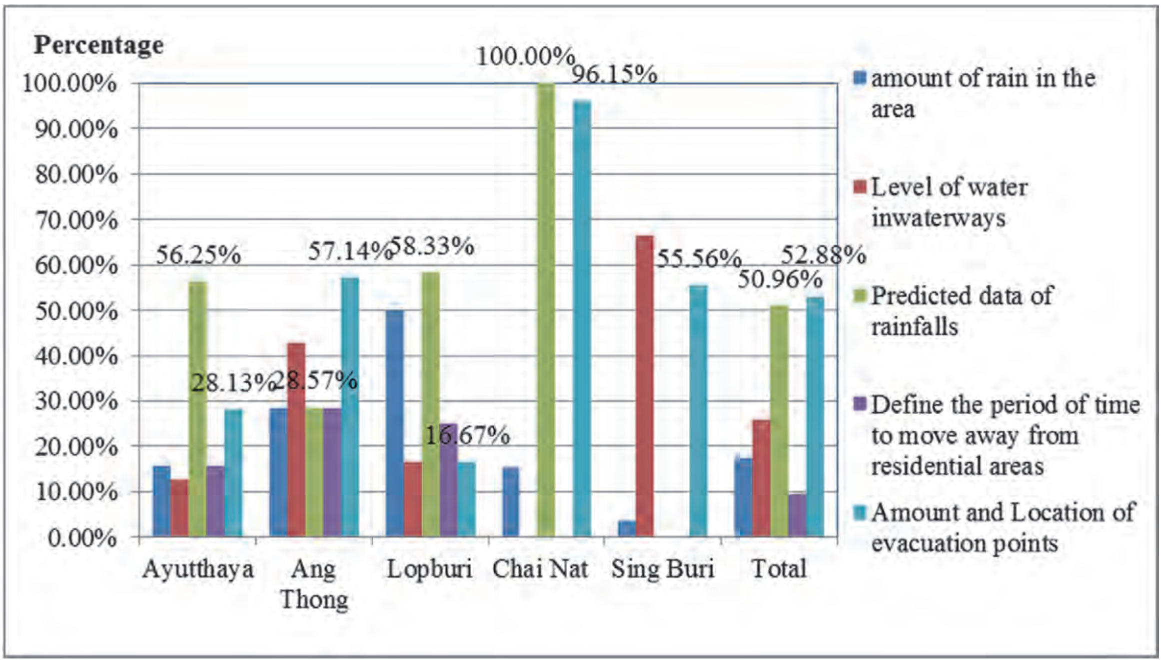


Figure 51-2 City Residents in 5 Provinces Survey: Percentage of respondents per Received Information, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 48-1, as the total number of each group of respondent*

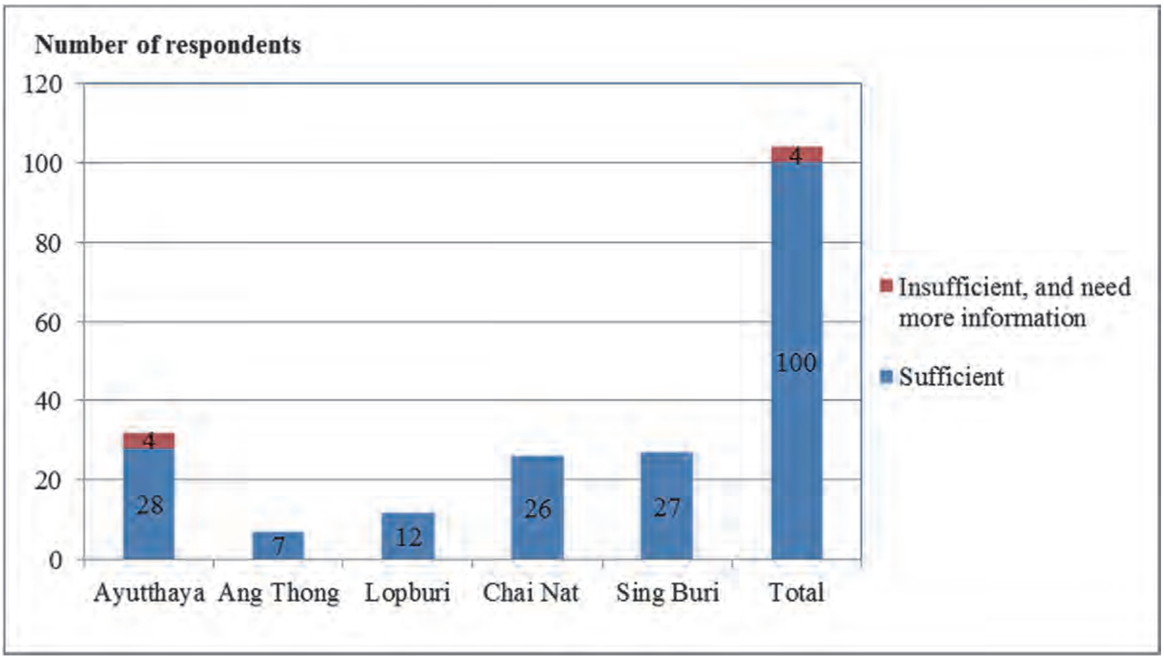


Figure 52-1 City Residents in 5 Provinces Survey: Number of respondents per the sufficiency of received information, during the recovery period

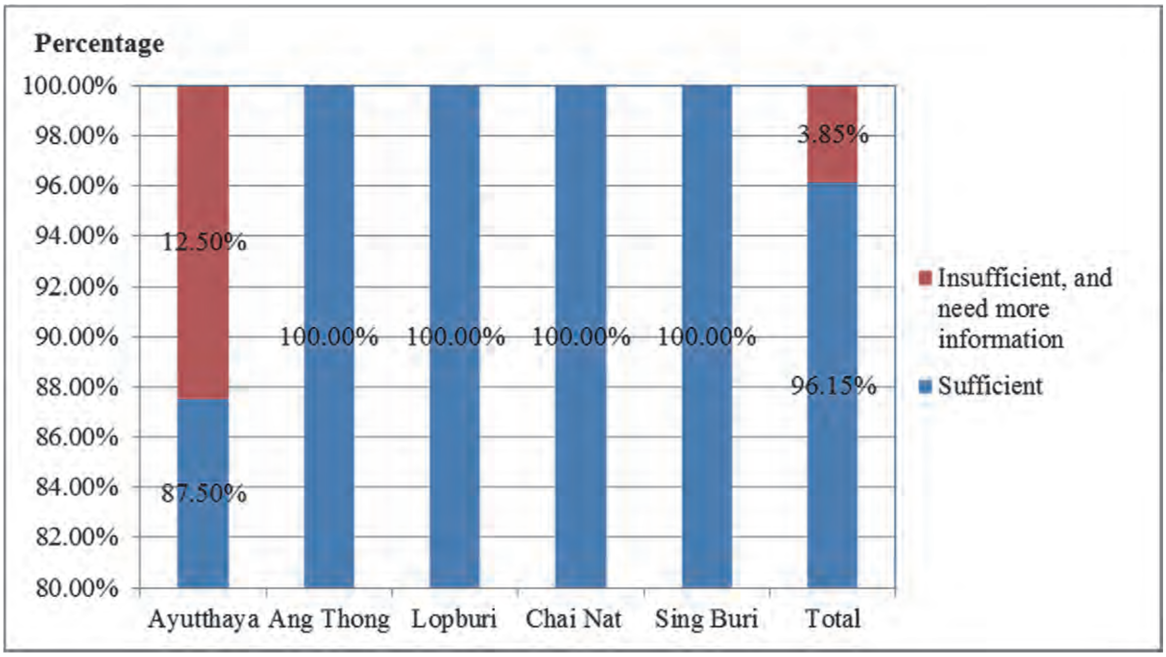


Figure 52-2 City Residents in 5 Provinces Survey: Percentage of respondents per the sufficiency of received information, during the recovery period

**In percentage calculation, considered the number of respondents who received the information, referred to the blue part in Figure 48-1, as the total number of each group of respondent*

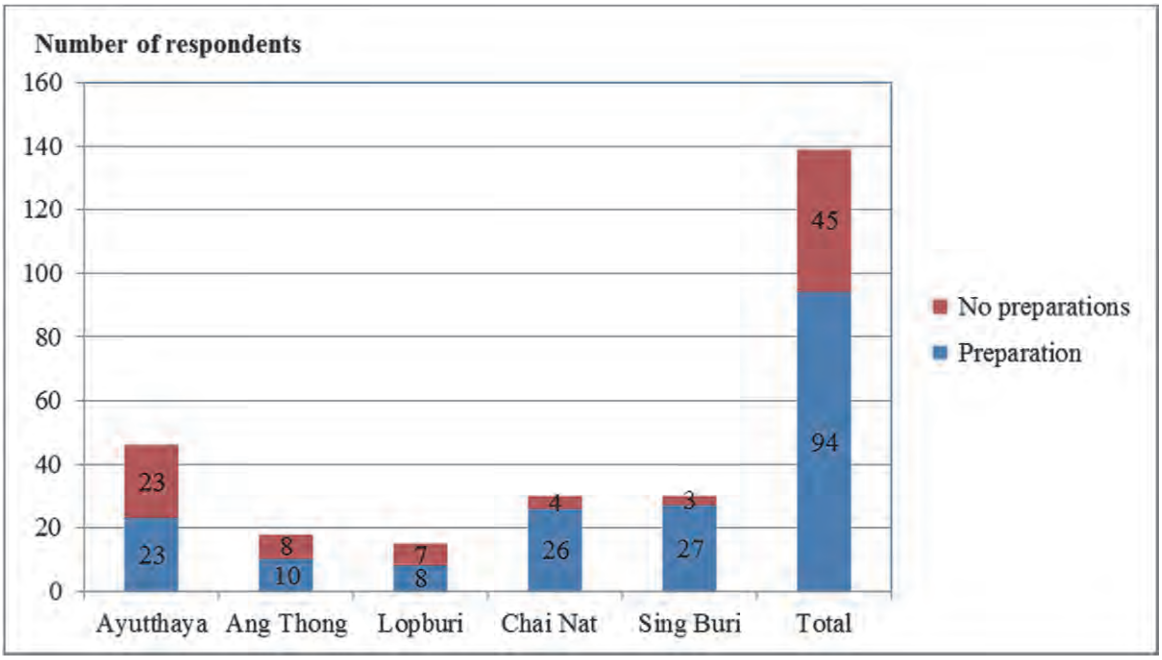


Figure 53-1 City Residents in 5 Provinces Survey: Number of respondents who prepared to handle the 2011 flood

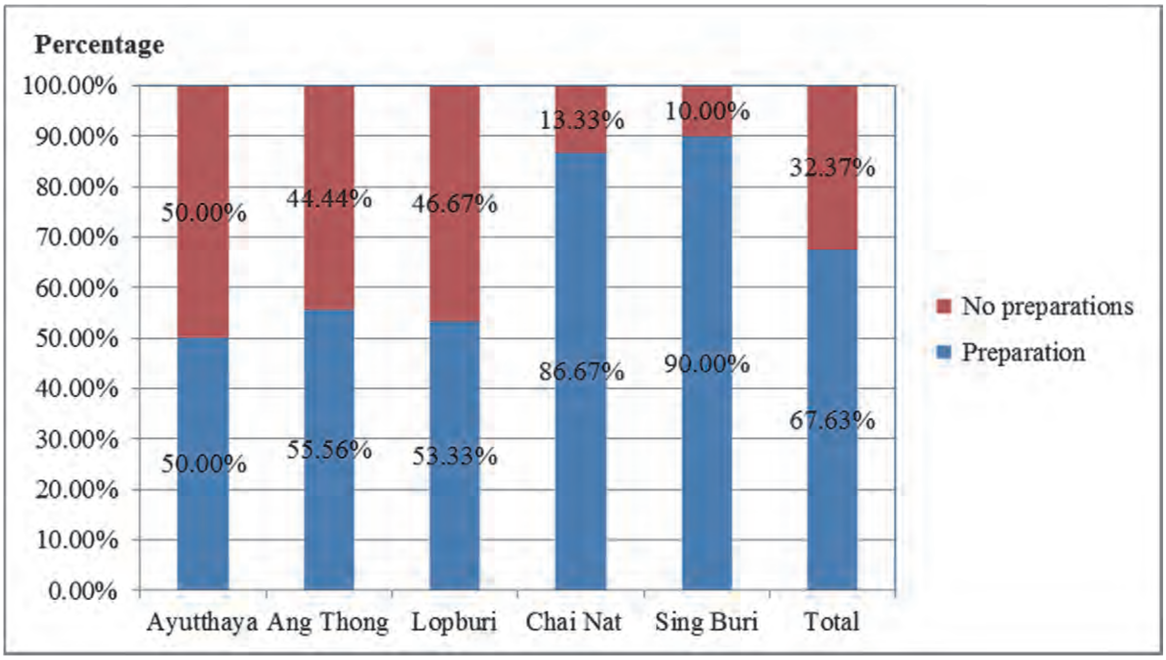


Figure 53-2 City Residents in 5 Provinces Survey: Percentage of respondents who prepared to handle the 2011 flood

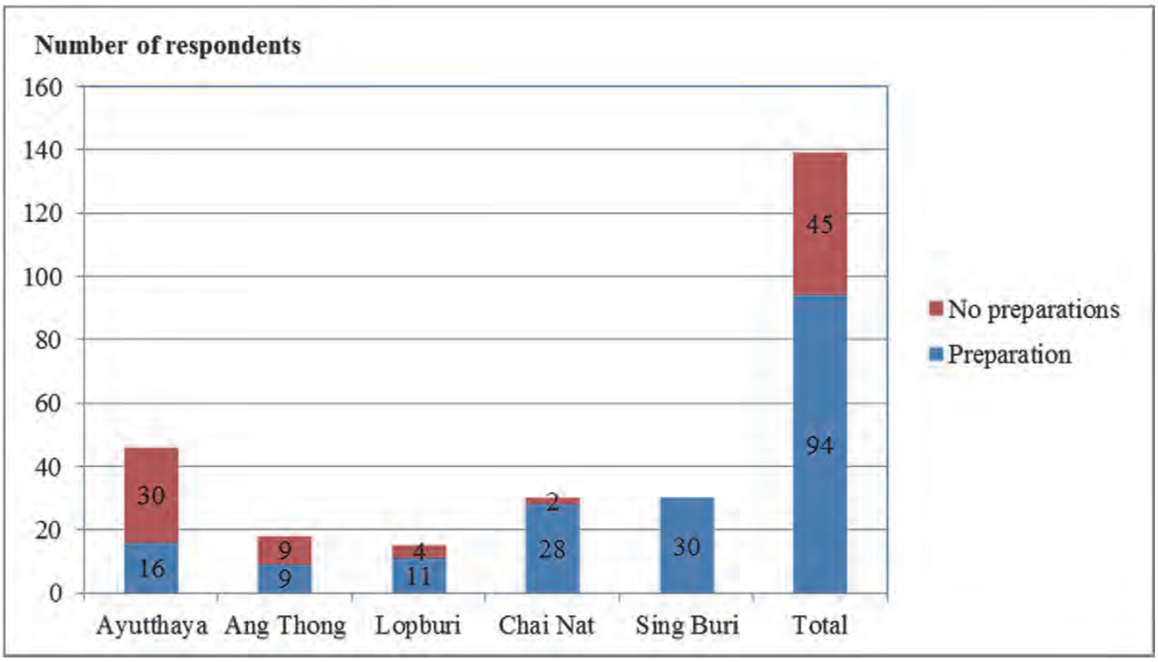


Figure 54-1 City Residents in 5 Provinces Survey: Number of respondents who prepared to handle the future flood

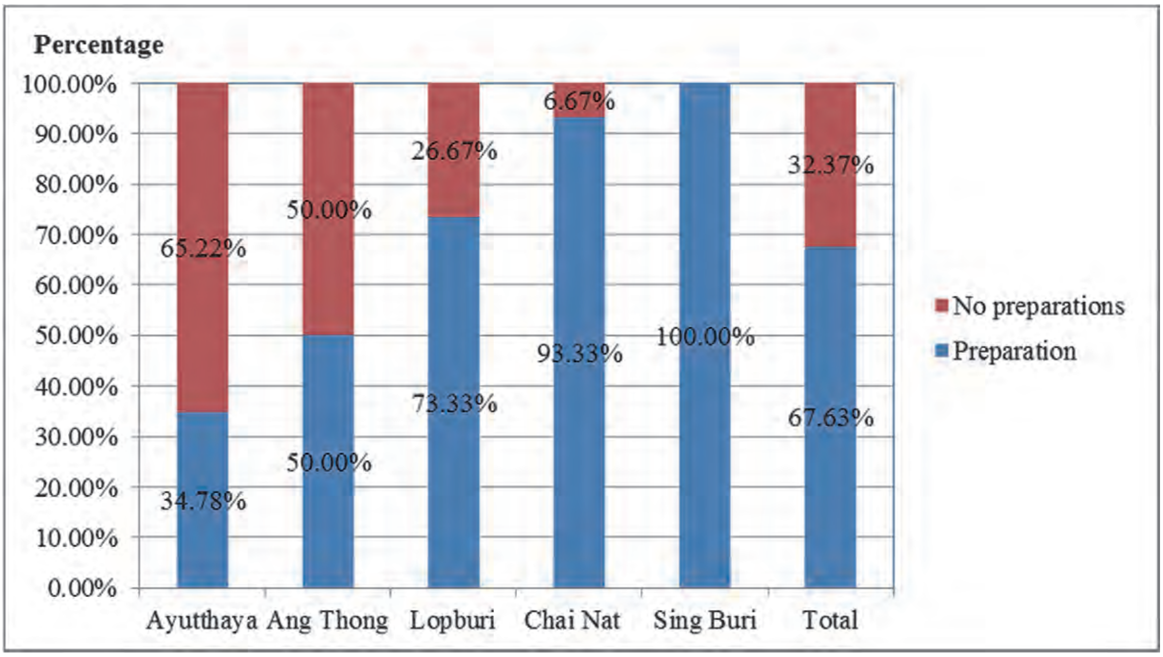


Figure 54-2 City Residents in 5 Provinces Survey: Percentage of respondents who prepared to handle the future flood

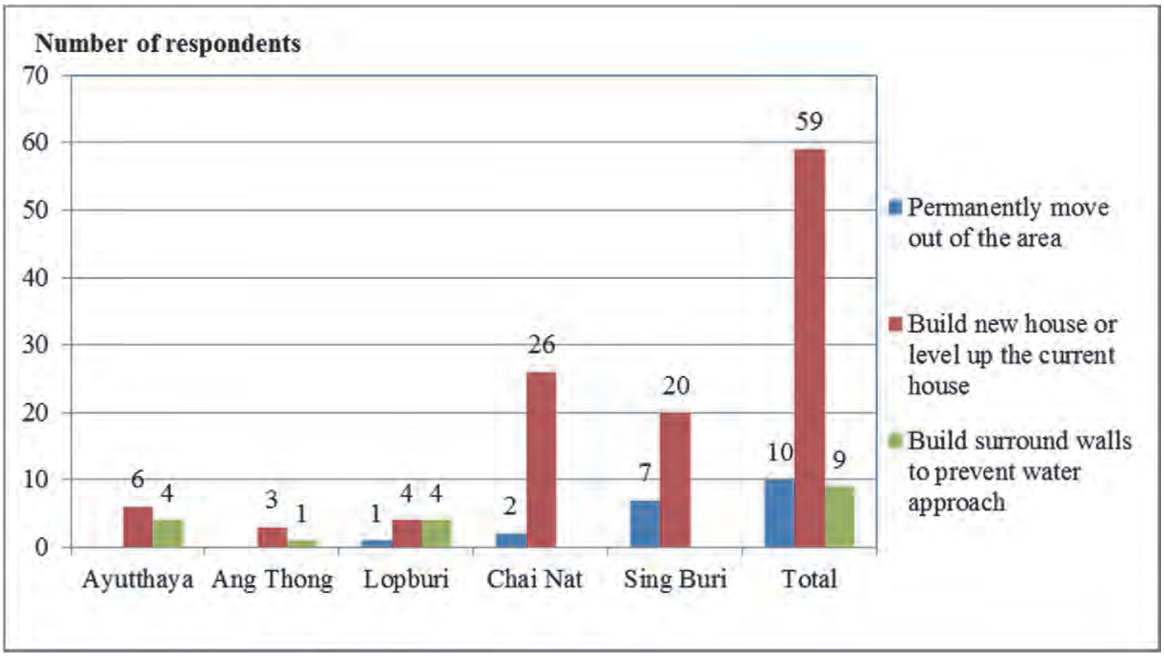


Figure 55-1 City Residents in 5 Provinces Survey: Measures that (Number of) respondents prepared to handle the future flood

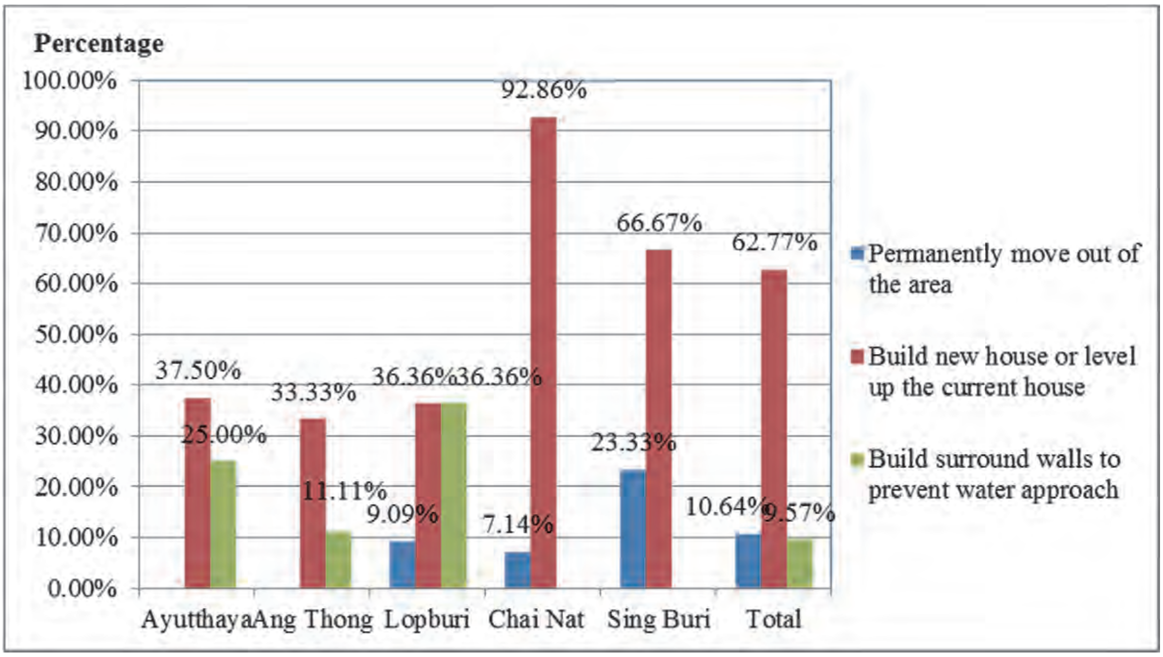


Figure 55-2 City Residents in 5 Provinces Survey: Measures that (Percentage of) respondents prepared to handle the future flood

**In percentage calculation, considered the number of respondents prepared to handle future flood, referred to the blue part in Figure 54-1, as the total number of each group of respondent*

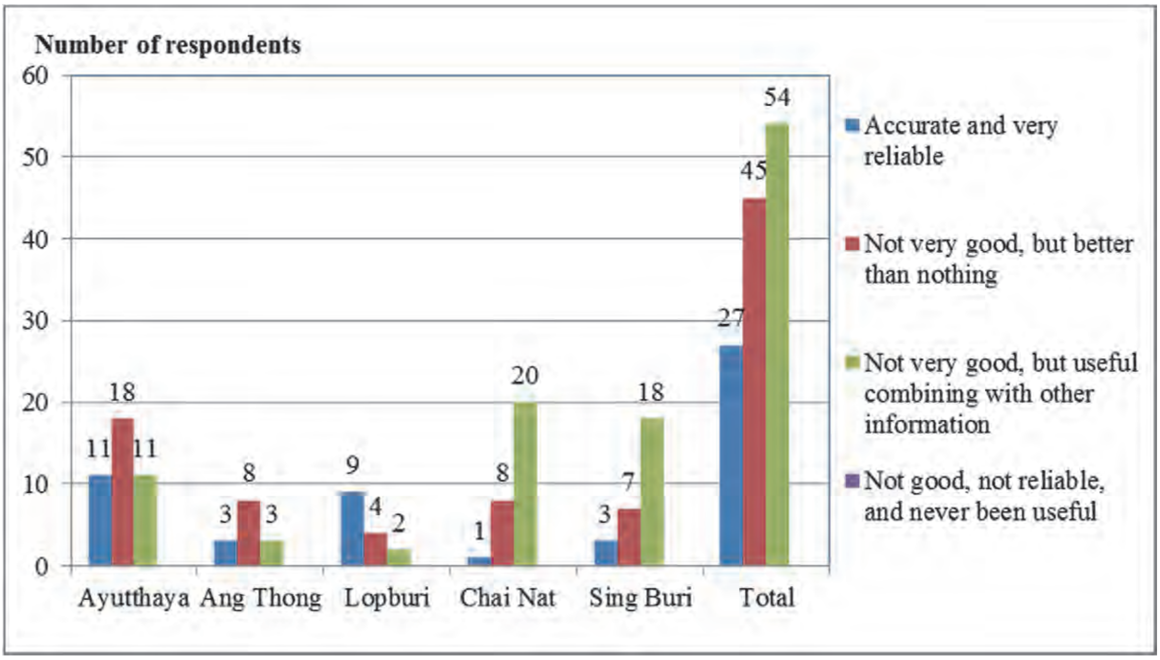


Figure 56-1 City Residents in 5 Provinces Survey: How (Number of) respondents feel about the exist flood forecasting and warning system

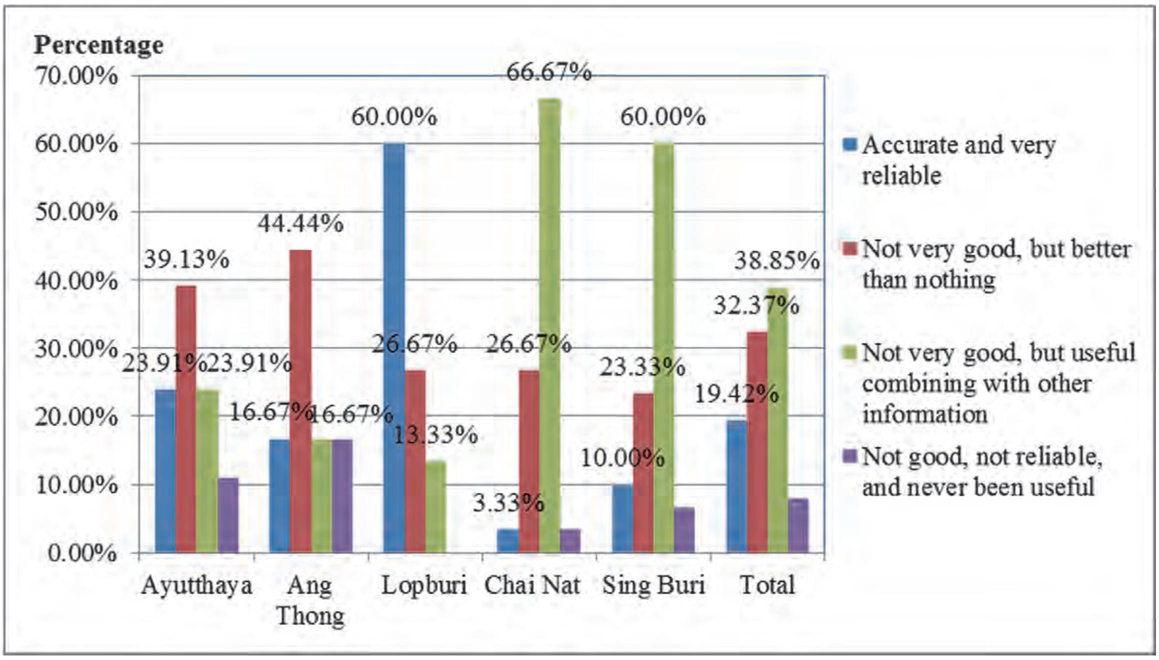


Figure 56-2 City Residents in 5 Provinces Survey: How (Percentage of) respondents feel about the exist flood forecasting and warning system

**In percentage calculation, considered all of the respondents, as the total number of respondent*

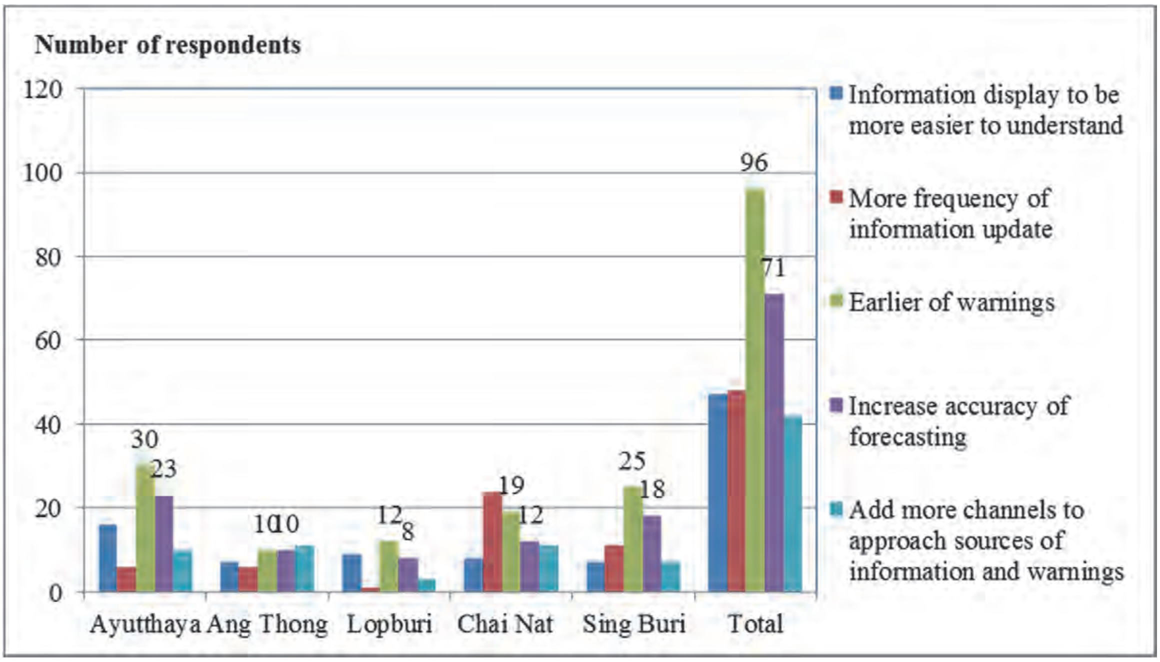


Figure 57-1 City Residents in 5 Provinces Survey: The Suggestion that (Number of) respondents gave, in order to improve the existing flood forecasting and warning system

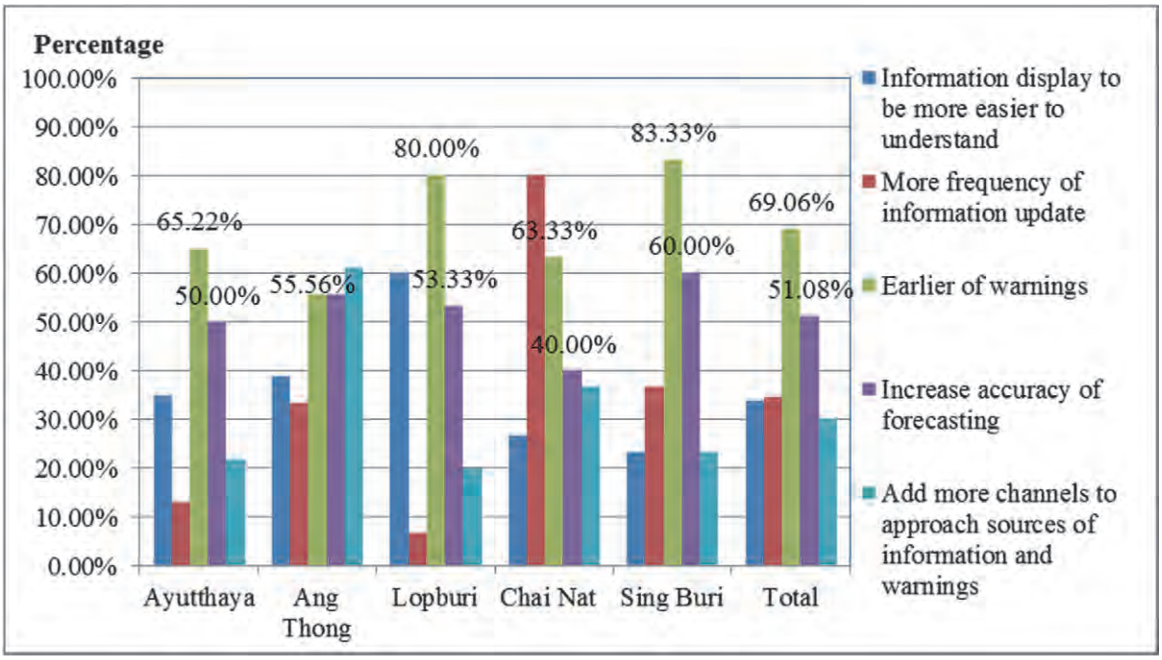


Figure 57-2 City Residents in 5 Provinces Survey: The Suggestion that (Percentage of) respondents gave, in order to improve the existing flood forecasting and warning system

**In percentage calculation, considered all of the respondents, as the total number of respondent*

5.3 Factory Interview

The flood occurred in 2011 has been described as the worst flood in terms of the amount of water and people affected. The damage was estimated by Federation of Thai Industry (Central region section) at least 185 billion Baht, in which included 25 billion Baht damage on the Agriculture, 65 billion Baht damage of the housing in the communities and suburb villages, and 95 billion Baht damage on Thai industry. It was also reported that 930 factories in 28 provinces were affected, including seven industrial estates in Ayutthaya and Pathum Thani provinces.

The brief sequences of the inundation in and around 7 industrial estates, which are Saharattananakorn, Rojjana, Hi-tech, Bang Pa-In, Navanakorn, Factory land and Bangkadi Industrial Estates, are as follows:-

October 4, 2011, the dyke protecting water around Saharattananakorn Industrial Estate was collapsed due to the sudden current of flood. The water strongly flowed through all area and caused the submergence of 46 major factories, with hundreds of sub-contract factories.

On October 8, 2011, the strong current of flood broke down 10-m high water blockage in Rojjana Industrial Estate. It caused the inaccessible of some major manufacturing plants such as Honda. Accordingly, on October 11, the whole area of Rojjana Industrial Estate, which consisted of 198 factories with 90,000 – 100,000 staffs and investment of about 58,000.00 million Baht, was fully submerged.

October 12, 2011, there was the message from the authority of Bang Pa-In Industrial Estate that the water current seriously flowed through the estate and there was the evacuation warning already. There was the evaluation of tremendous damage since this industrial estate consisted of various hi-tech factories such as Western Digital, which is the world's second largest producer of hard disk drives accounting for approximately 25% of the world's production. During the same time, the staffs and people living in Navanakorn Industrial Park in Pathum Thani were ordered to evacuate immediately. All operations were shut down, after the efforts to prevent the flood water flow into the important factory center failed. The managing director of Navanakorn Plc announced that the water was flowing through an opening between five and eight meter wide in a north dyke.

October 13, 2011, the water approached Hi-tech Industrial Estate. Although the authorities tried to intercept the water, but seemed worthless, but finally, the flood flowed through the South of the industrial estate. The estate announced for the evacuation at about 10 am.

October 14, 2011, the Factory land Industrial Estate, which is the location of 99 factories, was inundation approached. The maximum depth was more than 1.5 m. It caused temporary closure of all factories.

October 20, 2011, the backside dyke of Bangkadi Industrial Estate in Pathum Thani was failed; accordingly, the flood water continually flowed through all area. The water level increased rapidly and reached 2-m in the next day. Many staffs and authorities were remained in the industrial estate until there was the rescue team arrived.

The damage of more than 800 factories in 7 industrial estates in Ayutthaya and Pathum Thani Provinces were estimated by Ministry of Industry, as shown in *Table* 6.

Table 6 Damage Summary of 7 Industrial Estates hit by 2011 Flood

	Flood-hit industrial estates	Number of plant	Investment (Mil. baht)	Number of workers
Ayutthaya				
	Saharattananakorn	46	9,472	14,696
	Rojjana	213	56,000	90,000
	Hi-tech	143	65,312	51,186
	Bang Pa-In	90	60,000	60,000
	Factory land	84	8,000	8,500
	Total of Ayutthaya	**576**	**198,784**	**224,382**
Pathum Thani				
	Navanakorn	227	180,000	128,311
	Bangkadi	36	25,000	30,000
	Total of Pathum Thani	**263**	**205,000**	**158,311**
	Total	**839**	**403,784**	**382,693**

Source: Ministry of Industry, August 3, 2012.

The economics of other countries besides Thailand has been significantly affected by the flood as well. Japan is the hardest one since many major Japanese plants such as Toyota, Honda, Hitachi and Canon, were submerged and temporarily shut down for more than a month.

In this study, 35 factories in 7 Industrial Estates have been selected as the questionnaire respondents, as the name list previously shown in *Table 3*. The questionnaire results are shown in *Appendix D.*

The 2011 flood caused the inundation that the water covered the 1st floor of all interviewed factories, but did not conceal the whole level. 91.43% of them described that the period of time of the water approached until highest flood water level was 6-12 hours and it takes 1-2 months to get dry.

Based on the questionnaire result, 100% of the respondent received the warning during monitoring period / before flood reached the area; 100% got the informing from local entrepreneur network and 80% received the warning from Industrial Estate Authority of Thailand, IEAT, as the result shown in *Figure 58.* It seems that the most effective channels of information and warning issuance are telephone, both making the alarm call and sending SMS, and word to mouth, as shown in *Figure 59. Figure 60* shows the information that the respondents daily received; 88.57% got the information of time period to return to factory area, 82.86% got the information of water level in the waterways. However, 31.43% of the respondents indicated that the received information was not sufficient since some of them did not get the information of time period to return to factory area, the number and location of evacuation points and evacuation routes in case of increasing of water level, as shown in *Figure 61.*

45.71% of the respondents indicated that they received the flood warning 3-7 days before flood reached the area, while 42.86% got the informing 1-2 days before flood reached the area. Although 68.57% mentioned that the received information was sufficient for taking flood alleviation action, but most of them, 60%, felt that the information was less reliable, less useful and not satisfied on the flood forecasting and warning system. 100% of the respondents requested the improving of the accuracy of flood forecast and warning system, while 41.67% needed the advance notification of 1-4 weeks before water approach.

During the flood period, 88.57% of the respondents received the information of the situation and warning, in which all of them got the informing from the local entrepreneur network, 74.19% got the information from IEAT, as shown in *Figure 62,* via Telephone (both the alarm call and SMS) and word of mouth, as shown in *Figure 63.* It was found that 83.87% of the respondents, who received the information, received the information of period of time to return to factory area and more than 50% got the rain data and water level in the nearby waterways, as shown in *Figure 64.*

However, 32.26% of the respondents who received the information mentioned that the received information was not sufficient since some of them did not get the name list of contact persons/ or agencies to contact for assistance, the water level in nearby waterways, including the rain data, as the result shown in *Figure 65*. These indicate the uncertainty of warning issuance.

*Figure 6*6 shows the time period that the respondents received the flood warning, 41.94% of the respondents indicated that they received the flood warning 3-7 days before flood reached the area, while 32.26% got the informing 1-2 days before flood reached the area. Although 67.74% mentioned that the received information during the flood was sufficient for making decision and taking action, but most of them, 64.52%, felt that the information was less reliable and less useful, and 61.29% did not satisfy on the flood forecasting and warning system. 100% of the respondents requested the improving of the accuracy of flood forecast and warning, while 16.13% asked for changing pattern of data as numeric and graph, and 12.90% asked for more frequency of data updated such as more often than once per hour.

During the recovery period, 100% of the respondents received the information of the situation, in which all of them got the informing from the local entrepreneur network, 88.57% got the information from IEAT, as shown in *Figure 67,* via Telephone (both the alarm call and SMS) and word of mouth, as shown in *Figure 68.* Although 97.14% of respondents got the information of certain period of time to return to the factory area, as shown in *Figure 69,* but some of them did not receive this information. This also indicates the inconsistency of the information and warning issuance system.

Although 87.71% of the respondents said that the received information was sufficient for making decision, but more than 45% did not satisfy on the accuracy and reliability of the information. It was found that 97.14% asked for the improving of flood forecast and warning accuracy and 5.71% requested for more frequency of data updated and in the pattern of animation.

It could be summarized that almost all of the respondents prepared to handle the flood before the water reached their places because they have been informed about the flood situation in other areas. 94.12% moved things to the higher places and prepared sandbags around the factories, as the result shown in *Figure 70.* Just 2.86% of them did not take any action because they were confused with the situation information they received and could not decide how to deal with the situation.

When the respondents asked for the preparation to handle with future flooding, 68.57% prepared by setting up the flood prevention and mitigation plan, built surround walls to prevent water, built level up the current area and some of them have permanently moved out, as the result shown in *Figure 71*. 70.83% of the respondents think that they cannot rely on the warning or information and it is better to prepare to prevent the situation and 25% feel that they cannot rely on government authorities. However, 31.43% or respondents did not prepare for the future flooding since they think that they can ask for assistance from government authorities if it happens again and some of them think that such a great flood might never happen again.

Figure 72 presents how the respondents feel about the existing forecasting and warning systems. More than 57% of the respondents said that the existing system is not good, not reliable, and never been useful. 20% said that although the system is not very good, but still useful in combining with other information, while 17.14% said that it is better than having nothing.

Thus, from *Figure 73*, 88% of the respondents asked for the displaying to be easier to understand such as in the pattern of animation, narration and graph. 77.14% requested higher accuracy of the flood forecasting, and 42.86% needed earlier of warning; i.e. at least 3-7 days before the water approach.

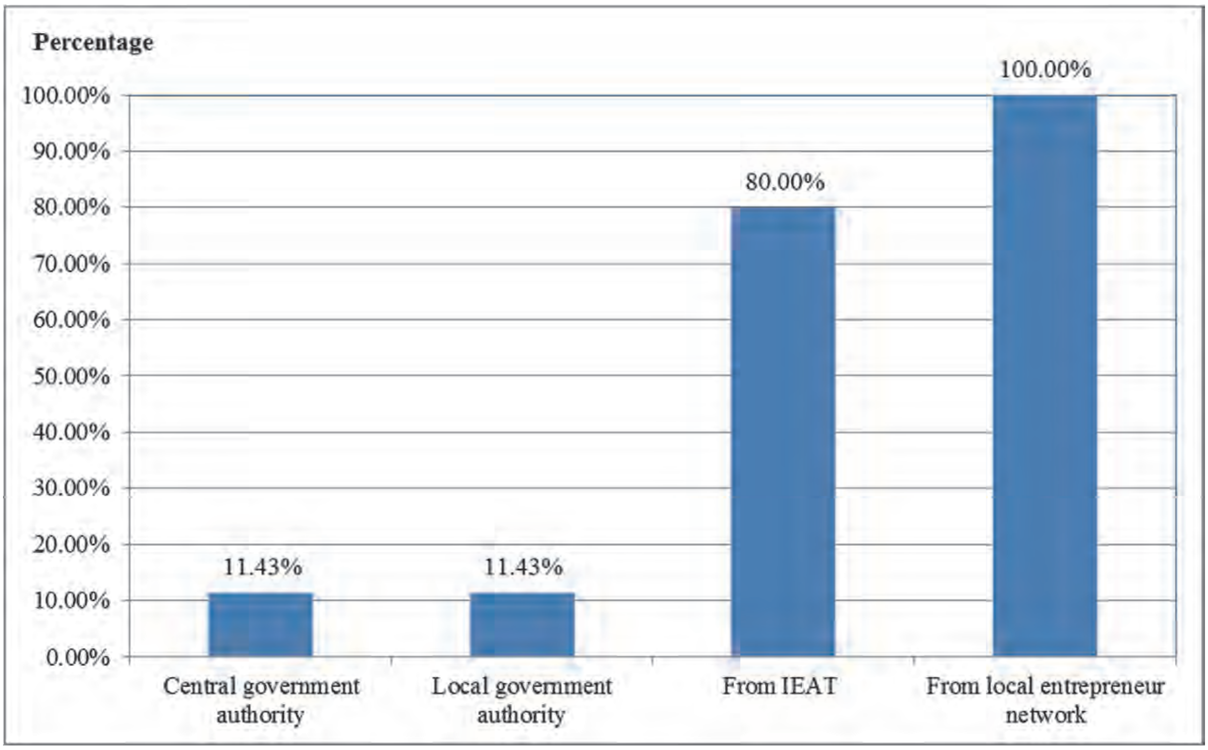


Figure 58 Factory Survey: Sources of inundation information and warning, before the flood reached the area

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the warning, before the water reached their places*

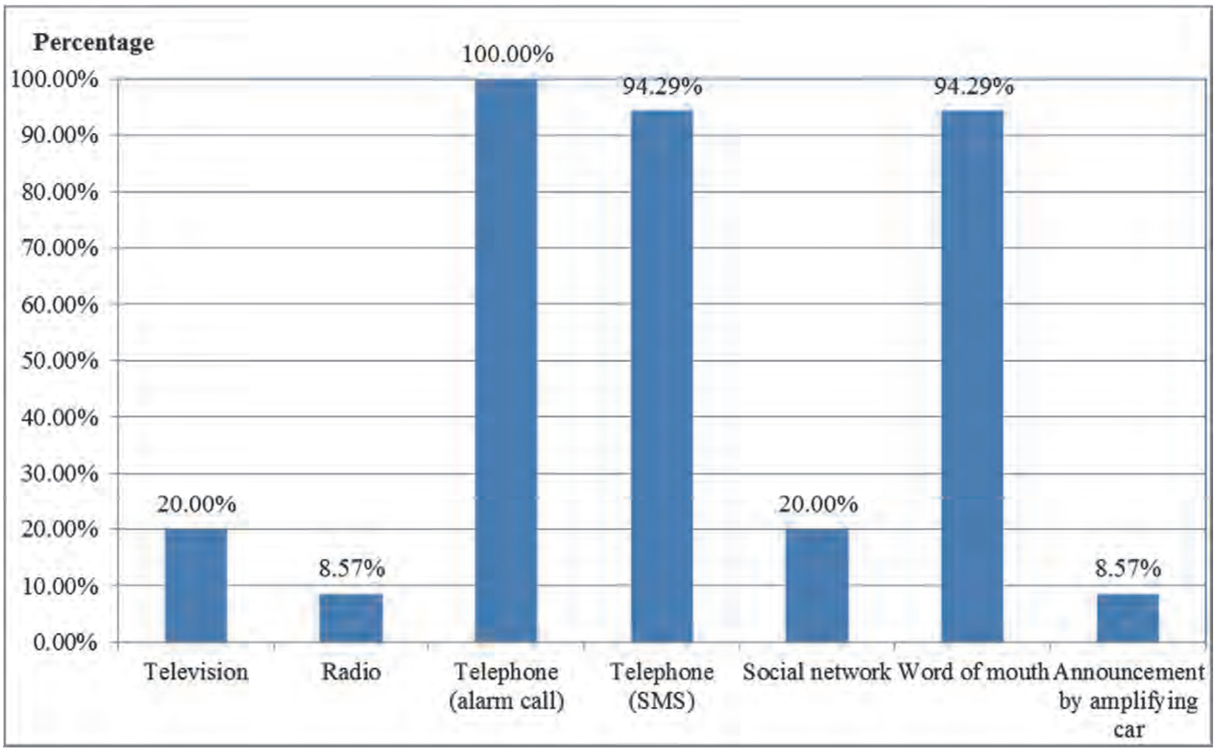


Figure 59 Factory Survey: Channel of inundation information and warning, before the flood reached the area

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the warning, before the water reached their places*

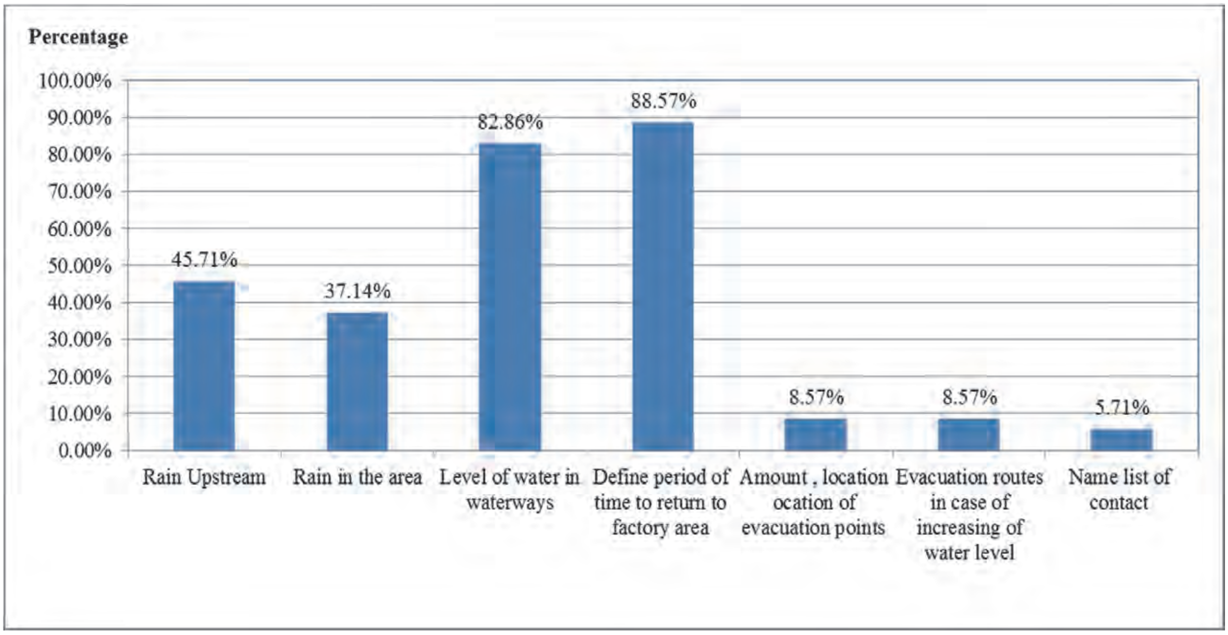


Figure 60 Factory Survey: Received information, before the flood reached the area

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the warning, before the water reached their places*

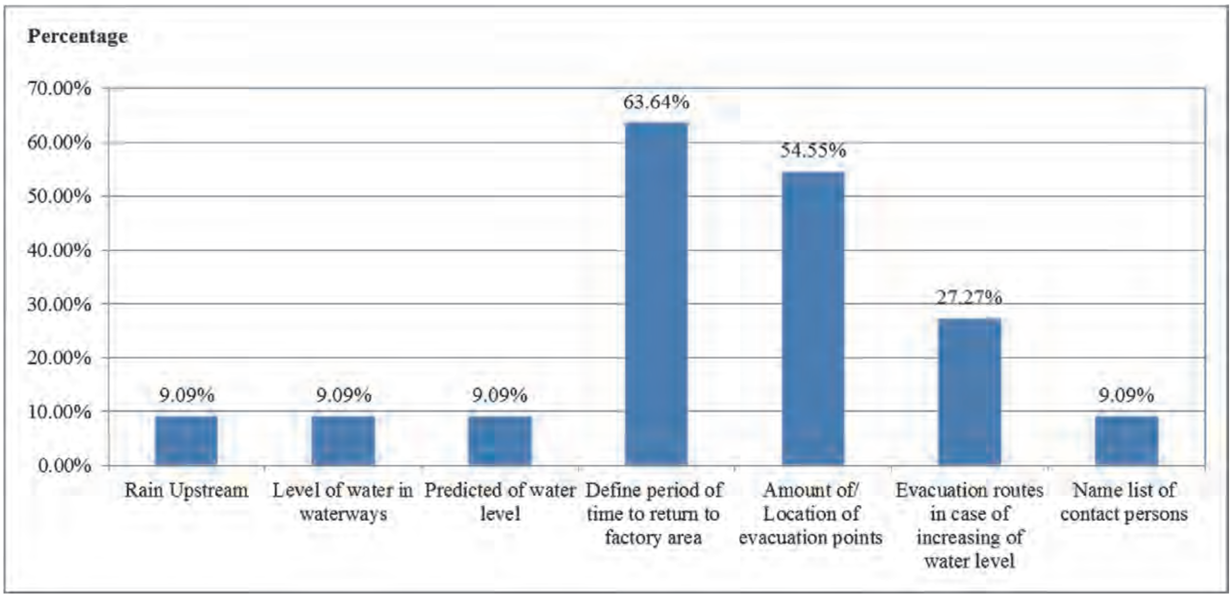


Figure 61 Factory Survey: Additional required information, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

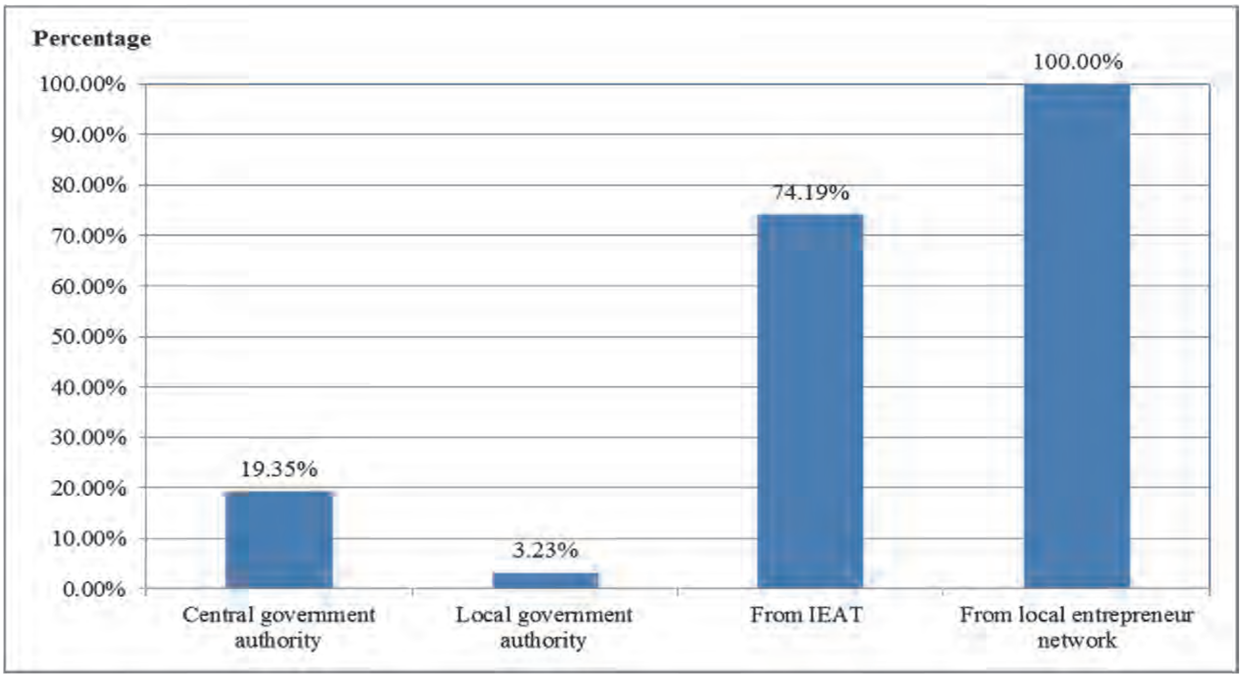


Figure 62 Factory Survey: Sources of inundation information and warning, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

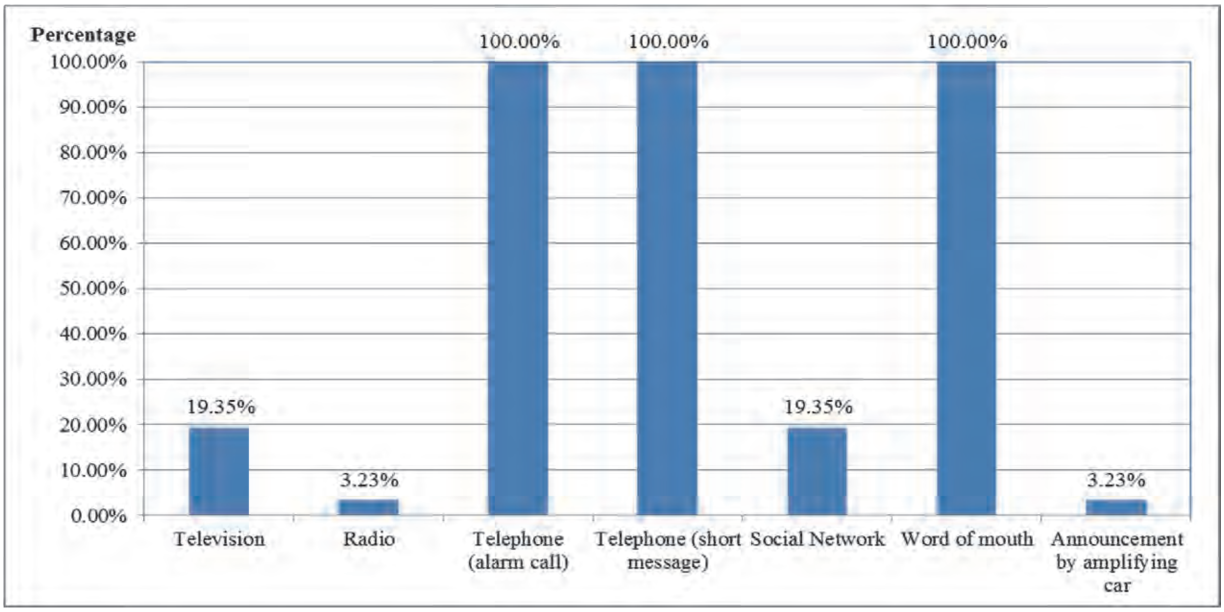


Figure 63 Factory Survey: Channel of inundation information and warning, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

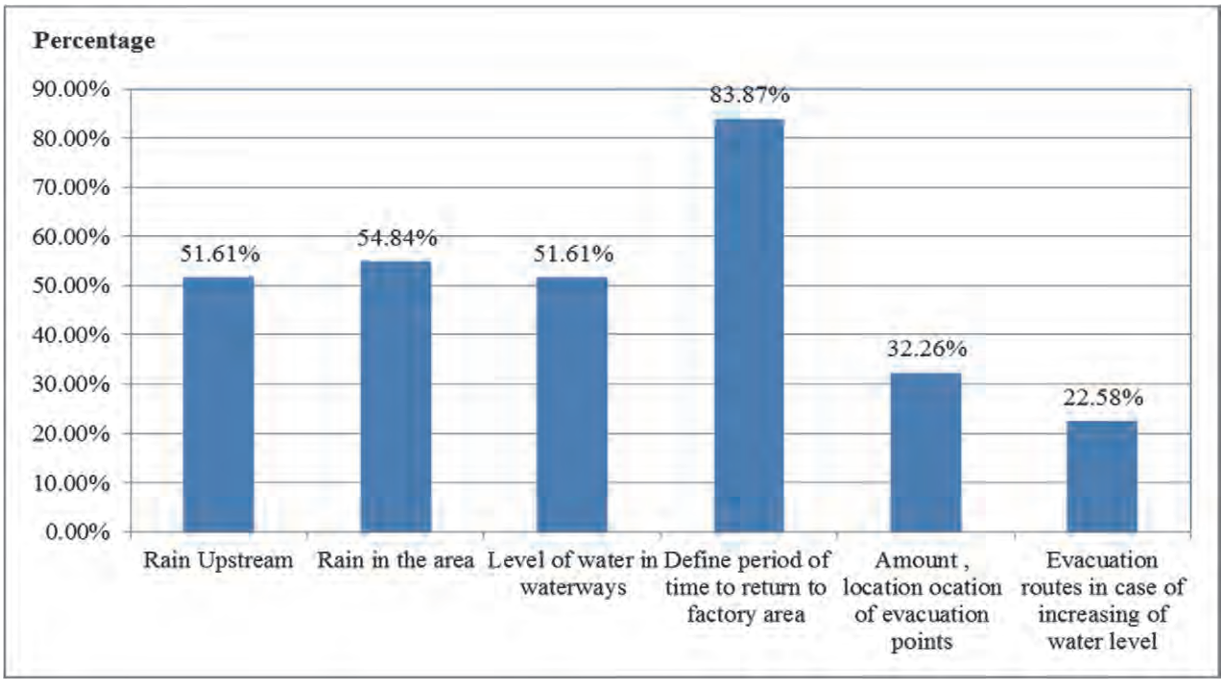


Figure 64 Factory Survey: Received inundation information, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

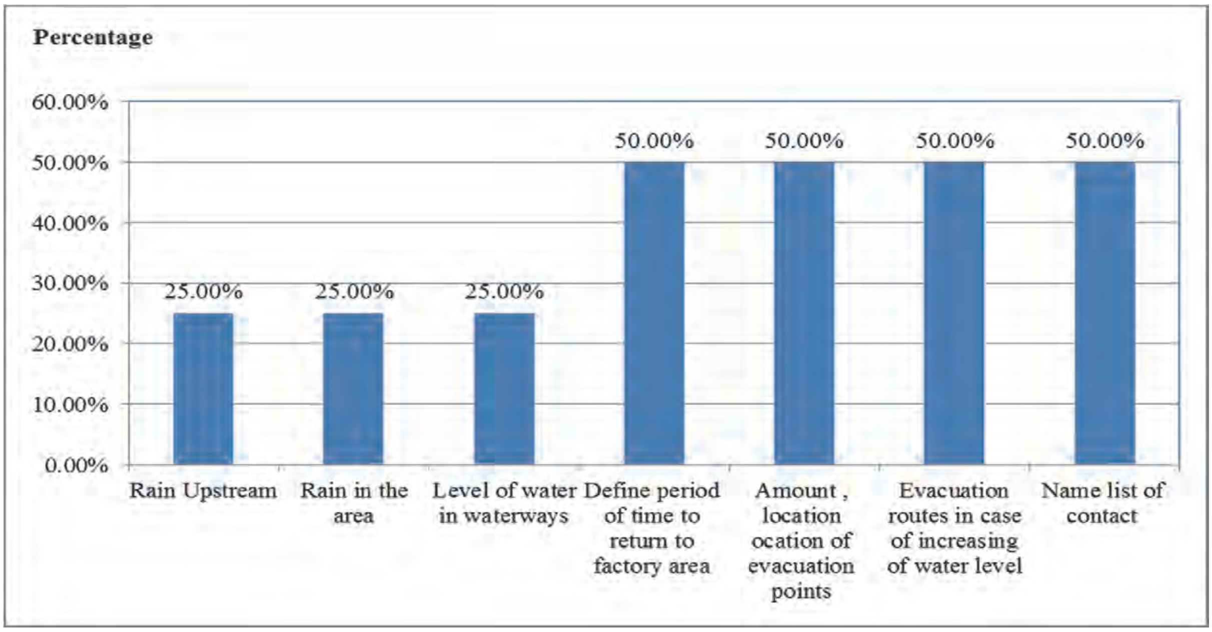


Figure 65 Factory Survey: Additional required information, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

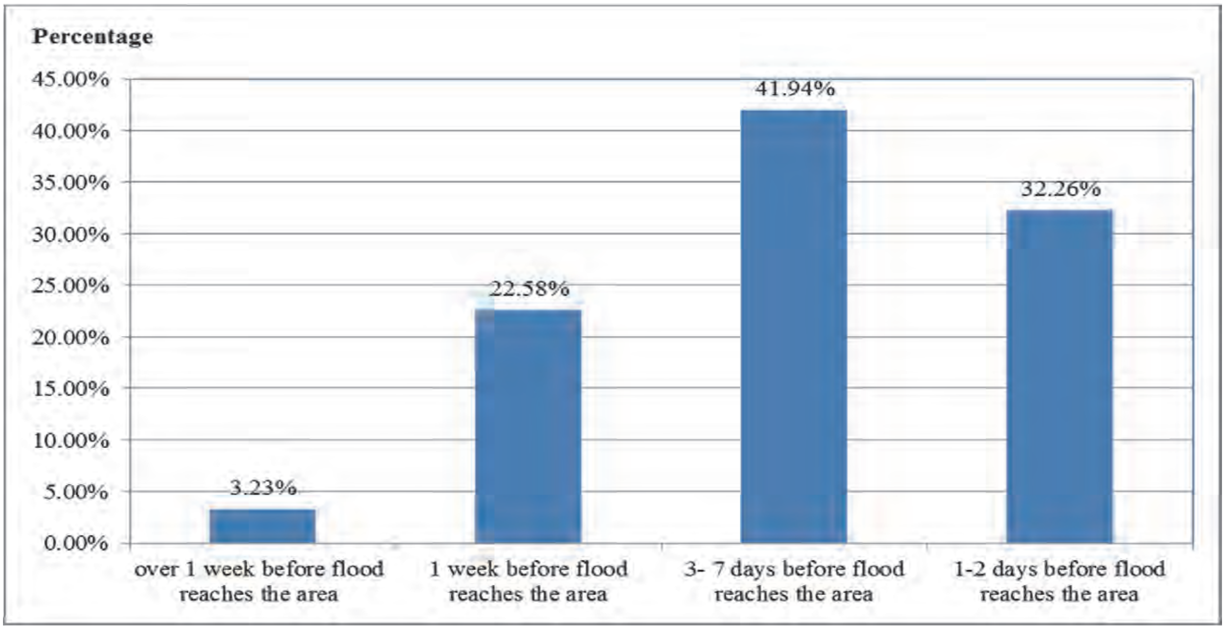


Figure 66 Factory Survey: Time period of receiving information and warning, during the flood reaching the area

**The total number of respondents from 7 industrial estates is 35, in which 33 factories received the warning*
***In this percentage consideration, considered the number of respondents who received the information as the total number*

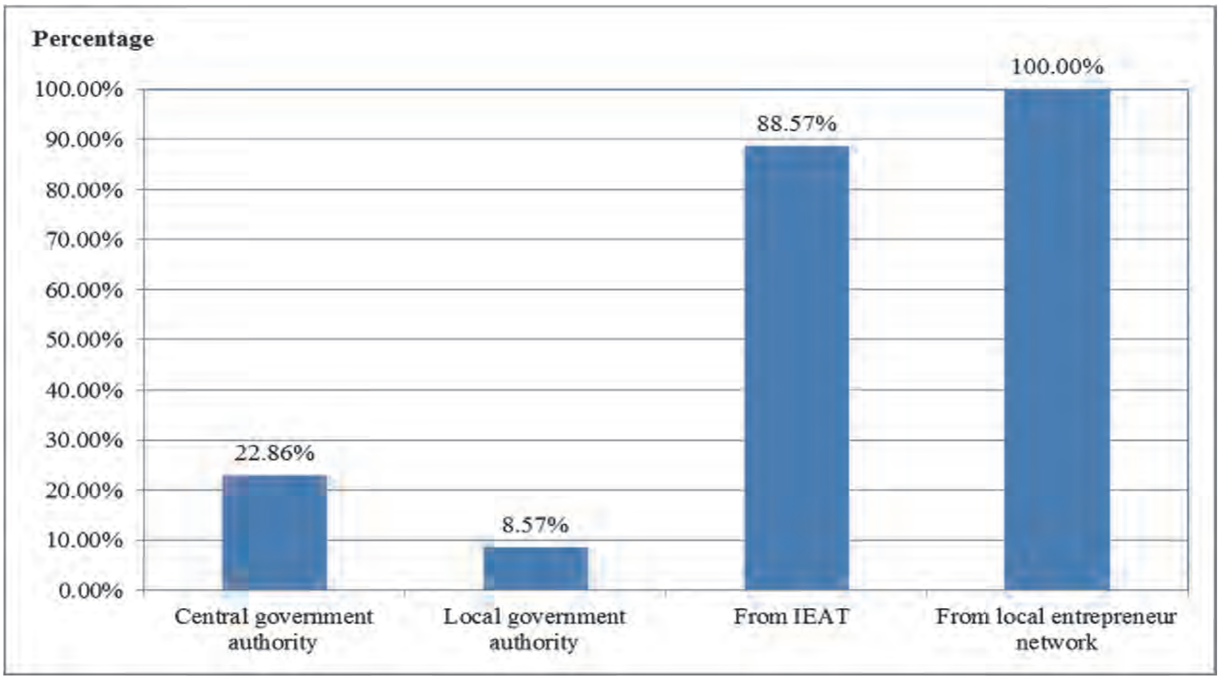


Figure 67 Factory Survey: Sources of inundation information and warning, during the recovery period

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the information, during the recovery period*

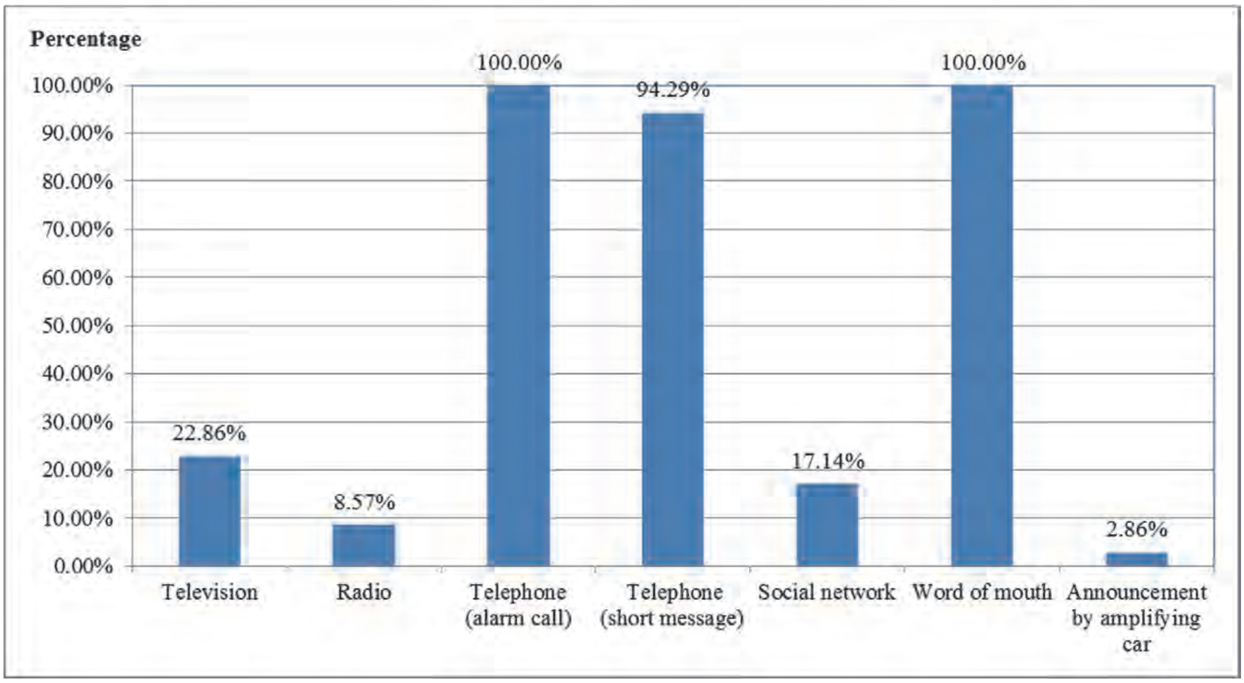


Figure 68 Factory Survey: Channel of inundation information and warning, during the recovery period

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the information, during the recovery period*

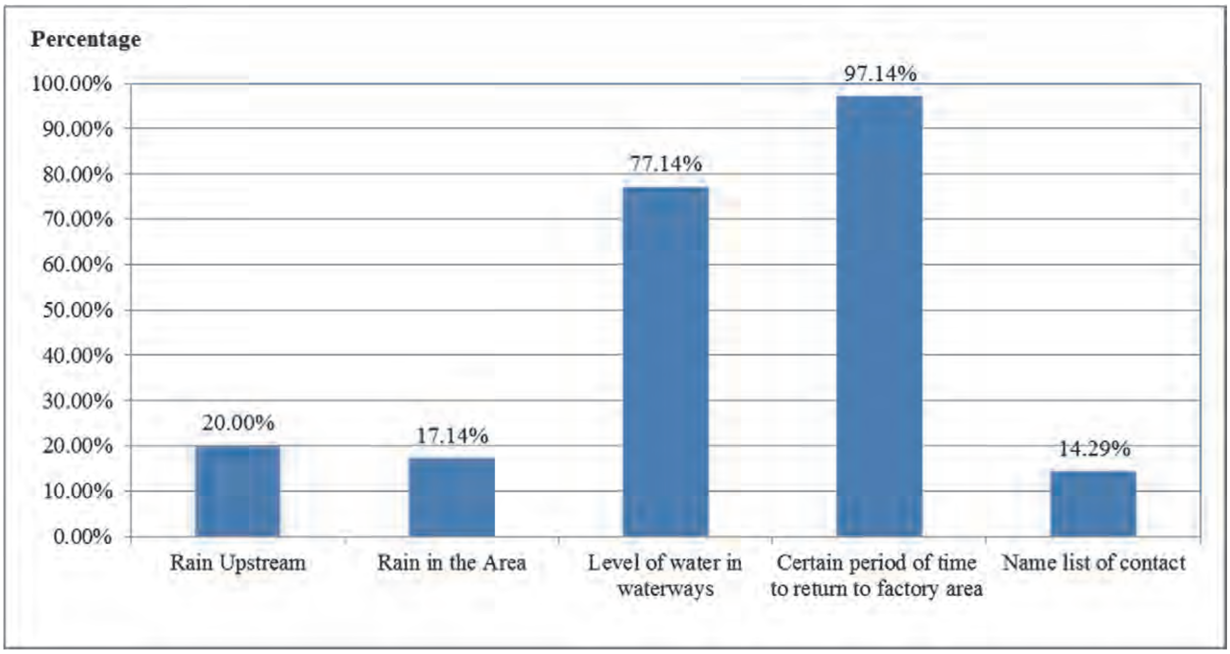


Figure 69 Factory Survey: Additional required information, during the recovery period

**The total number of respondents from 7 industrial estates is 35, in which all 35 factories received the information, during the recovery period*

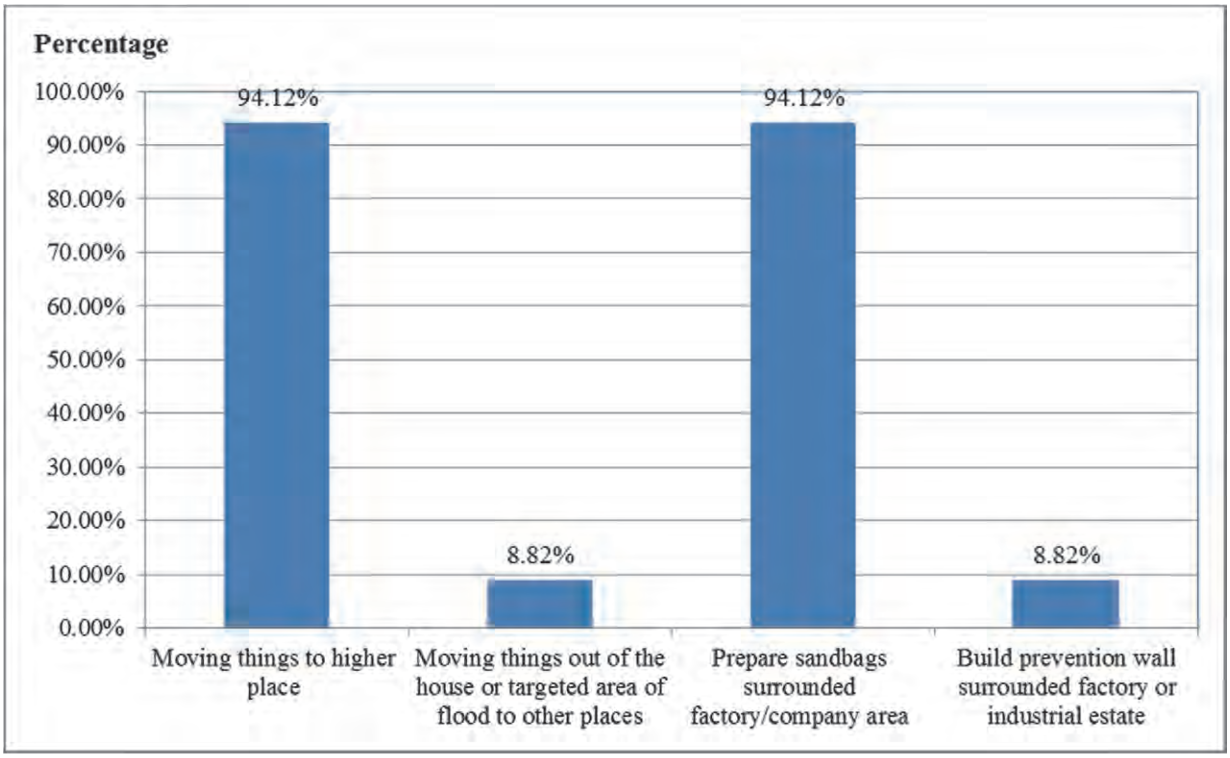


Figure 70 Factory Survey: Measures of preparing for 2011 flooding

**The total number of respondents from 7 industrial estates is 35, in which 34 factories prepared for 2011 flooding*
***In this percentage consideration, considered the number of respondents who prepared for the flood as the total number*

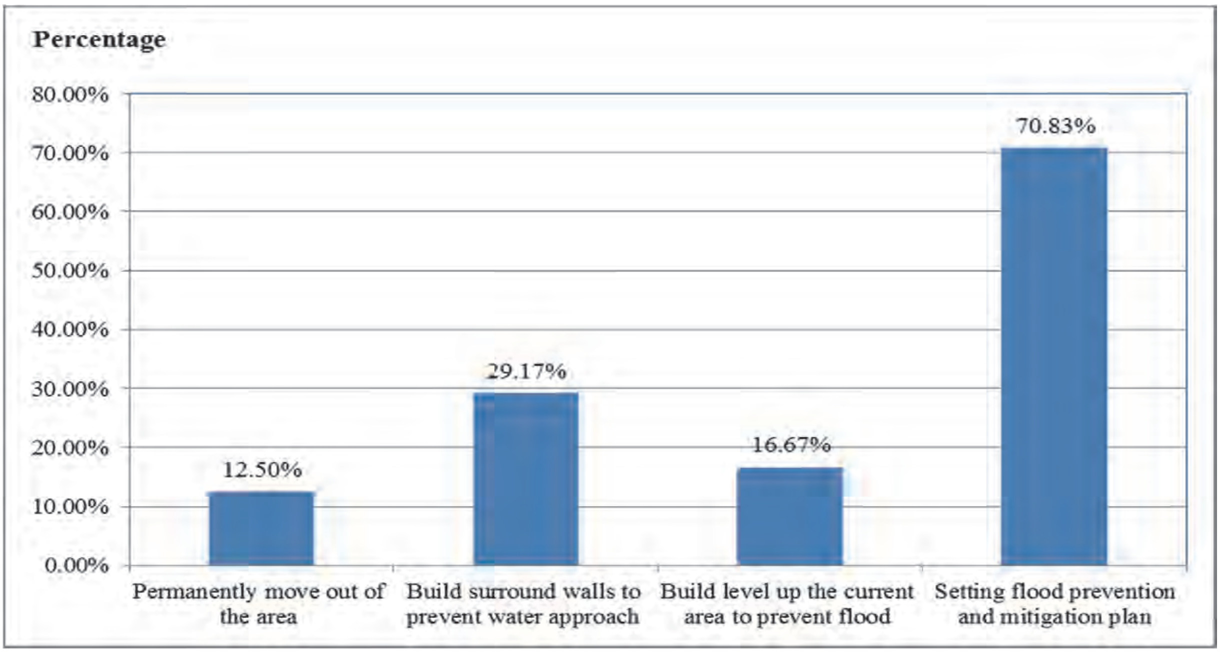


Figure 71 Factory Survey: Measures of preparing for future flooding

**The total number of respondents from 7 industrial estates is 35, in which 24 factories prepared for future flooding*
***In this percentage consideration, considered the number of respondents who prepared for the future flooding as the total number*

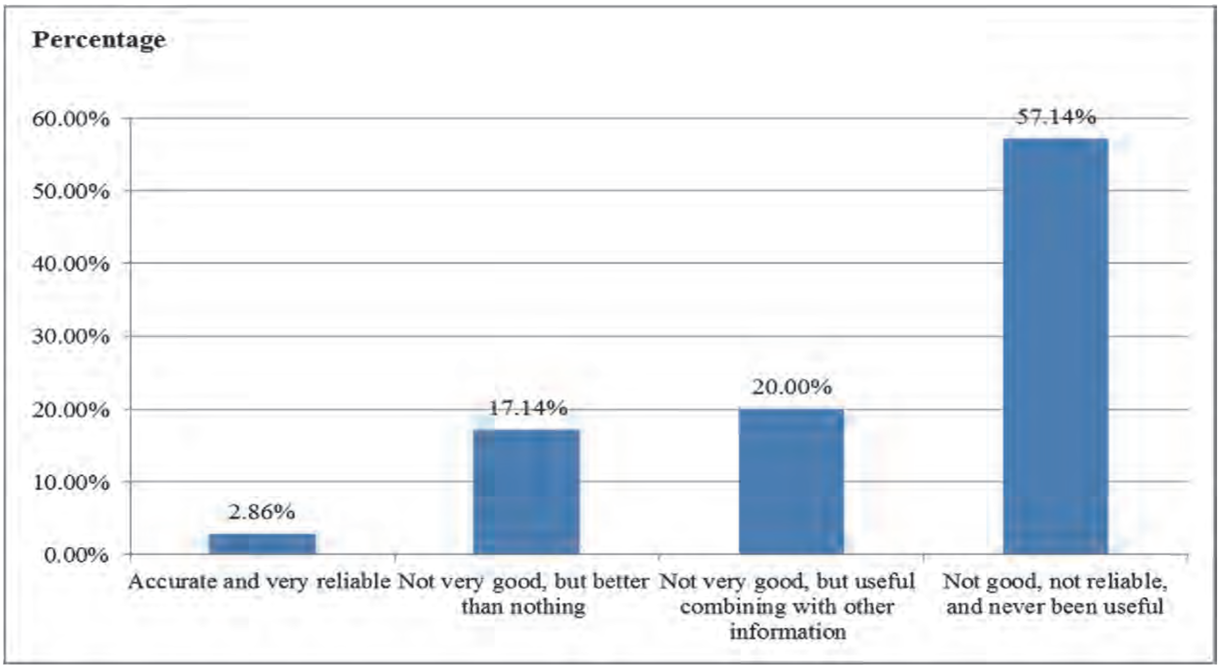


Figure 72 Factory Survey: How factory feel about the existing flood forecasting and warning system

** In this percentage calculation, considered all of 35 respondents, as the total number of respondents*

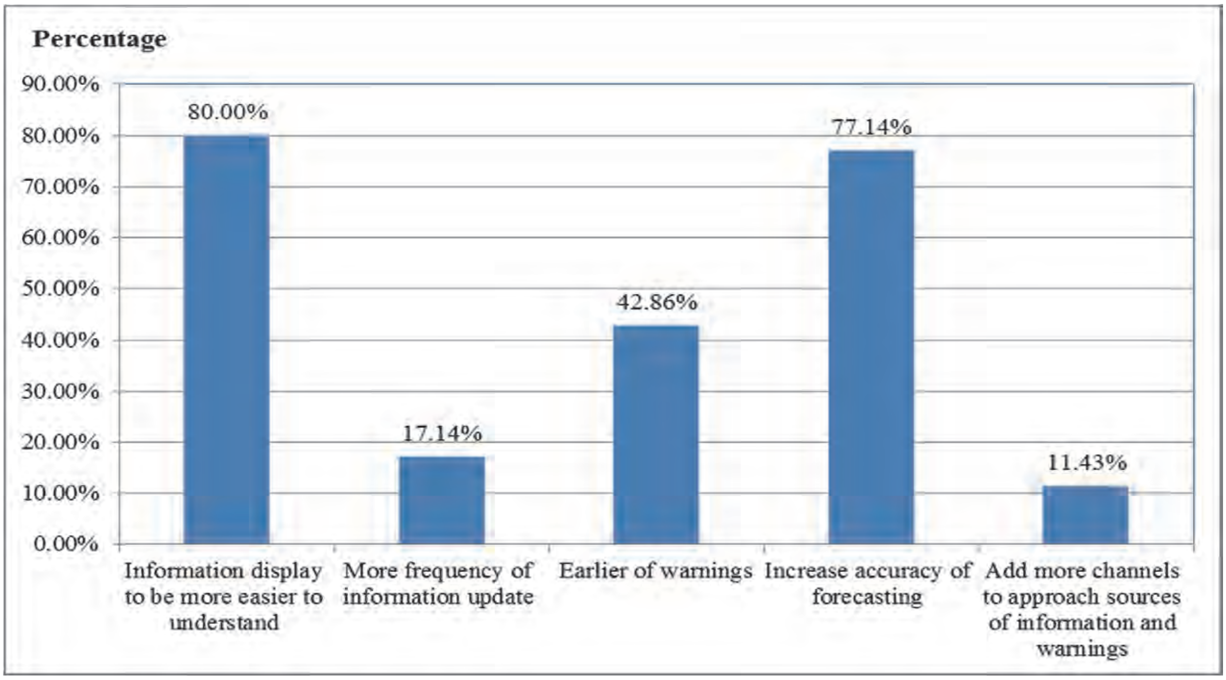


Figure 73 Factory Survey: Suggestions for flood existing forecasting and warning system improvement

* *In this percentage calculation, considered all of 35 respondents, as the total number of respondents*

5.4 Local Agency Interview

5.4.1 Questionnaire Result

In order to investigate the actual situation of 2011 flood warning and local agencies' action, 188 local agency officers from Subdistrict Administrative Organizations (SAO), and from Provincial Office Disaster Prevention and Mitigation (ODPM) have been interviewed based on the questionnaire with additional questions. The questionnaire results of local agency have been statically analyzed, as shown in *Appendix E.*

The numbers of respondents in Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri are 40, 36, 28, 42 and 42, respectively. Thus the total number is 188. The entire reviewed local agencies did not have a role in measuring data such as rainfall, water level, or weather condition. They just received the data from other authorities, and then 79.79% of them transferred to the people in the area and 55.85% of them transferred to the local operational units. It was found that the main sources of data are Royal Irrigation Department (RID), Department of Disaster Prevention and Mitigation (DDPM), and the district officer, as the result shown in *Figure 74-1* and *74-2*, in which the data that was daily transferred were the water level in waterways, the rainfall, and sometimes the weather data, as the result shown in *Figure 75-1* and *75-2.*

More than 80% of the respondents indicated that the received information was sufficient for processing of water level forecast and water level at the lowest reaches since the objectives of data processing were sending to the citizen and business sectors, as the result shown in *Figure 76-1*, *76-2,* in the form of narration and numerical data. It seems that most of the respondents satisfied on the data they processed and daily transferred; as 60% of them indicated the minimum deviation to 100% accuracy, *Figure 77-1, 77-2.* However, the error that sometimes occurred was mainly caused by the computer or tools error and human error, as indicated in *Figure 78-1, 78-2.*

In order to verify the role of the local organization to put on alarm before-during-after the flood, it was found that before the water reached their places, 33.51% of the local authority displayed and/or transferred the data as the normal condition, while 58.51% displayed and /or transferred more frequent than normal case, but no emergency alarm, as shown in *Figure 79-1, 79-2,* in the pattern of narration, numerical data and sending as short message via mobile phone. 61.17% of respondents displayed / transferred only the data received from other units and 38.30% displayed / transferred all existing data; both the data that measured and processed by themselves and the received data. The displayed / transferred information before the approaching of flood were water level in rivers, canals, in the monitoring spots in the responsible areas, rain upstream and rain within the area, as shown in *Figure 80-1, 80-2.* During the period before the flood reached, only 24.47% of the respondents gave the information for evacuation and assistance during the flood such as evacuation routes and evacuation camp.

During the flood period, 38.30% of the local authority displayed and/or transferred the information, including the evacuation information, more frequent than normal case, while 35.64% displayed and/or transferred the information more frequent than normal case, but no special warning and 26% displayed the information as normal case, as shown in *Figure 81-1, 81-2,* in the pattern of narration, numerical data and sending as short message via mobile phone.

More than 58% of the respondents displayed / transferred all existing data, which are the data measured by themselves and the received data, 36.71% displayed / transferred the data got from other agencies and 3.19% displayed / transferred only data measured and processed within the unit. The displayed / transferred information during the approaching of flood were water level in rivers, canals, in the monitoring spots in the responsible areas, rain upstream and information for evacuation and assistance such as evacuation routes and name list of contact agencies for assistance, as shown in *Figure 82-1, 82-2.* Most of the evacuation information was the verbal information sending word to mouth and by making a call.

During the recovery period, the information display and transfer was back to normal condition, as the result shown in *Figure 83-1, 83-2*. More than 96% of the respondents indicated that they received the information for evacuation and assistance after the flood, including the information of water level**,** the rain upstream and within the area, etc., as shown in *Figure 84-1, 84-2.*

In the survey of local agency's satisfaction towards their roles in forecasting and flood warning in 2011, 40.96% of the respondents satisfied on their roles, while 54.26% moderately satisfied since they indicated the error information that caused the delay preparation. In addition, they expect more accurate information and system, as well.
Finally, the respondents indicated the problem or obstacle in forecasting and flood warning in 2011 as the result shown in *Figure 85-1, 85-2.* The main problems were the un-readiness / insufficient of tools, and un-readiness / insufficient of personnel.

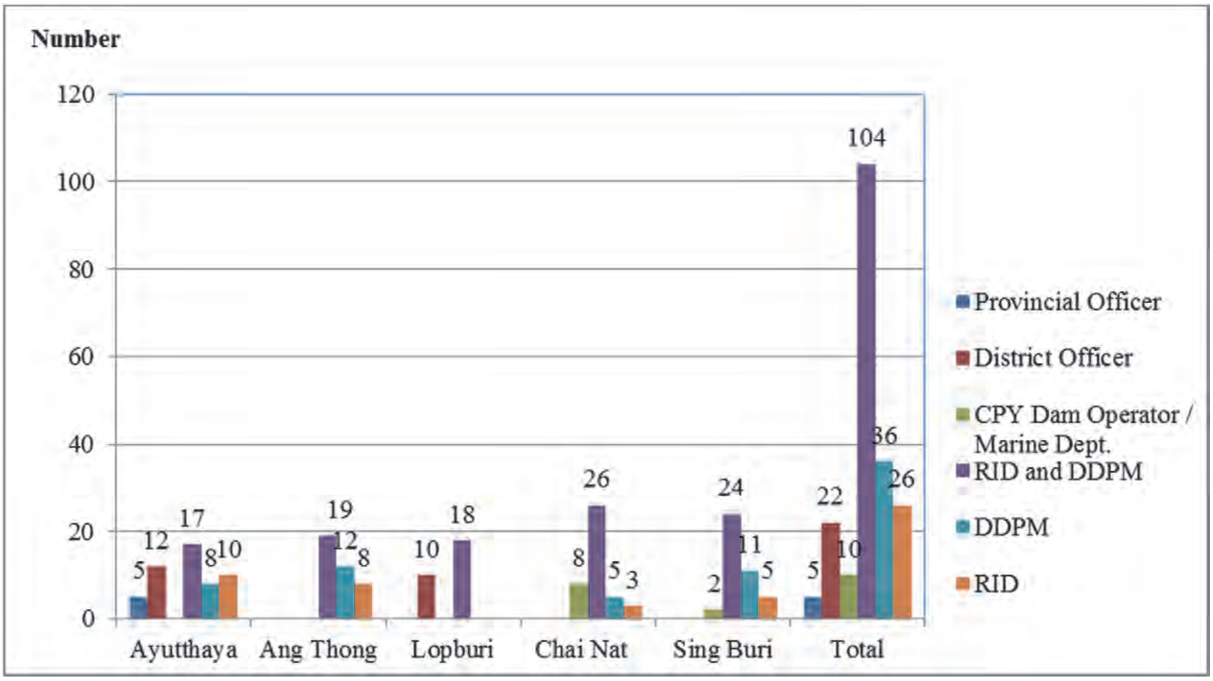


Figure 74-1 Local Agency Survey: Number of respondents per sources of inundation information and warning

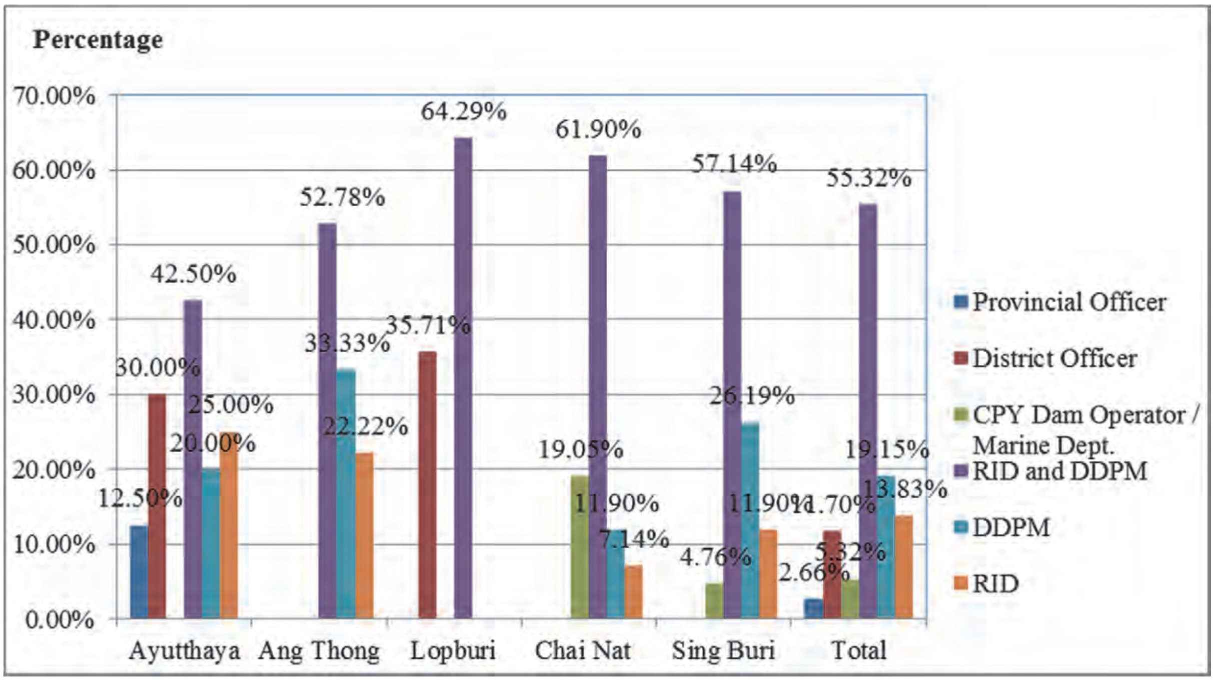


Figure 74-2 Local Agency Survey: Percentage of respondents per sources of inundation information and warning

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

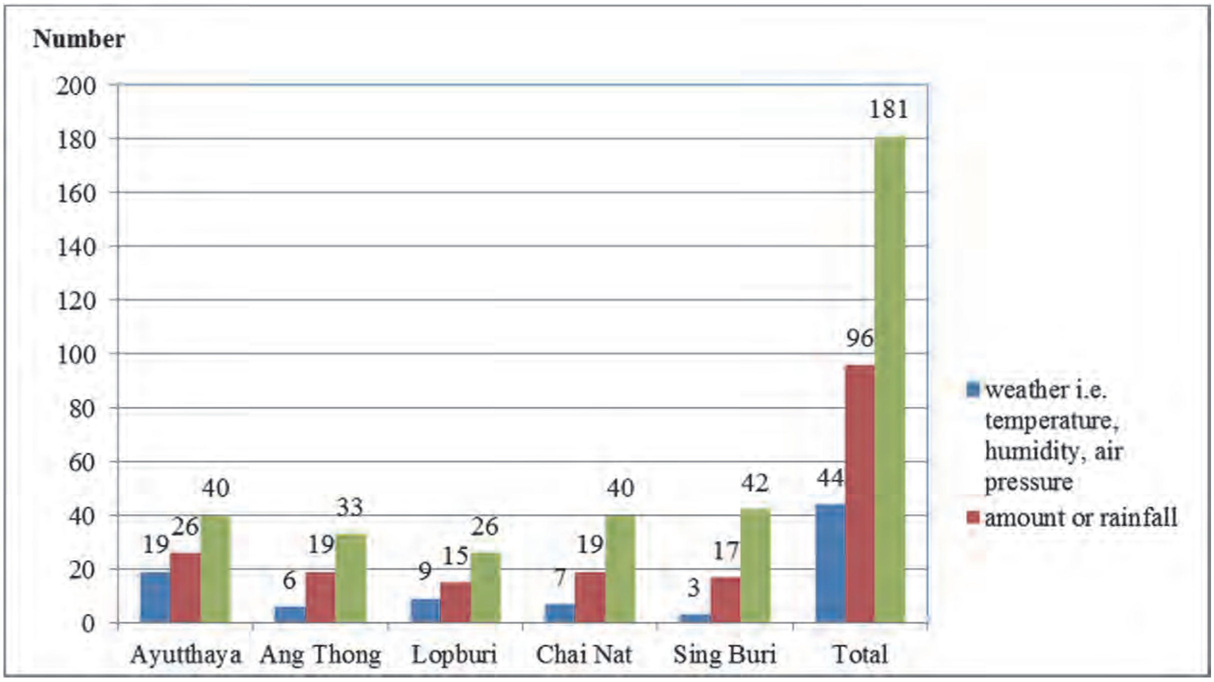


Figure 75-1 Local Agency Survey: <u>Number of respondents</u> per received information

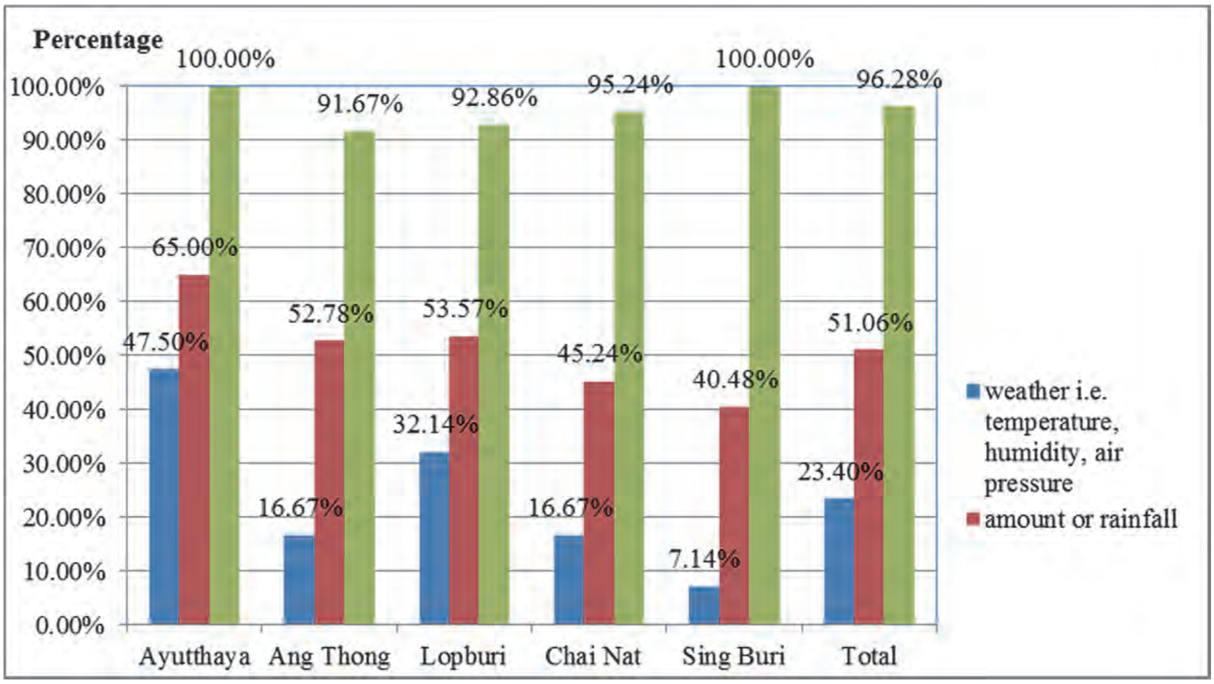


Figure 75-2 Local Agency Survey: <u>Percentage of respondents</u> per received information

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

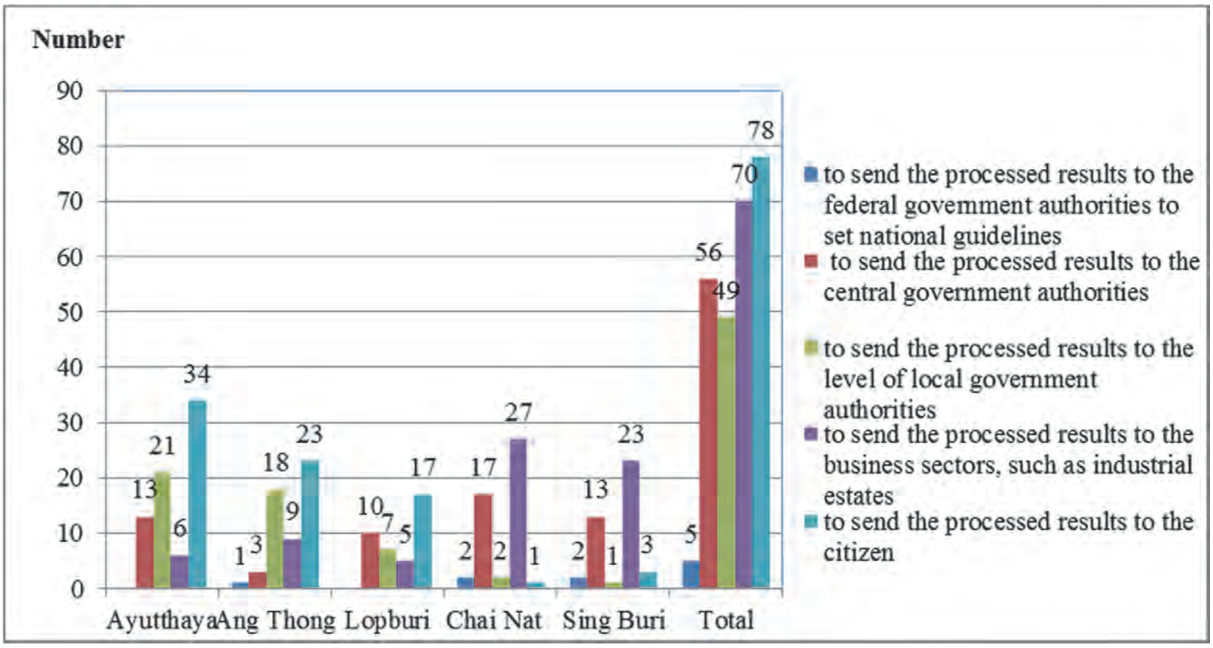


Figure 76-1 Local Agency Survey: <u>Number of respondents</u> per the roles of the Authority in flood forecasting and warning in 2011

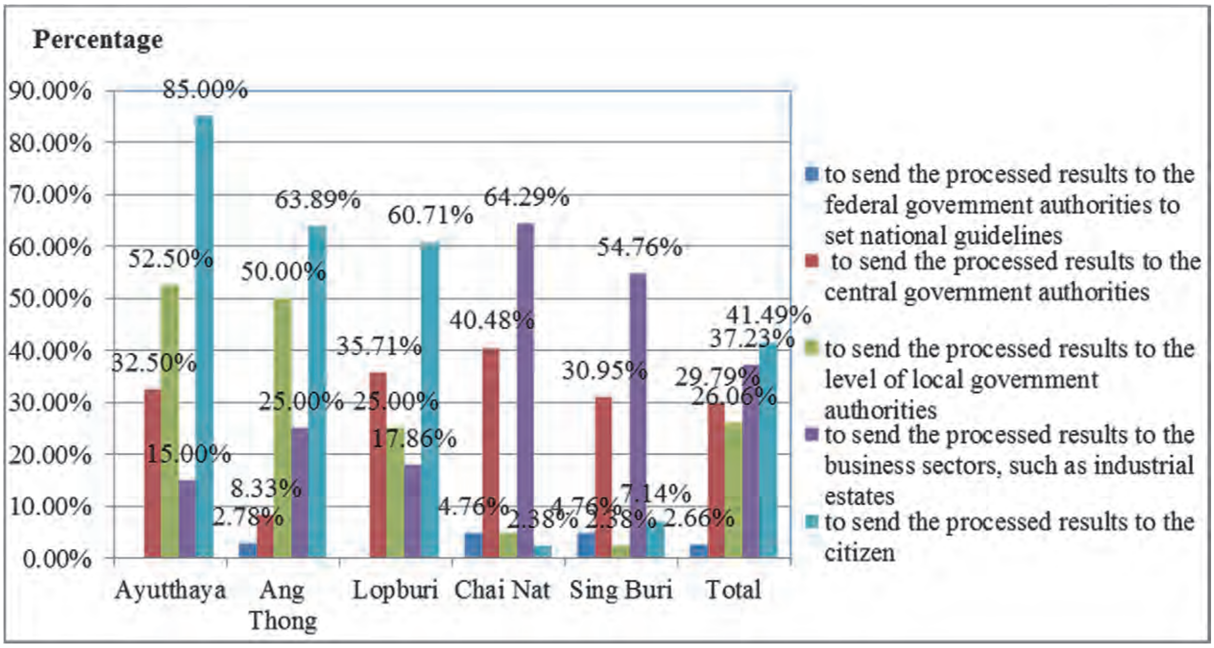


Figure 76-2 Local Agency Survey: <u>Percentage of respondents</u> per the roles of the Authority in flood forecasting and warning in 2011

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

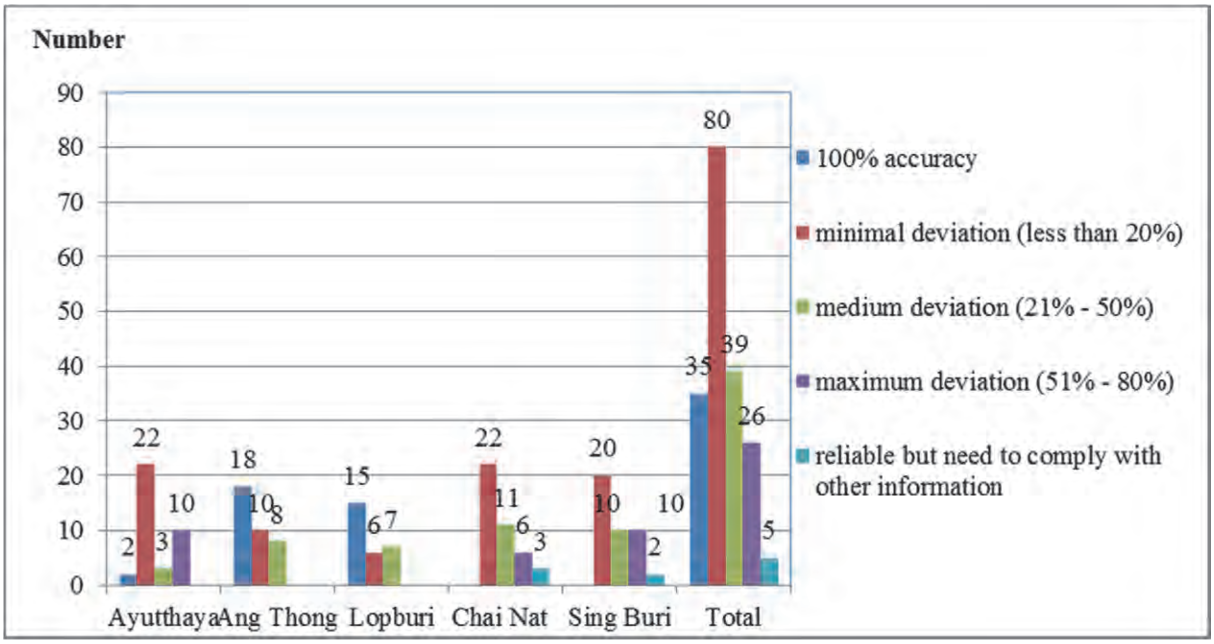


Figure 77-1 Local Agency Survey: Number of respondents per accuracy of the data processing

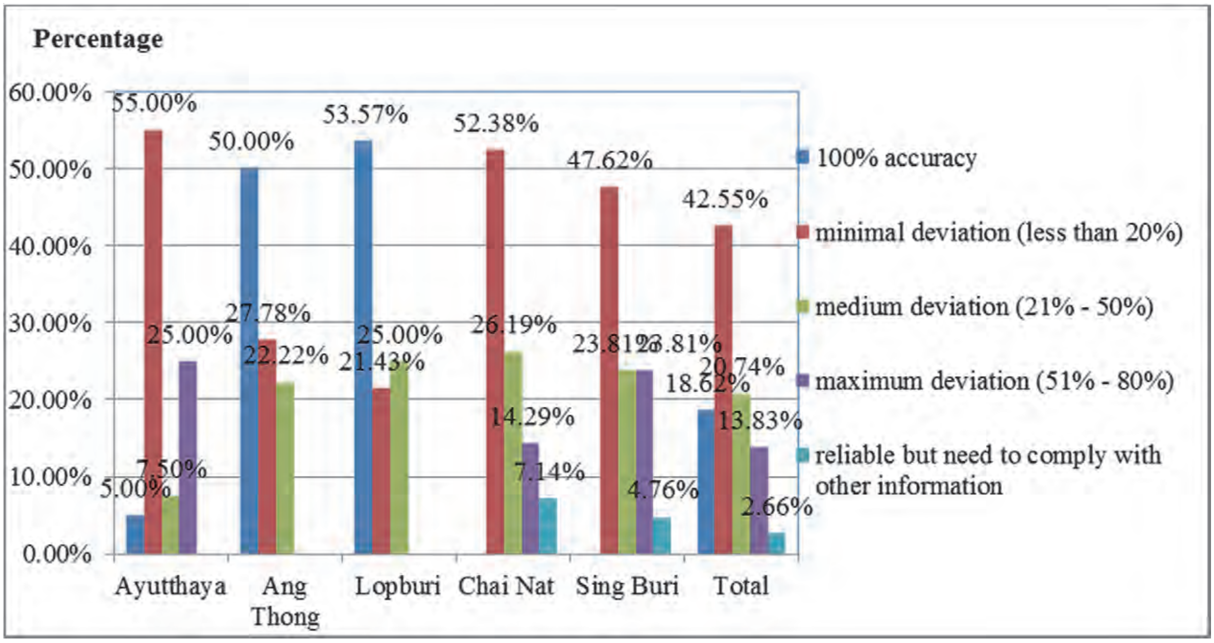


Figure 77-2 Local Agency Survey: Percentage of respondents per accuracy of the data processing

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

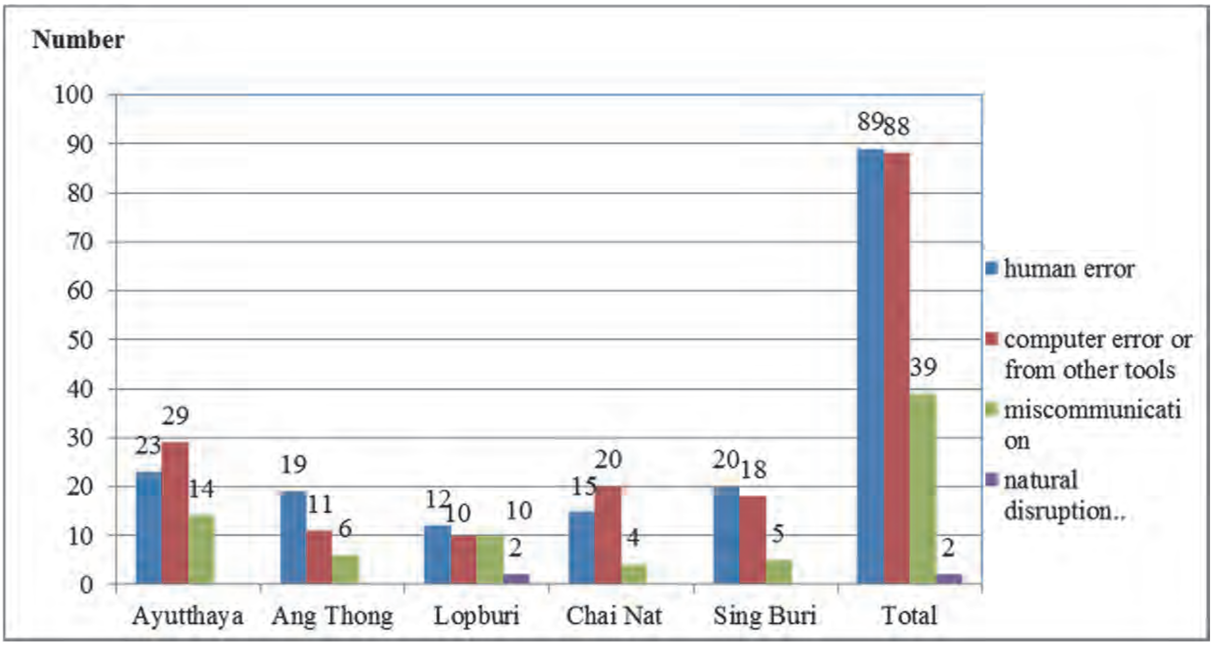


Figure 78-1 Local Agency Survey: Number of respondents per causes of error of information transferring and warning issuance

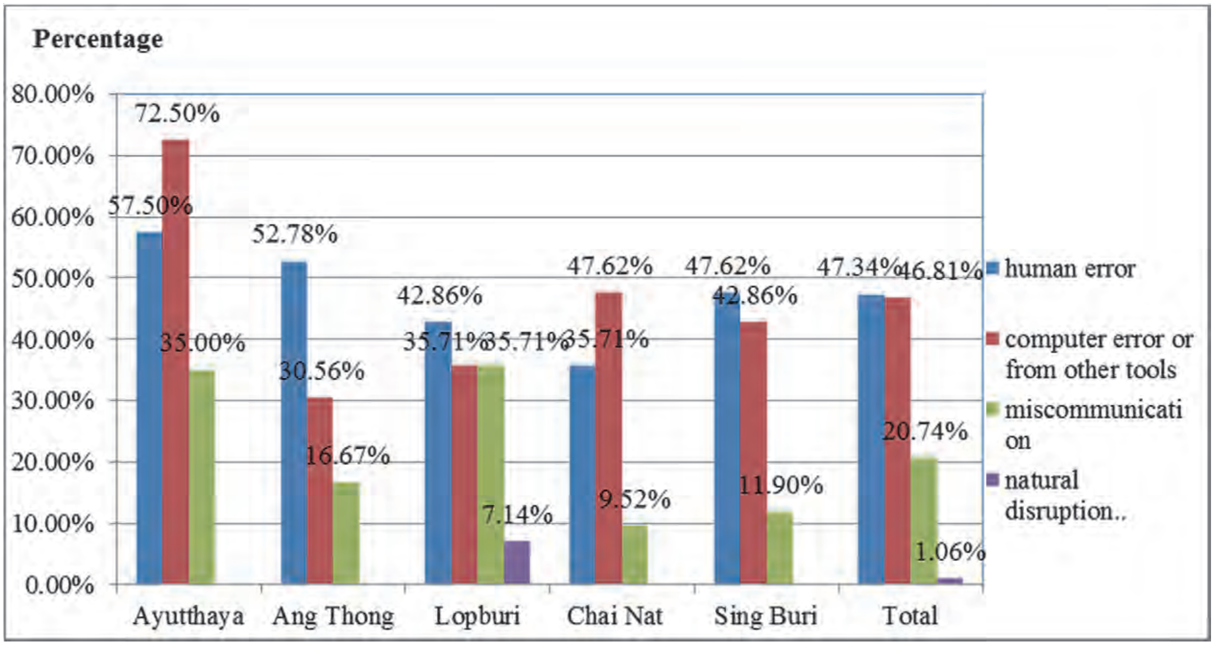


Figure 78-2 Local Agency Survey: Percentage of respondents per causes of error of information transferring and warning issuance

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

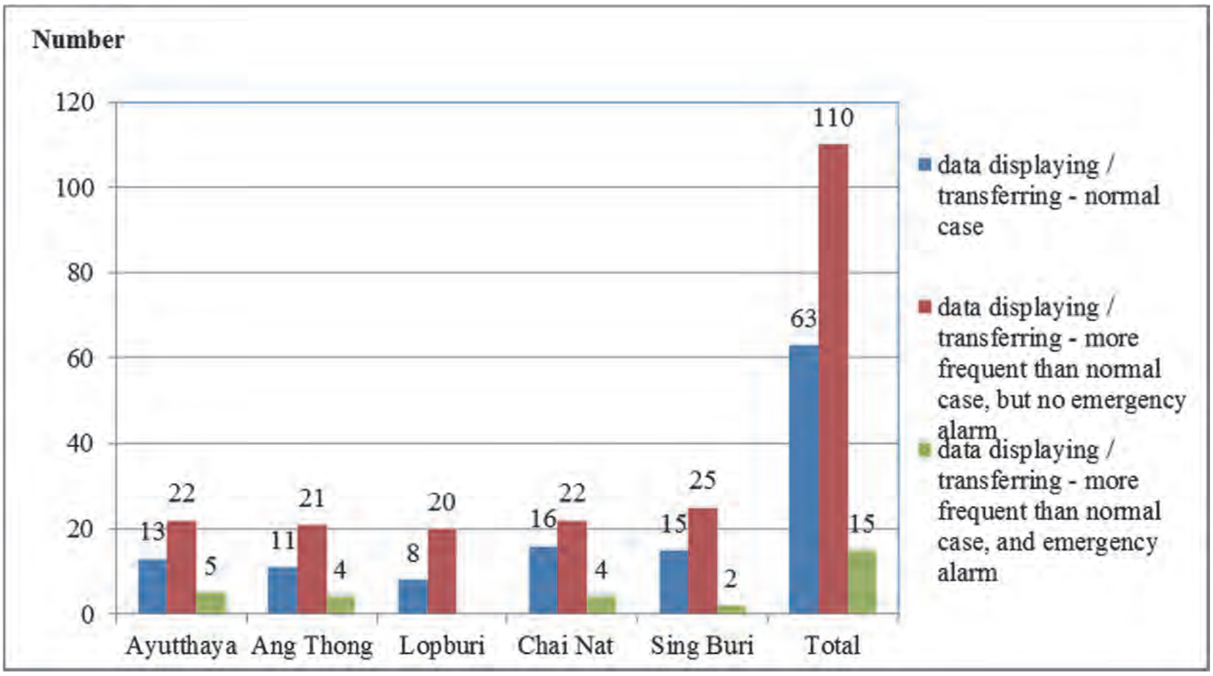


Figure 79-1 Local Agency Survey: Number of respondents per the roles of the organization to display/ transfer the information, before the water reaches the areas

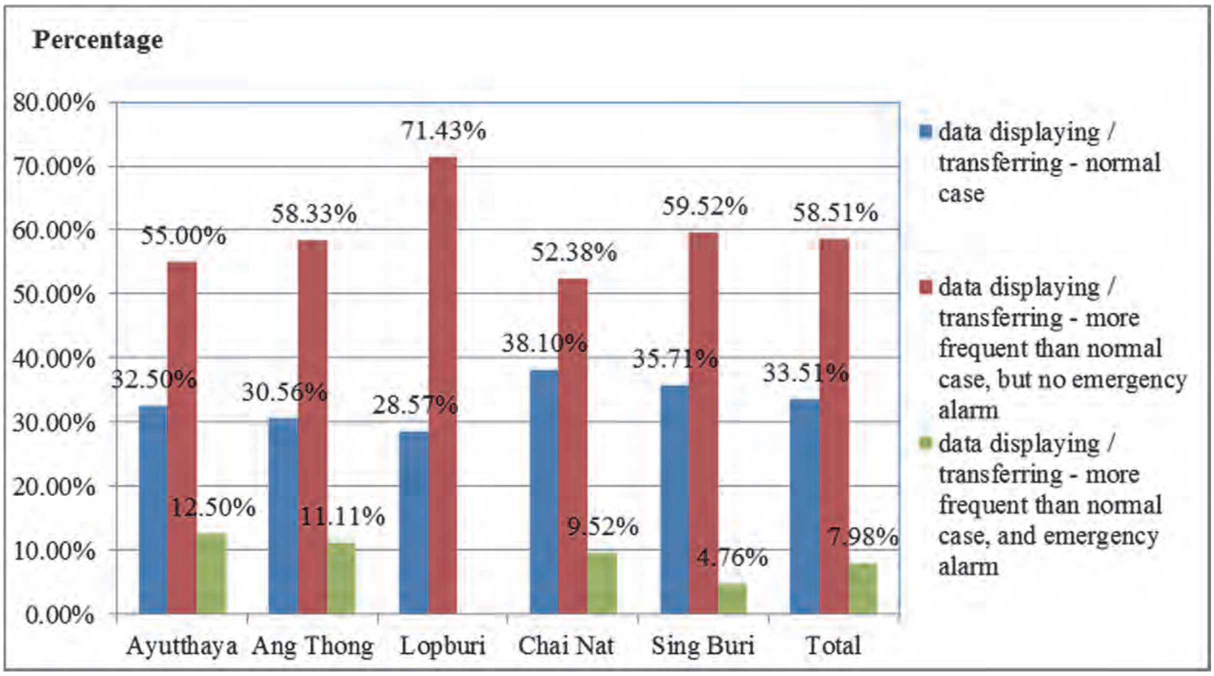


Figure 79-2 Local Agency Survey: Percentage of respondents per the roles of the organization to display/ transfer the information, before the water reaches the areas

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

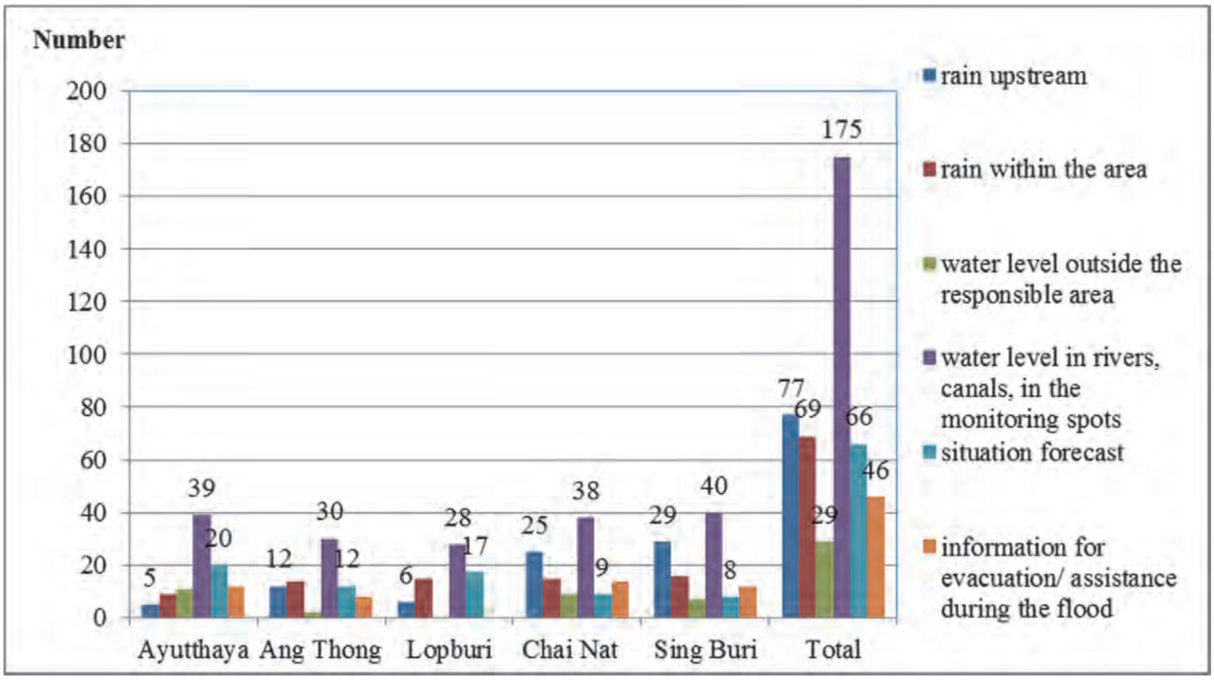


Figure 80-1 Local Agency Survey: Number of respondents per displayed/transferred information, before the water reached the area

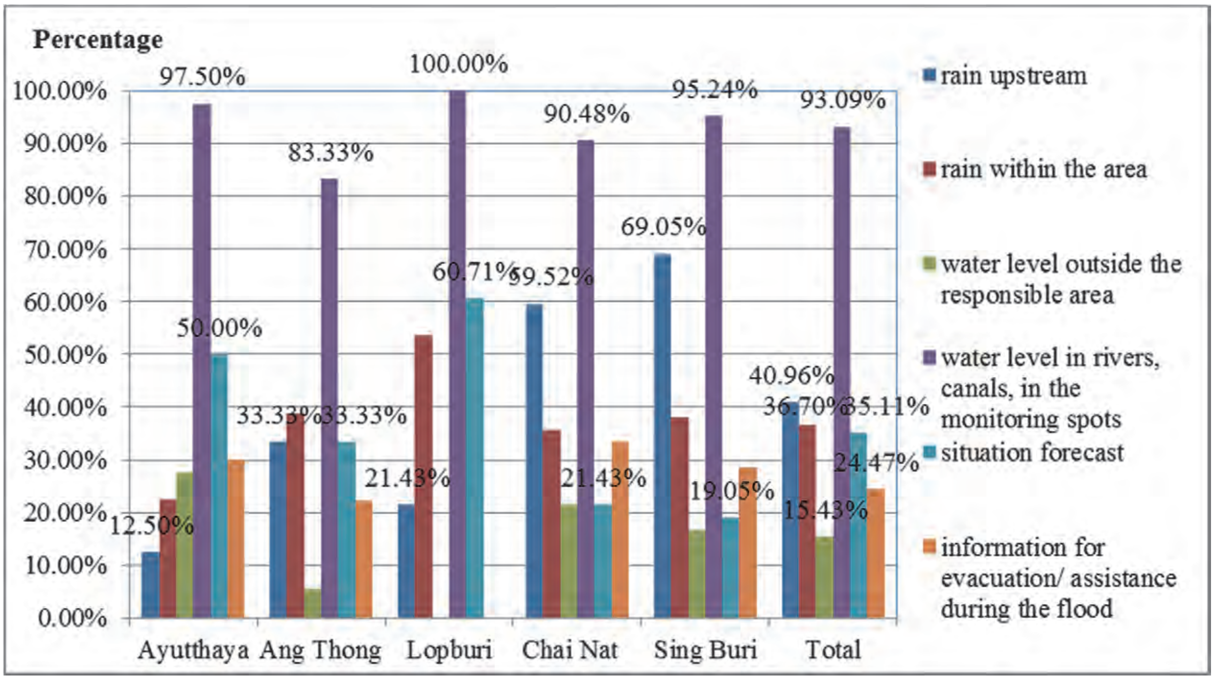


Figure 80-2 Local Agency Survey: Percentage of respondents per displayed/transferred information, before the water reached the area

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

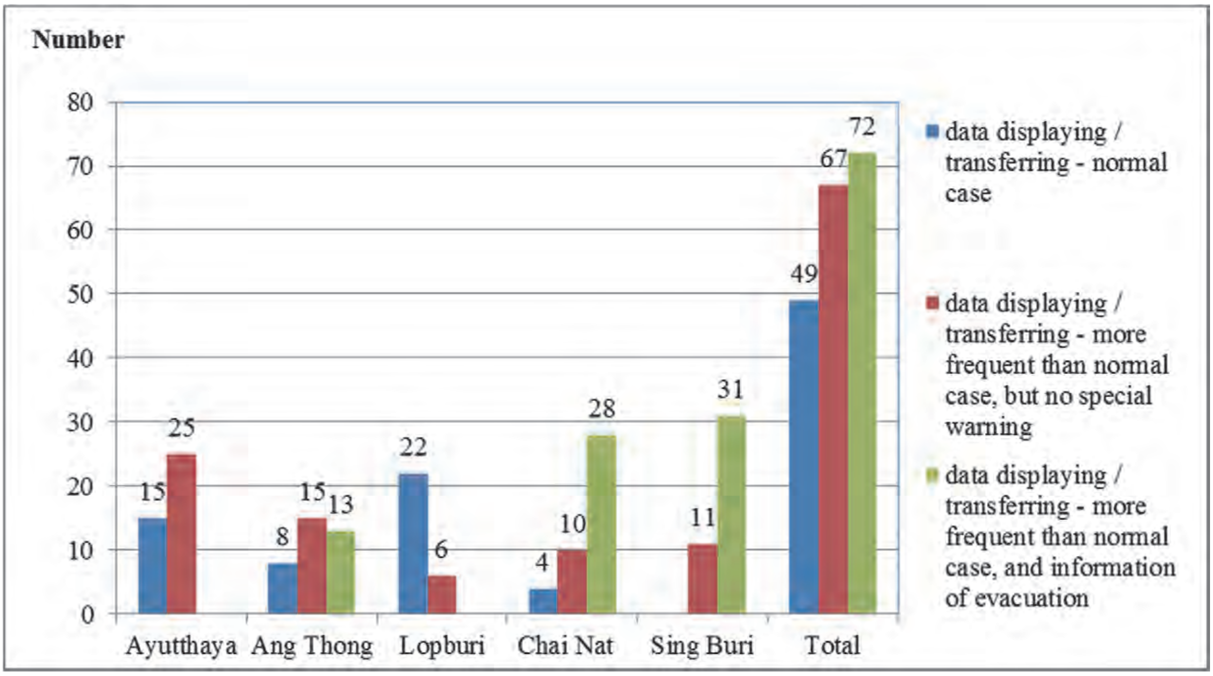


Figure 81-1 Local Agency Survey: Number of respondents per the roles of the organization to display/ transfer the information, during the water reaching the areas

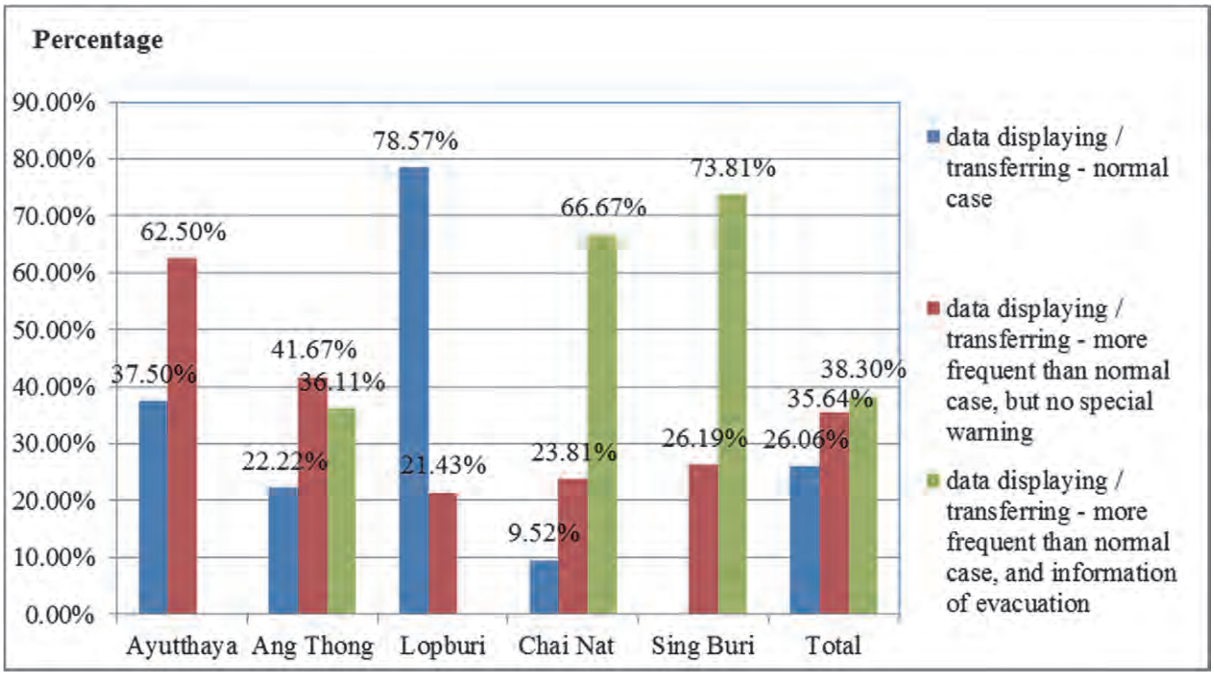


Figure 81-2 Local Agency Survey: Percentage of respondents per the roles of the organization to display/ transfer the information, during the water reaching the areas

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

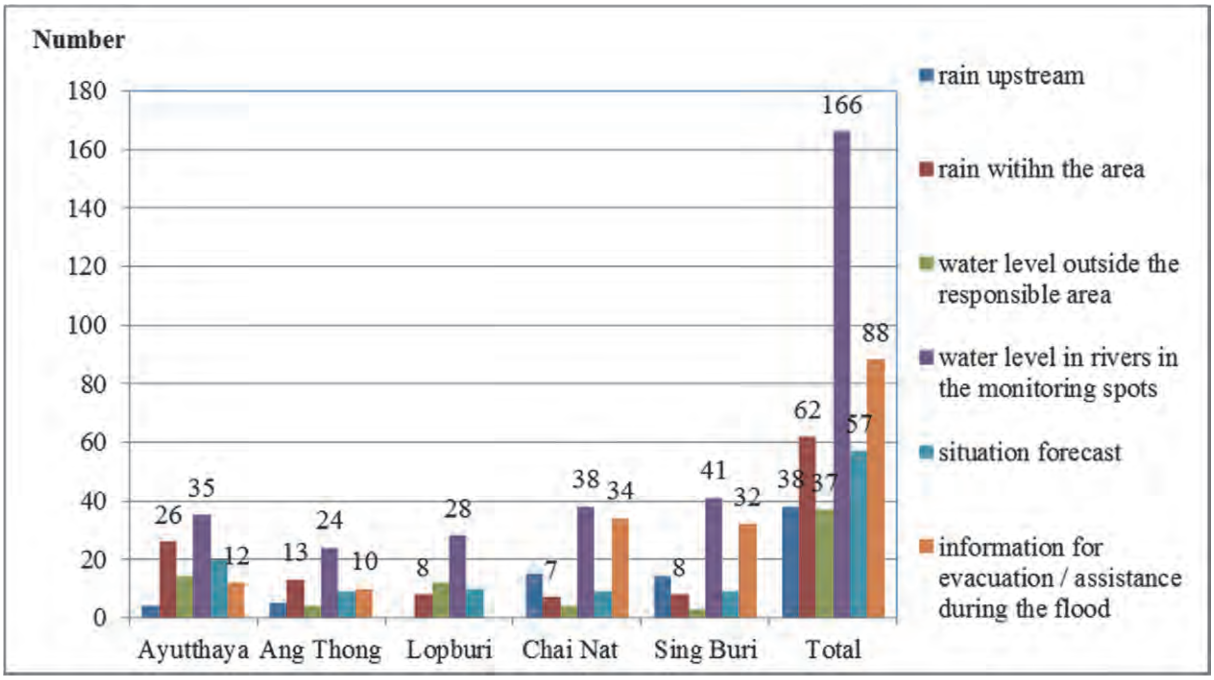


Figure 82-1 Local Agency Survey: Number of respondents per displayed/transferred information, during the water reaching the areas

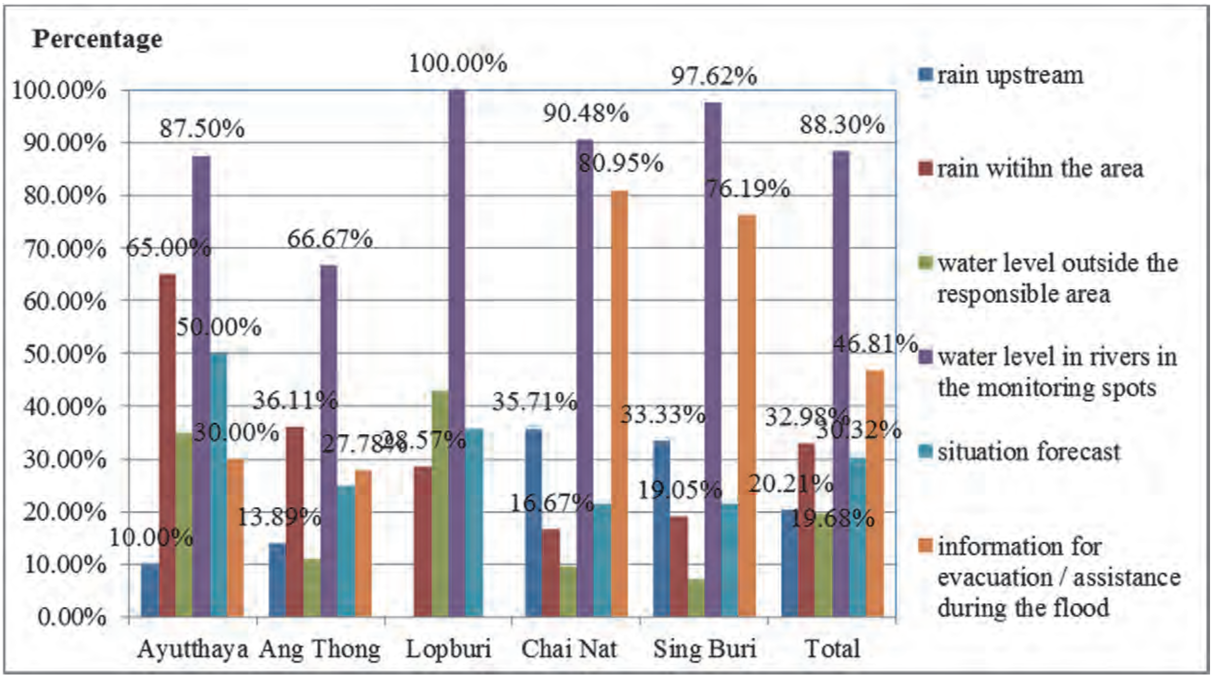


Figure 82-2 Local Agency Survey: Percentage of respondents per displayed/transferred information, during the water reaching the areas

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

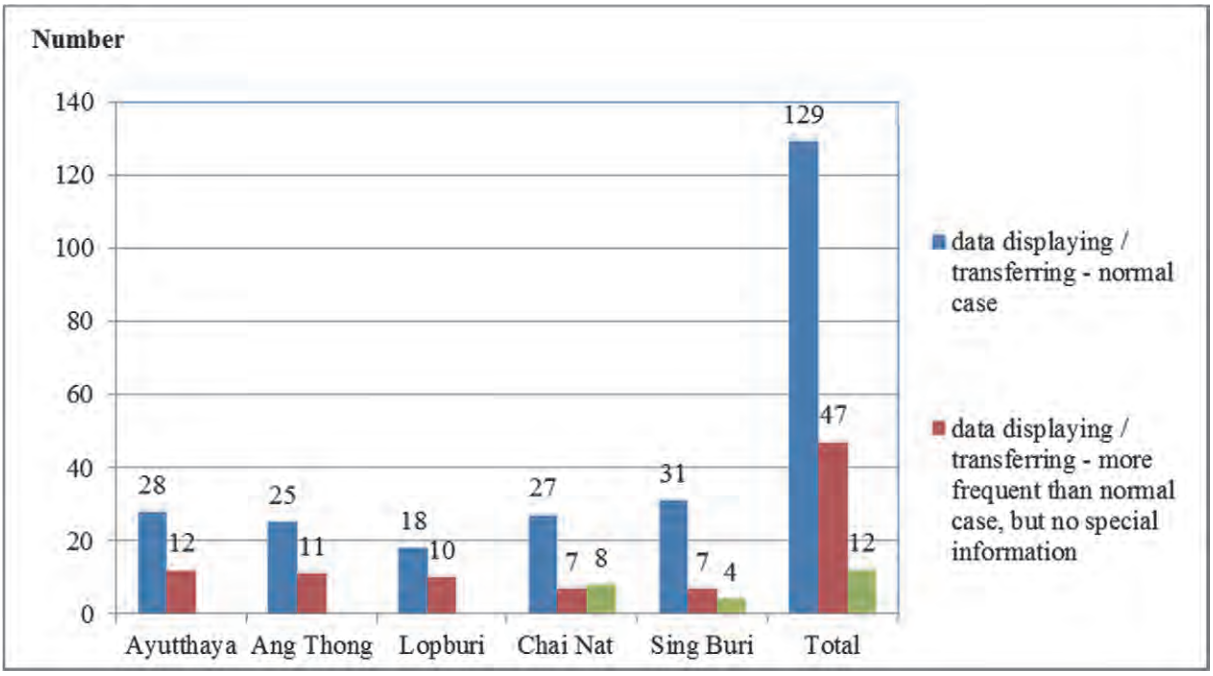


Figure 83-1 Local Agency Survey: Number of respondents per the role of the organization to display/ transfer the information, during the recovery period

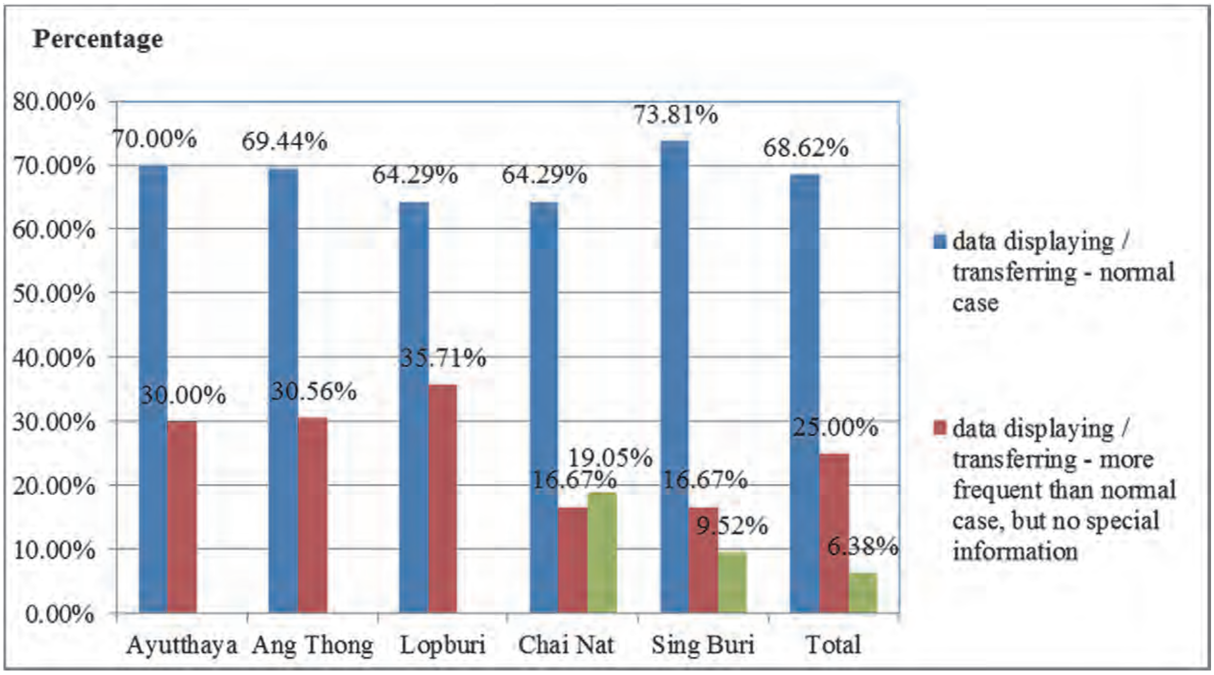


Figure 83-2 Local Agency Survey: Percentage of respondents per the role of the organization to display/ transfer the information, during the recovery period

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

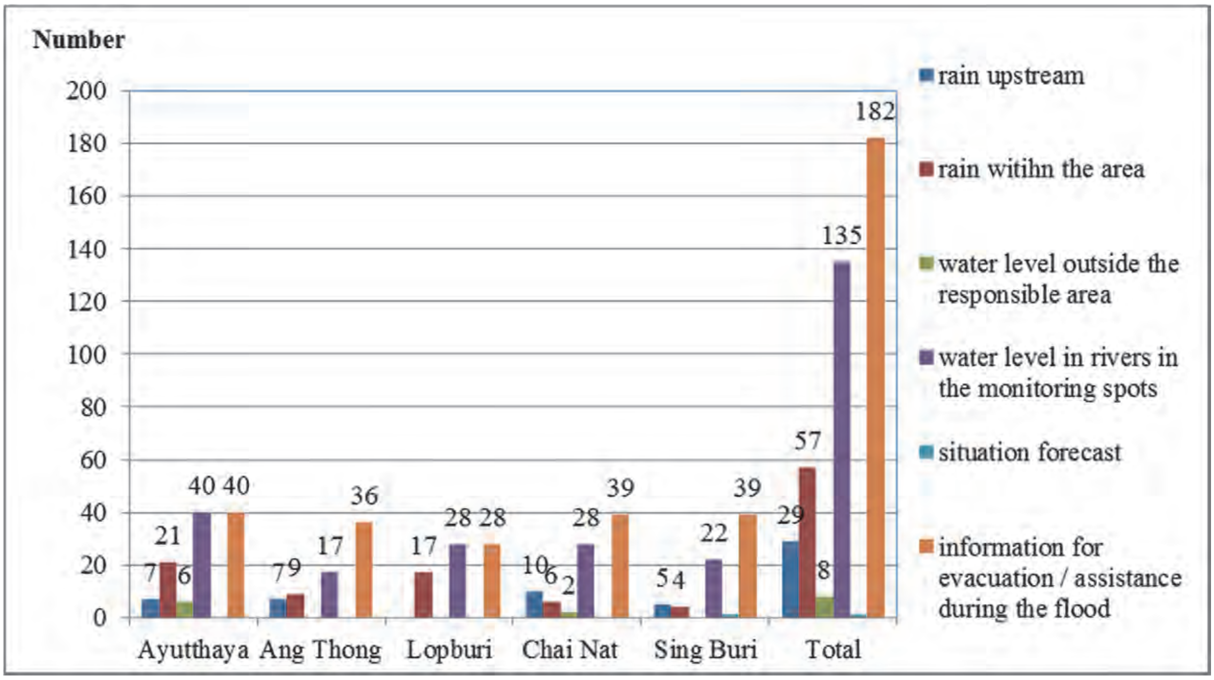


Figure 84-1 Local Agency Survey: Number of respondents per displayed/transferred information, during the recovery period

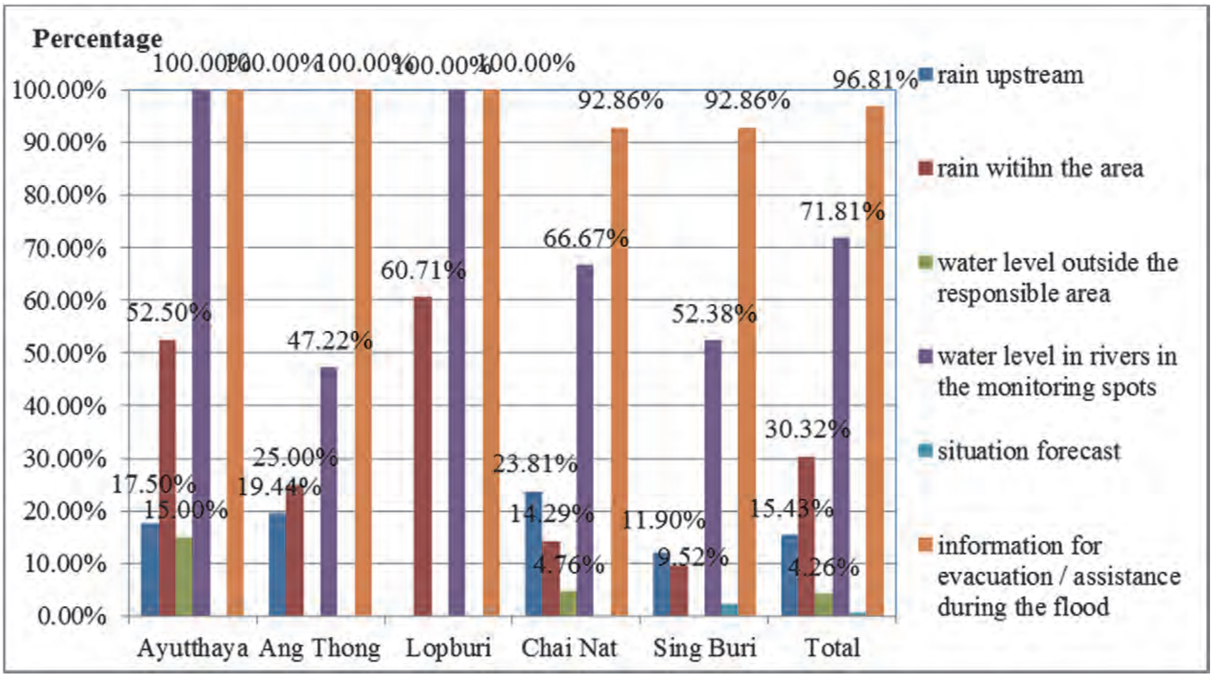


Figure 84-2 Local Agency Survey: Percentage of respondents per displayed/transferred information, during the recovery period

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

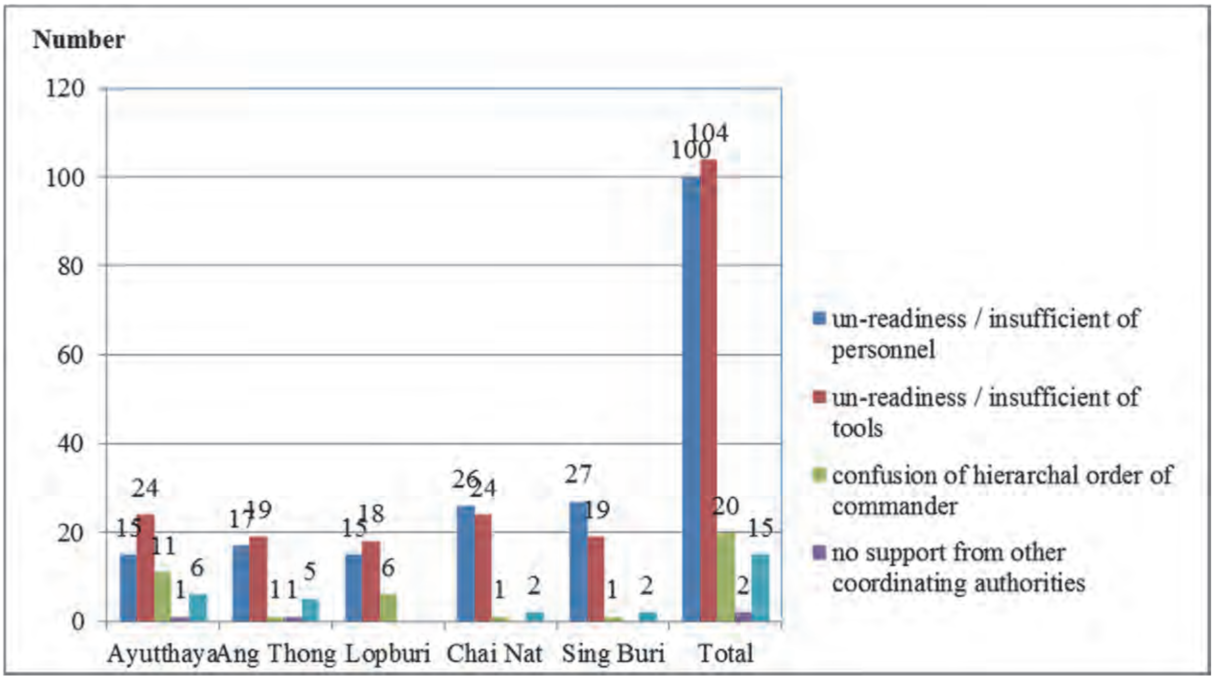


Figure 85-1 Local Agency Survey: Number of respondents per problem or obstacle in forecasting and flood warning in 2011

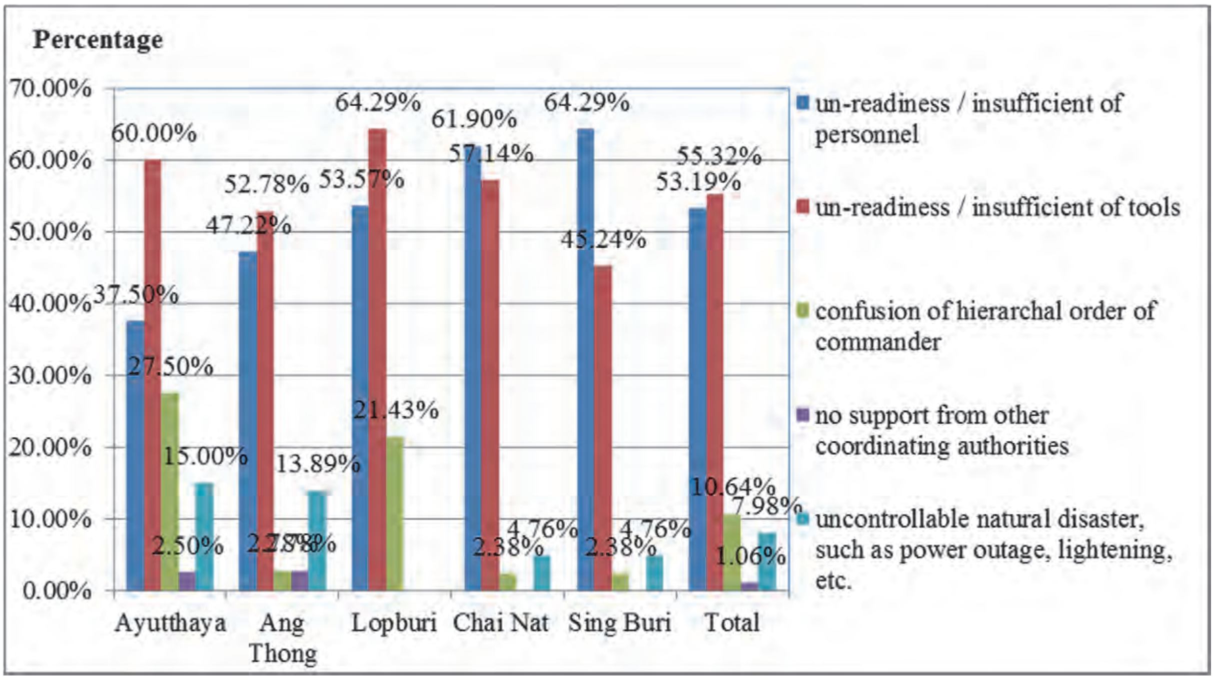


Figure 85-2 Local Agency Survey: Percentage of respondents per problem or obstacle in forecasting and flood warning in 2011

** In this percentage calculation, considered all of respondents of each province, which is 40, 36, 28, 42, 42 for Ayutthaya, Ang Thong, Lopburi, Chai Nat and Sing Buri, respectively, and the total number of respondents is 188.*

5.4.2 Interviewed Summary

At the beginning of the year 2011, the provincial offices received the early warning from the National Disaster and Warning Center (DDPM) about the storms that would pass over the country. Thus, the provincial offices, including the provincial DDPM offices had to keep updating the water level in the main rivers nearby and the water upstream of Chao Phraya Dams, with RID 12 and DWR.

Since the provincial level of the provinces in the lower reach of the Chao Phraya River basin received the information of inundation situation upstream, with the warning from the National Authorities, they officially informed the lower level authorities such as district officers and SAO by sending the official letter. In addition, based on the statistical record and the provincial authorities' flooding experiences in the past, the provincial administration can analyze, evaluate and make decision of flood warning issuance to the local authorities under their responsibility (district and sub-district level). Nevertheless, the entire information and warning message had to be distributed in the formal pattern such as official letter. Subsequently, the local agencies had keep cautions on the inundation situation. They also received the information of rainfall and water level upstream from RID 12. They can also update the flow situation of the Chao Phraya River and the upstream rivers through RID's flow diagram on RID website, in which RID had the task of analyzing and evaluating the situation day by day.

During the flood caution period, there was the daily meeting that local authorities would receive the command from central government agencies. Then, they would understand how to deal with the flood and can take action as commanded.

However, during the approaching of flood, the local authorities had trouble in communicating with provincial authority. They mentioned the difficulty of sending or receiving official letter. Sometimes, in order to send the letter, they had to ride a motorcycle to the provincial office even though the area was inundated. Besides, there were several problems dealing with the flood forecasting and warning system, as listed below:-

- There are no natural disaster mitigation and management planning, which they can learn how to take alleviation action during each period of disaster.
- Sometimes the local authorizes got the inundation information from Television and radio, but it was different from the information they officially got from the provincial authority. It caused them the confusion. However, finally, they had to do as they were officially commanded.
- The lacking of appropriate apparatus for taking flood alleviation action.
- The lacking of budget for flood protection and management.
- The lacking of personnel who can give suggestion on the instant problem that differently occurred everyday.
- Some communities had no experience dealing with flood, thus they needed the equipment, suggestion and helps.
- The citizen, who never had flood experience, did not believe in the warning issuance, thus they did not prepare or take any alleviation action.
- Some of flood victims, especially the elderly denied to evacuate although there places was inundated because they worried about their houses and their properties. This situation caused the difficulty for local DDPM officers to assist them since the area was fully covered with flood water.

5.5 National Flood Defense Organization

During the period that the Northern and Northeastern Thailand has started to be flooded due to tropical storm in May, various local authorities such as Provincial Office Disaster Prevention and Mitigation (OPDM), provincial authorities, Subdistrict Administrative Organizations (SAO) had taken the responsibility on flood alleviation, evacuation assistance, and instant situation management.

However, the situation had become worsen since the flood was still on going by late August. It continually caused the increasing of damage and deaths. Thus, after visited the affected people, the Prime Minster assigned the working group to set up the Emergency Operation Center for Flood, Storm and Landslide under the Disaster Prevention and Mitigation Department of the Ministry of Interiors to coordinate warning and relief efforts. The armed forces had been mobilized to distribute aid to affected people, and civilian groups and organizations were also involved. However, after the Emergency Operation Center had encountered with the problem since it could not exercise adequate authority, a Flood Relief Operations Center (FROC) has then been set up superseding under the responsible of the designated director, who was the Minister of Justice during that period.

In this study the roles of National Flood Defense Organizations who took the responsibility on 2011 flood forecasting and warning issuance has been investigated. Thirty respondents from 9 organizations, which are:-

1. Thai Meteorological Department, Ministry of Information and Communication Technology
2. Office of The National Broadcasting and Telecommunications Commission, Ministry of Information and Communication Technology
3. National Disaster and Warning Center, Ministry of Information and Communication Technology
4. Department of Disaster Prevention and Mitigation, Ministry of Interior
5. Royal Irrigation Department, Ministry of Agriculture and Cooperatives
6. Hydro and Agro Informatics Institute, Public Organization under the Ministry of Science and Technology
7. Hydrographic Department, Royal Thai Navy
8. Department of Drainage and Sewerage, Bangkok Metropolitan Administration
9. Department of Water Resources, Ministry of Natural Resources and Environment

have been interview. The interview result of each organization has then been summarized as follows:-

5.5.1 Thai Meteorological Department, Ministry of Information and Communication Technology

Respondents:

1.	Mr. Putchaphan Sirisap;	Position: Meteorologist, Professional Level
2.	Mr. Rittigrit Karin;	Position: Meteorologist, Practice Level
3.	Mr. Samrit Tangsuwan;	Position: Meteorological Technician, Professional Level

Summary

Thai Meteorological Department (TMD) is the organization that generally supply the weather related parameters information such as the temperature, humidity, rain, wind, etc., including the weather forecasts for the entire country. It daily publicizes all measured and forecasted information, with the disaster warnings, on TMD's website to fulfill the requirement from administration and management in natural disaster mitigation.

TMD has 4 types of measuring stations, which are:-

1. Weather Station
2. Agro Meteorological Station
3. Hydro Meteorological Station
4. Aeronautical Meteorological Station

Commonly, the weather station has a task to measure weather related parameters 8 times / day, and then broadcasts both the measured data and the forecasted information on the website: http://www.tmd.go.th. Later, any organization or publics, such as Royal Irrigation Department, National Disaster and Warning Center, Department of Water Resources, etc. can take any publicized information directly, without any permission request, for further action.

According to the 2011 inundation, before the occurrence of flood, TMD had announced the storms that possibly pass over the country over the year, in which affect the runoff and water quantity. It released the early warning of rain and had updated the situation monthly, weekly, daily.

During the flood period, since FROC had been set up at Don Mueang Airport, TMD assigned permanent staffs to support FROC's function. Every morning the director of forecasting division briefed the daily weather condition for both TMS' staffs, during TMD morning talk and the FROC working members, during FROC's daily meeting. Thus, other organizations such as RID, DDPM, Department of Drainage and Sewerage were daily situation updated. After they had good understanding in weather condition, they can take advantage on using the weather parameters for flood forecasting and warning issuance further.

TMD staffs had been on duty under FROC until it moved the temporary office from Don Mueang Airport to the Energy Complex building; i.e. after the flood reached Don Mueang Airport at the end of October, 2011.

However, after the period that water had approached Ayutthaya and the lower reach, the weather information seemed not so important because there was no additional rainfall during the end of the year.

By the way, the TMD respondents mentioned the problem of the organization that TMD's staffs usually have low ability in making explanation or public presentation. It causes the warning ignoring from public and other organizations. Thus, in order to improve the existing warning issuance system, TMD should, not only improve the capability of the measuring and forecasting system, widely present the organization's potentiality and ability as well. It should convince public how much the reliability of the forecasted data, including the warning issuance from the organization. Then, it could be the meteorological IT data and service center at the national level for users in any ventures as intended.

5.5.2 Office of The National Broadcasting and Telecommunications Commission, Ministry of Information and Communication Technology

Respondents:

1.	Mr. Prasert Aphiphunya	Position: Commissioner of NBTC Inspector and Evaluation Commission
2.	Acting Sub Lt Ekkachai Wittaya	Position: Operation Staff

Summary

The National Broadcasting and Telecommunications Commission (NBTC) is responsible for telecoms sector as well as broadcasting sector. However, in the year 2011, the broadcasting sector did not play significant role.

The NBTC respondents indicated that at the beginning stage of flood, there was the confusion among flood victims and DDPM officers since there was too much information from various sources. It caused the information duplication and the difficulty in making decision.

Therefore, after that NBTC had invited broadcasting and telecommunication entrepreneurs to have the consultation on October 11, 2011. Then, NBTC commissioners had set up the guideline, measures and process of flood victims assisting, as follows:-

1. Request for the collaboration from broadcasting and telecommunication entrepreneurs in distribution of flood information, which is confirmed and/or transferred from The National Broadcasting Services of Thailand (NBT) and FROC. NBTC also prescribed the period of information broadcasting 3 times/ day; i.e.10:00 a.m., 4:00 p.m. and 10: 00 p.m.

2. Assign the NBTC secretary to officially request 3 main telecommunication entrepreneurs; DTAC, AIS and Truemove, to extend the expiration date of prepaid mobile, including exempting the fee appropriately.

3. Assign the NBTC secretary to request the related agencies under NBTC to allocate their staffs to assist and support FROC, which has the temporary office at Don Mueang Airport.

4. Assign the NBTC secretary to command the related agencies to make the collaboration with the amateur radio users who live in inundation area for reporting the situation and/or informing any help needs.

5. In the long term, shall set up telecommunication service for the disaster mitigation in the NBTC master plan.

The processes of work seem much better systematic in flood assistance. NBTC staffs could make the cooperation with amateur radio users, who stay in the inundation area, and local DDPM officers. The flood situation had been continually reported, thus the help needs can be requested and sent to the responsible agencies 24 hours/day.

In addition, the victim in flooding area could also call NBTC staffs and asked for the inundation situation information around their places, including other important information such as the water level in the waterways, the rainfall upstream, etc. The NBTC staffs gave them in the information received from other official agencies and from amateur radio users. Thus, the people in and around the inundation area can make decision and evacuate before the water approach.

Most of the time, NBTC staffs were called for the help request from local communities, they collaborated with army forces to send food, water and the assisting of evacuation as well.

However, the respondents indicated the problems during flood period as follows:-

1. The flood victims denied evacuating although the water level continually increased since they worried about their houses and their assets.

2. NBTC got difficulty in dealing with FROC authority, especially the controller of donated stuffs, and the army force during the night time.

3. Some organizations requested the communication equipment, but had not returned after used.

Nevertheless, it could be summarized that, during the 2011 inundation, NBTC had the main role in 2-way information distribution via amateur radios. Thus, the real situation in inundation area had been reported and the victim's help needs can be sent to the related agencies via NBTC's communication network all 24 hours. Moreover, NBTC also indirectly assisted in mobile communication as they sent the request of collaboration to main telecommunication entrepreneurs.

5.5.3 National Disaster and Warning Center, Ministry of Information and Communication Technology

Respondents:

1. Gp.Capt Somsak Khaosuwan Position: Director of NDWC

2. ADM Somnuak Swatteuk Position: Senior Expert

Summary

National Disaster Early Warning System has been established in 2005 following the catastrophic tsunami disaster of 26th December, 2004. Currently, the National Disaster and Warning Center (NDWC) has the mission to be the natural disaster information center with used of high quality and reliable communication system for control and command in the crisis and make the early warning, in international standard level.

It could be said that the early warning is the main role of NDWC on all natural disaster prevention and management. On the year 2011, before the occurrence of flood, NDWC took used the year-round storm forecast information from the Meteorological Department for its forecasting. Since NDWC forecasted the rainfall and runoff over the 2011 using its mathematical model, it had made the early warning to Provincial offices over the country. Thus, it was assumed that, provincial organizations had been informed and had to be aware and update the real situation during that period by themselves. In addition, the related organizations such as RID had been assumed to be able to estimate the inflow water of the dams as well.

Following the several storms since July 2011, NDWC had made the warning to provinces that would be affected through provincial ODPM offices and provincial offices. Each provincial authority was assumed to keep caution ever since.

After the flood approached the lower reach of the Chao Phraya River Basin, including Ayutthaya, the Prime Minister assigned the disaster related agencies, including NDWC, to establish the Emergency Operation Center, which later changed to be FROC. Then, NDWC had the main role in making the observation in and around the inundation areas, gathering at site information, problem and needs, then reported in the FROC working group's daily meeting every morning.

During these days, since 2012, NDWC plays the important roles in setting up the community surveillance network, which can keep their eyes on whatever causes the disaster and then make the warning to the local communities nearby. NDWC has also set up the disaster prevention and mitigation measures training, including the process of 2-way communication in crisis, to the communities, especially the high risk area.

5.5.4 Department of Disaster Prevention and Mitigation, Ministry of Interior

Respondents:

1. Ms. Natchinya Chayao Position: Website Information Update Staff
2. Ms. Ansumalin Angsusingha Position: Head of Situation Evaluation Section
3. Ms. Nantaya Nhomphakdee Position: Policy and Planning Analyze Senior Staff
4. Ms. Duangnapha Uttamangkhapong Position: Foreign Relations Senior Officer

Summary

Department of Disaster Prevention and Mitigation (DDPM) has the mission in setting up the Master Plan and promote the disaster prevention and mitigation measures. It designates the safety policy, constructs the disaster prevention and warning systems and the recovery plan, and evaluates the implementation later.

In the normal condition, after DDPM, receives various information from RID, TMD, Department of Mineral Resources (DMR), etc., twice a day, the Information Processing division and Information Analysis Division would interpret and analyze disaster risk of each area over the country. Then, it publicizes the information on DDPM website, and also broadcasts the warning message through Provincial, District and local OPDM centers. However, during the crisis, DDPM would receive the situation report more frequently; more than 2 times a day. DDPM, then, analyzes and considers the risky level of each area based on its disaster statistic record and later implements disaster handling plan that was theoretically set up. It also transmits the information such as water level, rainfall and the evacuation routes, in the pattern of numerical data and the narration, to sub-agency over and over.

During the inundation period 2011, DDPM had not only worked on their usual mission in distribution the flood situation information and warning, but also played a role as FROC's secretary. The main task was summarizing daily inundation situation to the FROC board in the daily meeting. Then, FROC board can designate the flood prevention and alleviation actions.

However, there were several problems in 2011 crisis management since the organization had been pressured by political sector. DDPM administrator could not take the disaster handling action plan that was previously set up, thus it caused the confusion in making command. Moreover, since the Prime Minister had not accepted that the 2011 inundation was over level 3-crisis, which the Prime Minister has to make the command, but she announced that it was just level 2-crisis. Thus, level 2 – crisis's responsible agencies had to take their missions as designated in level 2-crisis handling action plan. (See Appendix F for more information of crisis level defining.) It caused the delay in flood management and the international agency could not support or assist. Besides, the people and flood victims did not get the real-situation information, thus they cannot take any alleviation properly.

5.5.5 Royal Irrigation Department, Ministry of Agriculture and Cooperatives

Respondents:

1.	Mr. Pongsak Aroonwijitsakul	Position: Director of Operation & Maintenance Division
2.	Mr. Lerboon Udomsap	Position: Head of Operation & Maintenance Division. RID 11
3.	Dr. Ekkawit Jornpradit	Position: Researcher/Lecturer of Irrigation College
4.	Mr. Surat Thanusilp	Position: Director of Irrigation Project, Phichit Province

Summary

According to Ministerial Regulation Organizing the Royal Irrigation Department, Ministry of Agriculture and Cooperatives B.E. 2554, duties and responsibilities of RID in which related with disaster is "Implementation of activities related to prevention of damages from water; safety of dams and appurtenant structures; safety of navigation in commanded areas and other related activities that may not be specified in annual plan" and "Implementation of other activities designated by laws or properly assigned by Cabinet or Minister".

During the 2011 Flood crisis, RID had daily measured various parameters such as rainfall runoff, water level of the main rivers, tributaries and canals in BMA and perimeter. Then, it broadcasted these data, including the tidal level data which was received from Hydrographic Department, on RID website and also transmitted to the organization who requested such as Industrial Estate Authority of Thailand (IEAT), central government, provincial offices, provincial ODPM in the pattern of numerical data, graphs and narration. Sometimes these data had been sent in the form of electronic files, facsimile or through social applications.

In September – November 2011, RID had tried to drain the water through drainage canals both east and west sides, but it faced the problem due to politicians. That caused the broken of Bang Chom Sri regulator, then the water reached central part, especially the area along the Chao Phraya River and Pasak River. The flood approached the agricultural area and farmland and caused tremendous damage.

In addition, not only the political policy, the respondents mentioned the problems that:-

- Although there were continual measured data, but there was no RID sub-organization who can take use or forecast the movement of overflow.
- Telemetering stations and measuring apparatus had been damaged since there were not enough maintenance budgets.
- During the 2011 flood crisis, RID was not promptly ready to handle the situation since it was lacking of equipment, budget and human resources.
- The confusion in information and command caused the delay in taking any action.

The respondents suggested that RID needs high accuracy mathematical model that can be used to predict the movement of water, both the water in waterways and the land overflow. Besides, the single command system during the crisis is necessary and it should allow the expert or responsible agency to handle the situation and make decision, instead of politician.

5.5.6 Hydro and Agro Informatics Institute, Public Organization under the Ministry of Science and Technology

Respondents:

1. Dr. Surajate Boonya-Aroonnet Position: Head of Hydro Modeling Section
2. Mr. Warin Sophonpattanakul Position: Researcher
3. Ms. Walai Chaisombat Position: Computer System Staff
4. Mr. Nares Khengngern Position: Head of Institute Communication Group

Summary

The main duties of the institute are:-

- data gathering and integrating into one database which is 24-hour available for any purpose of use, and
- developing flood forecasting model and scenarios, with use of integrated data, for the decision maker.

During the 2011 inundation crisis, the missions of HAII were:-

- scanning the water depth in canals by using Eco-sounder, which is the process used to detect the shallow of the channel and indicate the location for Army for the evacuation purpose.
- providing the information related with inundation situation, inundation depth, water level and the weather forecast for FROC and the public,
- field surveying by using UAV (Unman-Aviator), small plane with camera, flew over the inundation area, in order to monitor the dyke (Bigbag barrier line) and then uploaded the video to youtube.com.

The data and information that HAII disseminated on HAII website and transmitted to the organizations who requested were in the pattern of numerical data, graphs, animation and narration. In addition, Dr. Royol Chitradon, HAII director, was the member of FROC board, thus he broadcasted the information by himself through television and other government media. However, it was rather difficult for HAII to make public understand the scientific number. They needed someone to interpret and simplify the data to the citizen.

In addition, HAII dealt with the problem of mathematical model calibration since there was no historical data of water level or flow during great flood in the past. It caused the accuracy of mathematical prediction.

Lastly, the respondents mentioned the problem of warning and evacuation delay due to political policy and politicians. Besides, the central government had also delayed in taking any action and making command due to the lacking of equipment, budget and human resources, as well.

5.5.7 Hydrographic Department, Royal Thai Navy

Respondents:

1.	CDR Siriwat Siriwattanakul	Position: Head of Navy Oceanography
2.	CDR Supasit Khongdee	Position: Royal Thai Navy Authority, responsible on Thai Gulf
3.	LCDR Pichet Puahengsap	Position: Royal Thai Navy Authority, responsible on Thai Gulf
4.	LCDR Ronnakorn Tarawetrak	Position: Royal Thai Navy Authority, responsible on Thai Gulf

Summary

Hydrographic Department, Royal Thai Navy, generally, has the mission in measuring and calculating the water level of Thailand territorial waters, including the Chao Phraya River. Therefore, it has installed the metering stations at the station in front of the Royal Thai Navy Headquarters, Hydrographic Department-Bangna and at the Chulachomklao Fort, Samut Prakarn. The automatically measuring system would real-time transmit the water level data through line telephone modem. Thus, the water level changes can be updated all 24 hours, in which advantage for the 1-3 days-water level forecasting.

During the 2011 flood, from September – November, Hydrographic Department had supported the measured data of tidal level, water level of the Chao Phraya River, Tha Chin River, and Bangpakong River, the flow through the estuary, the inundation map and the meteorological data for FROC and related government organizations. Therefore, they can use this information for further forecasting, warning, making decision.

In addition, Hydrographic Department had made the collaboration with central government mass media, local radio stations and Royal Thai Navy radio station for broadcasting the information and warning through public and private mass media sectors. Thus, the people can update the data and flood situation information daily, and can take alleviation action properly.

However, the respondents mentioned the problem of information confusion among public since the communication systems, and the social network are widely used. The people received too much data from too many sources. It caused panic and confusion.

Moreover, the political interference caused the delay in warning and taking action of government agencies, as well.

5.5.8 Department of Drainage and Sewerage, Bangkok metropolitan Administration

Respondents:

1.	Mr. Wirat Thathong	Position: Communication Expert
2.	Mr. Sanset Ruengrit	Position: Electrical Engineer Expert
3.	Mr.Somjit Khanaewan	Position: Statistic Expert
4.	Mr.Sathaporn Muanglieng	Position: Communication Staff

Summary

Department of Drainage and Sewerage (DDS), BMA, generally has the mission in controlling and maintenance the sewerage system, ditch, canal and drainage related structures, including the proposing of short-medium-long term planning for the drainage, flood prevention and wastewater disposal. In addition, DDS has the mission in gathering the information related with BMA and perimeter flood protection, with the flood prevention action plan as well.

During the 2011 flood, DDS had measured various data such as rainfall, water level in the main rivers and in the canals in BMA and then reported on DDS website and transmitted to the organization who requested. The information was broadcasted in the pattern of numerical data, graph and narration.

DDS had made the command to BMA's sub-organizations to drain the water through both east and west sides. It had utilized all available apparatus to protect the inner BMA from flood.

The respondents indicated the problem and obstacles are as follows:-

- There was the confliction of flood drainage policy between FROC and BMA ; i.e. FROC wanted to drain the flood through Viphavadee Rangsit road while BMA wanted to drain the flood through Chao Phraya River and Rangsit-Nakhon Nayok side.
- DSS's apparatus were not properly for overflow drainage since it is too big and needs long time to establish. Therefore, DSS solved the problem by laying the sand bags and established the smaller pump and drained the flood through the pumping tunnel Khlong Makkasan and Bangkapi.
- DSS had the problem dealing with central government agencies, including the Royal Thai Police.
- DSS does not have the flood and overflow forecasting mathematical model and does not have the specialist in this field of work.
- The inundation information that the mass media broadcasted was distorted sometimes. It caused panic to the people.

5.5.9 Department of Water Resources, Ministry of Natural Resources and Environment

Respondents:

1.	Mr. Samrit Wilaipornratana	Position: Director of Development Research and Hydrology
2.	Mr. Tossaporn Suthajinda	Position: Civil Engineer, Senior Expert
3.	Mr. Thanasak Prasertsri	Position: Director of GIS Division

Summary

Department of Water Resources (DWR) has the mission in proposing the policy planning and measures and managing the problems related with water resources.

Before the flood period, DWR had measured various data such as rainfall, water level, water quality and displayed the data, including the data received from other organizations, on DWR website in the pattern of numerical information, graph, animation and narration. It also transmitted the data to local agency, SAO, district agency.

During the flood period, DWR measured the weather and water parameters more often and displayed every 15 minutes on the website. It also analyzed the data, forecasted the 1-5 days water level and then transmitted to central government, FROC, local agencies, IEAT, etc.

The respondents indicated the problem during the flood, as follows:-

- The lacking of human resources, equipment and budget.
- The confusion in disaster handling since there was no disaster handling action plan.

The respondents also requested the central government to allocate the budget for establishing the natural disaster forecasting and warning systems.

6. Summary

In the study on flood forecasting and warning issuance, 4 groups of respondents, which are city resident and farmer, factory, local agency, and national flood defense authority, from 5 provinces in the lower reach of Chao Phraya River basin have been interviewed. The numbers of interviewee are summarized in *Table* 7.

Table 7 Numbers of Respondents of each Category and Surveyed Areas

Respondents Category	Surveyed Area	Numbers of Respondent
City Resident	Ayutthaya	46
	Ang Thong	18
	Sing Buri	30
	Chai nat	30
	Lopburi	15
Sum		**139**
Farmer	Ayutthaya	36
	Ang Thong	42
	Sing Buri	30
	Chai nat	30
	Lopburi	23
Sum		**161**
Factory from 7 Industrial Estates	Saharattananakorn	5
	Rojjana	5
	Hi-tech	6
	Bang Pa-In	5
	Nawanakorn	5
	Factory Land	4
	Bangkadi	5
Sum		**35**
Local Agency	Ayutthaya	40
	Ang Thong	36
	Sing Buri	42
	Chai nat	42
	Lopburi	28
Sum		**188**
National Flood Defense Organization	TMD	3
	NBTC	2
	NDWC	2
	DDPM	4
	RID	4
	HAII	4
	Hydro Department	4
	DDS, BMA	4
	DWR	3
Sum		**30**

6.1 City residents and farmers, and factory

The summary of questionnaire results from city residents and farmers, and factories reveals the facts and problems related with the existing flood forecasting and warning issuance system and their expectation as described in *Table 8.*

It was found that during the monitoring period, before the flood reached the central part of the lower reach of the Chao Phraya River Basin, after most of the local agencies received the flood information from the national agencies, they had made the warning to residents under their responsibility. Thus, most of the residents, both the farmers and city residents received the warning**,** at least 1-2 days before the water reached their places. It seems that the local network, which included of local agency and local people, played the main roles in flood information distribution and warning. Although, the communication among the upper and lower levels of local agencies had to be official format, but among the local agencies and residents, the warning was in the pattern of verbal messages, word to mouth and by making a phone call. Moreover, the mass media had played the important roles in information distribution as well since TVs and radios are the appliance that widely used in almost every household.

However, among the factories from 7 industrial estate, although all of them got the verbal information from local entrepreneur network, but they were also received the warning from IEAT and central authorities as well. It shows how important of this sector and how much the national authority paid attention on the investors. However, some of the respondents were confused, due to too much information from various sources. Thus, instead of taking alleviation action, one of the respondents could not make decision how to deal with the situation.

During the period before the water reached, all target groups received the information of water level, the rain upstream and within their area, while some of the factories got the warning with the information of the expected time period that they would be able to return to the factory. The residents seems much satisfied on the information they received as about 84% of the farmers and city residents mentioned that the information was sufficient for making decision, but the respondents from factories seems expect more. While the farmers and city residents felt that the information was reliable and much useful, conversely, the factories mentioned that the reliability of the information was too low, less useful, and more than 60% of them felt not satisfy at all on the information they received.

The similar trend could be seen during the period that the flood was approaching their areas as well. Most of the farmers and city residents received the informed from local authorities and the local people network, but there seems to be some confusion and panic among the factory residents since some of the respondents from factory did not receive the inundation information. However, it may be caused by the uncertainty of the communication processes and the warning system.

More than 80% of the resident of farmer and city resident groups showed that they satisfied on the information they received, whereas just 67% of the respondents from factories said that the information was sufficient. In addition, most of the factories indicated that the information was less reliable, less useful and not satisfied at all. They expect much more accuracy of the warning system. Besides, they want to receive the suggestion of how to deal with the instant situation as well.

Since the inundation water level had been standing and no additional rainfall, the rainfall data seems not so necessary; the factories wish to receive information of the name list of contact persons or agencies to contact for assistance, in which some of them did not get during the recovery period of 2011 inundation. However, during this period, the factories seems much satisfy on the information they received than the other period of inundation. More than 88% of the respondents said that the information was sufficient; more than 50% mentioned that it was average to very reliable, and average to very useful. Actually, the increasing of satisfaction among the respondents from factories might be caused by the relief of them after the worst situation had been passed and they did not expect any more assistance from any agency.

Based on the questionnaire survey result, the respondents felt that the existing flood forecasting and warning system is not very good, but the farmers and city residents felt that it is better than having nothing, and it still useful when combining with other information they got from TVs, from friends or relatives who live in the upstream, and from the website such as Thai fight flood's website; https://www.facebook.com/ThaiFightFlood, etc. However, the factory respondents, who most of them are from Japanese companies, complained a lot on the existing system. Besides, some of them were suspicious whether the flood forecasting system was available during the 2011 inundation period or not. 57% of them felt that the system is not god, not reliable and never been useful.

Therefore, all of the respondents suggested improving the existing flood forecasting and warning system by increasing its accuracy, more advance notification before the water reaches, more frequency of information updating; i.e. more often than 1 time/day, and changing the pattern of information into the graphs, animation and narration that can be easier to understand. Besides, they requested additional information such as the name list of the person or agency that they can ask for assistance, the amount and location of evacuation points, including the evacuation routes in case of emergency.

Lastly, the uncertainty of the existing information and warning system should be improved, thus all people can approach the sources and receive the information and warning equitably.

Table 8 City residents and farmers, and factory Questionnaire Results

Subject	Before the Flood Approached the Area			During the Approaching of Flood			During the Recovery Period		
	City Resident	Farmer	Factory	City Resident	Farmer	Factory	City Resident	Farmer	Factory
Percentage of respondents who received information	79.86	80.12%	100%	80.58%	76.40%	88.57%	74.82%	68.32%	100%
Time of information received	• 33.33% , 3- 7 days before water reached • 30.63% ,1 week before water reached	• 33.59%, 1 week before water reached • 33.33% , 3- 7 days before water reached	• 45.71% , 3- 7 days before water reached • 42.86% ,1-2 days before water reached	• 38.39%, within the day the water reaches the area • 22.32%, 1-2 days before the water reached	• 35.77%, within the day the water reaches the area • 30.89%, 1week before the water reached	• 41.94% , 3- 7 days before water reached • 32.26% , 1-2 days before water reached	69.23%, period of time of the water dry out until the situation is back to normal	78.18%, period of time of the water dry out until the situation is back to normal	• 100%, The water approach until the water decrease • 100% period of time of the water dry out until the situation is back to normal
3 orders of main sources of information	1. Local government authority 2. Local people 3. Local people network	1. Local government authority 2. Local people network 3. Local people	1. From local entrepreneur network 2. IEAT 3. Central and Local authorities	4. Local people 5. Local government authority 6. Local people network	1. Local government authority 2. Local people 3. Local people network	1. From local entrepreneur network 2. IEAT 3. Central authority	1. Local government authority 2. Local people 3. Local people network	1. Local government authority 2. Local people 3. Local people network	1. From local entrepreneur network 2. IEAT 3. Central authority
Channel of information received	1. Word of mouth 2. Television 3. Announcement by amplifying car	1. Word of mouth 2. Television 3. Announcement by amplifying car	1. Telephone (alarm call) 2-1 Telephone (SMS) 2-1 Word of mouth	1. Word of mouth 2. Radio 3. Television	1. Word of mouth 2. Radio 3. Television	1-1 Telephone (alarm call) 1-2 Telephone (SMS) 1-3 Word of mouth	1. Word of mouth 2. Announcement by amplifying car 3. Radio	1. Word of mouth 2. Announcement by amplifying car 3. Radio	1-1 Telephone (alarm call) 1-2 Word of mouth 2. Telephone (SMS)
2 orders of pattern of received information	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric	1. Narration 2. Numeric
3 orders of received information	1. Water level in rivers and nearby waterways 2. Rainfall upstream 3. Rainfall within the living area	1. Water level in rivers and nearby waterways 2. Upstream rainfall 3. Rainfall within the living area	1. Water level in rivers and nearby waterways 2. Define period of time to return to factory area 3. Upstream rainfall	1. Water level in rivers and nearby waterways 2. Name list of contact persons / agencies to contact for assistance 3. Upstream rainfall	1. Water level in rivers and nearby waterways 2. Upstream rainfall 3-1 amount of / Location of evacuation points 3-2 Evacuation routes	1. Define period of time to return to factory area 2. Rainfall within the living area 3-1 Upstream rainfall 3-2 Water level in rivers and nearby waterways	1. amount of / Location of evacuation points 2. Rainfall forecast 3. Water level in rivers and nearby waterways	1. Rainfall forecast 2. amount of / Location of evacuation points 3. Rainfall within the living area	1. Certain period of time to return to factory area 2. Water level in rivers and nearby waterways 3. Upstream rainfall
Frequency of information update	1/day	1/day	1/day	1/day	1/day	1/day	1/day	1/day	1/day
Sufficiency of information	83.78% said that the received information was sufficient	84.50% said that the received information was sufficient	68.57% said that the received information was sufficient	81.25% said that the received information was sufficient	82.93% said that the received information was sufficient	67.74% said that the received information was sufficient	96.15% said that the received information was sufficient	90.00% said that the received information was sufficient	88.71% said that the received information was sufficient

Table 8 City residents and farmers, and factory Questionnaire Results (Cont'd)

Subject	Before the Flood Approached the Area			During the Approaching of Flood			During the Recovery Period		
	City Resident	Farmer	Factory	City Resident	Farmer	Factory	City Resident	Farmer	Factory
Credibility of information received									
• Less reliable	7.12%	3.88%,	60.00%	7.14%	17.89%	64.52%	11.54%	3.64%	45.71%
• Average reliable	45.05%	45.74%,	28.57%	41.96%	34.15%	35.48%	34.62%	36.36%	48.57%
• Very reliable	47.75%,	50.39%,	11.43%	50.89%	47.97%	0.00%	53.85%	60.00%	5.71%
Usefulness of information									
• Less useful	10.81%	6.20%	60.00%	7.14%	11.38%	64.52%	14.42%	5.45%	45.71%
• Average useful	33.33%	32.56%	28.57%	33.04%	28.46%	35.48%	29.81%	32.73%	48.57%
• Very useful	55.86%	61.24%	11.43%	59.82%	60.16%	0.00%	55.77%	61.82%	5.71%
Satisfaction towards existing flood forecast and warning system									
• Not satisfied at all	10.81%	5.43%	62.86%	2.68%	2.44%	61.29%	3.85%	1.82%	45.71%
• Less satisfied	15.32%	16.28%	14.29%	15.18%	17.07%	25.81%	9.62%	14.55%	25.71%
• Average satisfied	46.85%	31.78%	20.00%	44.64%	35.77%	12.90%	41.35%	41.82%	25.71%
• Very satisfied	27.03%	46.51%	2.86%	37.50%	44.72%	0.00%	45.19%	40.91%	2.86%
Suggestion for existing flood forecasting and warning system	1. Accuracy improving 2. One month advance notification 3. More information needs	1. One month advance notification 2. Accuracy improving 3. More information needs	1. Accuracy improving 2. 3-7 days advance notification 3. More often than 1/ day data updating	1. More information needs 2. Accuracy improving 3. 1/day data updating	1. Accuracy improving 2. More information needs 3. 1/day data updating	1. Accuracy improving 2. Change pattern of data to numeric and graph 3. More often data updating	1. Accuracy improving 2. More information needs 3. Change pattern of data to narration	1. Accuracy improving 2. More information needs 3. Change pattern of data to narration	1. Accuracy improving 2. Change pattern of data to numeric and graph 3. More often data updating
3 orders of additional required information	1. Name list of contact persons / agencies to contact for assistance 2-1 Water level in rivers and nearby waterways 2-2 Define the period of time to move away from residential areas	1. Evacuation routes in case of increasing of water level 2. Water level in rivers and nearby waterways 3-1 Amount of / Location of evacuation points 3-2 Name list of contact persons / agencies to contact for assistance	1. Define period of time to return to factory area 2. Amount of/ Location of evacuation points 3. Evacuation routes	1. Name list of contact persons / agencies to contact for assistance 2. Evacuation routes 3. Amount of / Location of evacuation points	1-1 Evacuation routes 1-2 Amount of / Location of evacuation points 2. Name list of contact persons / agencies to contact for assistance	1. Name list of contact persons / agencies to contact for assistance 2. Water level in rivers and nearby waterways 3. Rainfall within living area	1. Water level in rivers and nearby waterways 2. Rainfall upstream 3. Rainfall within the living area	1. Water level in rivers and nearby waterways 2. Rainfall upstream 3. Rainfall within the living area	Name list of contact persons or officials or agencies to contact for assistance
Respondents prepared for 2011 flood	67.63%	72.05%	97.14%						
Respondents prepared for future flooding	67.63%	58.39%	68.57%						

Table 8 City residents and farmers, and factory Questionnaire Results (Cont'd)

Subject	Before the Flood Approached the Area			During the Approaching of Flood			During the Recovery Period		
	City Resident	Farmer	Factory	City Resident	Farmer	Factory	City Resident	Farmer	Factory
Feeling to the current forecasting and warning systems									
• Accurate and very reliable	19.42%	24.22%	2.86%						
• Not very good, but better than nothing	32.37%	25.47%	17.14%						
• Not very good, but useful combining with other information	38.85%	44.10%	20.00%						
• Not good, not reliable, and never been useful	7.91%	6.21%	57.14%						
Suggestion for overall flood forecasting and warning system improvement									
• Information display to be more easier to understand	33.81%	46.58%	80.00%						
• More frequency of information update	34.53%	30.43%	17.14%						
• Earlier of warnings	69.06%	77.02%	42.86%						
• Increase accuracy of forecasting	51.08%	55.90%	77.14%						
• Add more channels to approach sources of information and warnings	30.22%	24.22%	11.43%						

Based on the questionnaire survey, although the accuracy of the existing flood forecasting and warning system is not so good, but the farmers and the city residents seems satisfy on the accuracy of the system. Moreover, they think that it is reliable and useful. However, if there is the occurring of great flood again in the future, the local authority would deal again with the problem of community evacuation since they deny moving out. They, especially the elderly, worry about their houses and properties. In addition, some residents, both the people who has nor never had flood experience, believe in their own considerations and their experience more than the warning from government authority. It will cause the difficulty in saving their security and assisting in all means.

Conversely, the factories that got drastically damage felt that the existing flood forecasting and warning system is not good, not reliable, and not useful. Some respondents from factories were surprised and suspicious whether the system was available during the 2011 inundation period or not. They did not satisfy on the accuracy of the system at all. It could be mentioned that the factories expect the system with highest accuracy , thus they can totally rely on.

6.2 Local Agency and National Flood Defense Agency

Based on the questionnaire survey result and interviews, it seems that the situation of 2011 inundation management was so confused. Various data came from various national agencies and most of them had been transferred to the provincial and district level organizations. It caused the information duplication and sometimes caused the difficulty for local agencies in making instant decision as well.

The sequences of information transferring and flood monitoring could be summarized as shown in *Figure 86*.

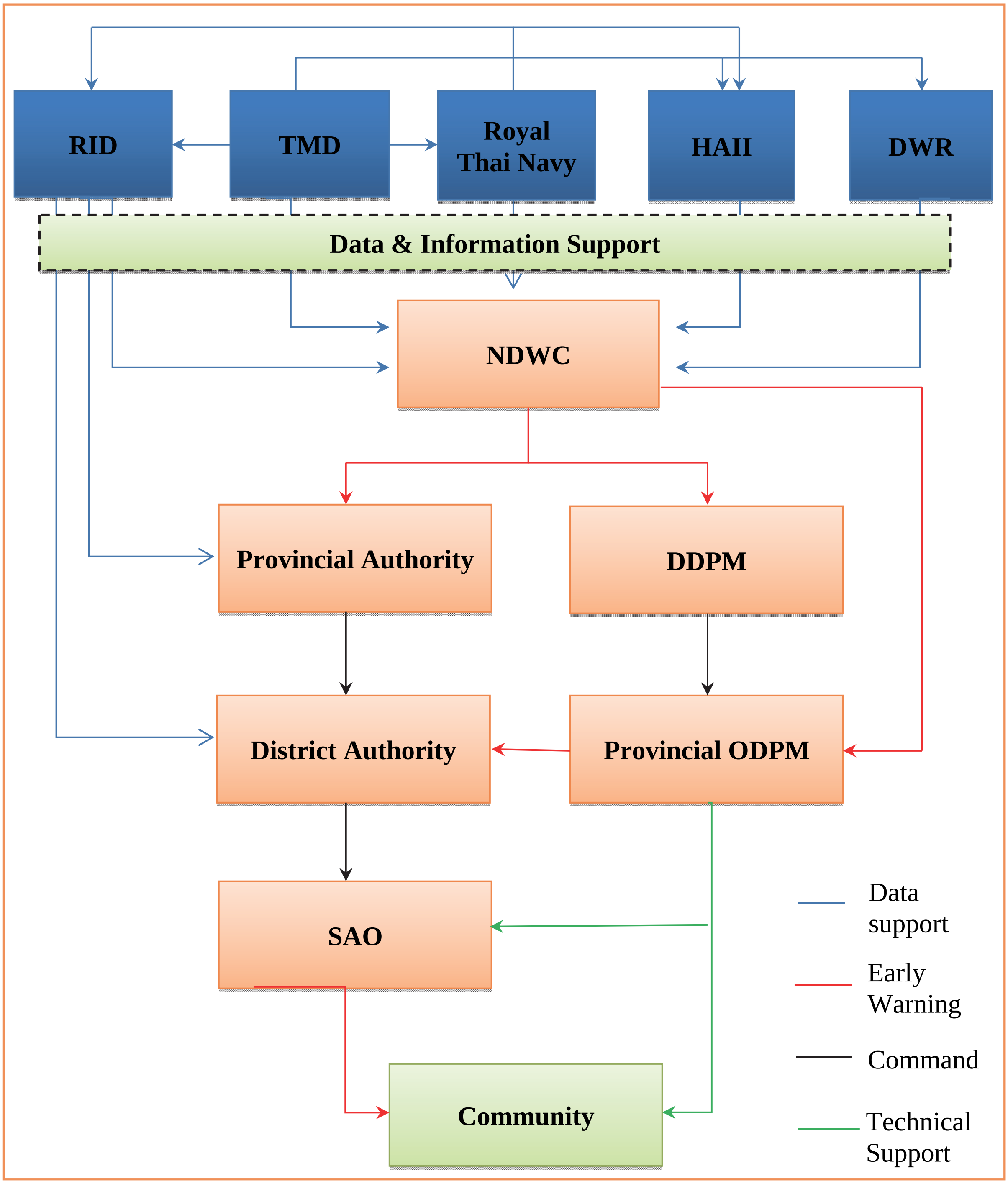


Figure 86 Sequences of data transferring and flood monitoring, before the water approaches

After the situation became worsen, the Emergency Operation Center had been established and later became to be a Flood Relief Operations Center (FROC), all water resources related organizations had to support all information, both the measured data and the forecasted information, to FROC. Then the FROC committee made the decision of flood alleviation action, including flood management measures. The sequences of information transferring and flood warning could be summarized as shown in *Figure 87*.

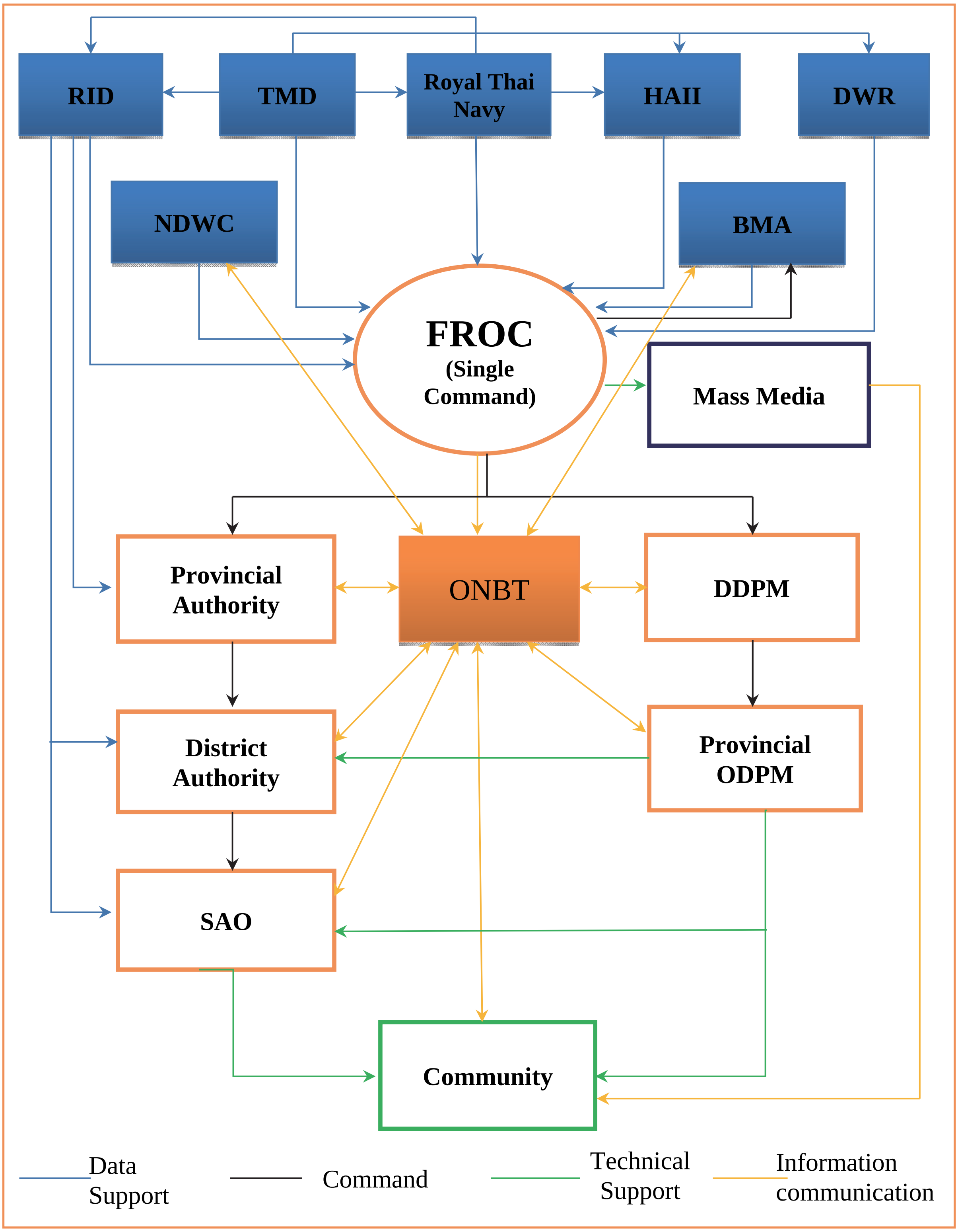


Figure 87 Sequences of data transferring and flood warning, during the flood approaching

However, during the 2011great flood, there were several problems dealing with flood forecasting and warning issuance, and flood management, as follows:-

- There was the interference from political sector. It caused the miscarriage in flood management. DDPM administrator could not take the disaster handling action plan that was previously set up, thus it caused the confusion in making command. Moreover, since the Prime Minister had not accepted that the 2011 inundation was over level 3-crisis, but she announced that it was just level 2-crisis. Thus, level 2 – crisis's responsible agencies had to take their missions as designated in level 2-crisis handling action plan. It caused the delay in flood management and the international agency could not support or assist.

- The political policy caused the distortion of flood situation information report. The people and flood victims did not get the real-situation information, thus they cannot take any alleviation properly.

- At the beginning of flood, there was too much information from various agencies and from the people in the inundation area. Everyone who has smart phone can be the situation reporter. It caused the confusion.

- Most of the water resources related national agencies, such as RID, NDWC, Royal Thai Navy, HAII have their telemetering stations and their own mathematical model for flood forecasting, thus different modeling result caused conflict and confusion.

- There are no historical data of flow and water level during the great flood in the past, thus the calibration and verification of the mathematical models cannot be done. It caused the error of flood forecasting.

- National agency needs high accuracy mathematical model that can be used to predict the movement of water, both the water in waterways and the land overflow.

- Several agencies found the difficulty in making public understand the scientific number. It caused public ignorance of flood forecasting and warning message.

- The difficulty of making officially command during the flood period caused the delay of local authority in taking action and assisted the victims.

- The local authorities do not have "flood handling manual", which they can learn how to deal with the inundation situation. Thus, it was rather hard for them, especially the area that never had flood experience, to make decision and take alleviation action properly.

- During the 2011 flood crisis, various agencies were not promptly ready to handle the situation since it was lacking of equipment, budget and human resources.

7. Recommendations

According to the study on flood forecasting and warning issuance, the actual situation of 2011 flood forecasting and warning processes has been investigated, including the roles of various government authorities and local agencies have also been examined. The causes of improper flood management are:-

1. Political policy and politician

2. Apparatus problems, including the low accuracy of flood forecasting system due to:-
   - The lacking of historical data for mathematical model calibration,
   - The lacking of mathematical model for the prediction of water movement, both the water in waterways and the land overflow.
   - There are too many mathematical models that belong to various organizations such as RID, Royal Thai Navy, NDWC, HAII, etc. In the case that there is difference among result from agencies, it would cause conflict and much of confusion. Finally, the final decision has to be made.

3. Lacking of personnel who can:-
   - process on flood forecasting,
   - give suggestion on the instant situation

4. No flood handling manual and no disaster evacuation rehearsal, especially for the local authority.

5. The people have no experience and no knowledge of how to deal with great flood.

6. The budget problem

7. The complexity of flood forecasting and warning system; i.e. although the single command system was set up, but the command had been designated by more than 1 authority anyway.

Thus, in order to improve the existing flood forecasting and warning system, not only the accuracy of the system should be improved, but system management should also be set up properly, with the experienced personnel, without the interference from the political sector. The expert or responsible agency should be allowed to handle the situation and make decision, instead of politician.

Moreover, the natural disaster handling manual and the rehearsal are also necessary. It would convince the people how important of the disaster warning and evacuation process. Therefore, in the future, whenever the warning is issued, the people will not be panic, but understand how to deal with the situation appropriately.

Appendix A

(Questionnaires)

Questionnaire Survey

on

2011 Flood Forecasting & Warning System

(Questions to City Resident and Farmer)

- ❖ To verify the information received and the flood warning
- ❖ To verify the sufficiency of the information received
- ❖ To examine the satisfaction of the flood forecasting and warning

(1) Information of the responder

(1-1) Gender

- ❑ Female
- ❑ Male

(1-2) Age

- ❑ Under 20
- ❑ 21-30 years old
- ❑ 31-40 years old
- ❑ 41-50 years old
- ❑ 51-60 years old
- ❑ Over 60 years old

(1-3) Occupation

- ❑ Farmer,
  plants ....
  ....
- ❑ Government officer
- ❑ Public sector (organizations, companies)
- ❑ Public sector (in industrial
  estate ....)
- ❑ Other; please
  specify ....
  ....

(1-4) Type of accommodation during 2011 flood

- ❑ Single story house
- ❑ Multi-story house
- ❑ Economic building
- ❑ Other; please
  specify ....
  ....

(2) Severity of the 2011 Flood

(2-1) Damage cased and depth of flood

- ❑ Besiege, but only outside the house
- ❑ Cover 1st floor, but not conceal the whole level
- ❑ Rise to 2nd floor of the house

(2-2) Period of time of the water approach until highest flood water level

- ❑ Less than 3 hours
- ❑ 3 – 6 hours
- ❑ 6 – 12 hours
- ❑ 12 – 24 hours
- ❑ Over 1 day

(2-3) Period of time of the water approach until water dry out

- ❑ less than 1 week
- ❑ 1 – 2 weeks
- ❑ 2 – 3 weeks
- ❑ 1 – 2 months
- ❑ Over 2 months

(3) Receive of warning during monitoring period / before flood reach the area

Receive of information / warning

- ❑ Received information of the current situation / alarm (skip to 3-A)
- ❑ Do not receive the information (skip to 3-B)

(3-A)

(3-A-1) Receive information from

- ❑ Central government authority; please specify

  ……………………………………………………………………

- ❑ Local government authority; please specify

  ……………………………………………………………………..

- ❑ From local people
- ❑ From local people network
- ❑ Other, please specify

  ……………………………………………………………………………………

(3-A-2) Channel of information received

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please specify

  ……………………………………………………………………………………

(3-A-3) Information received

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction ……………………………………………………………… in advance of ....hours / day

- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………… ………….

(3-A-4) The received information is sufficient or not

- ❑ Sufficient
- ❑ Insufficient and need more information, i.e.
  - ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
  - ❑ Amount of rain over the water basis area or other areas
  - ❑ Amount of rain in the area
  - ❑ Level of water in rivers, canals, nearby waterways
  - ❑ Sea level
  - ❑ Predicted data of rainfalls, in advance of ………….. hours / day
  - ❑ Predicted of water level, specify certain point of prediction ………………………………….
    in advance of ....hours / day
  - ❑ Define the period of time to move away from residential areas
  - ❑ Amount of / Location of evacuation points
  - ❑ Evacuation routes in case of increasing of water level

- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify …………………………………………………………………………………

(3-A-5) Patterns of the information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify ....

(3-A-6) Period of time in receiving the information

- ❑ Over 1 week before the water reaches the area
- ❑ 1 week before the water reaches the area
- ❑ 3- 7 days before the water reaches the area
- ❑ 1-2 days before the water reaches the area
- ❑ Within the day the water reaches the area

(3-A-7) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day

- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify……………………………………….…………………… ………..

(3-A-8) The information is reliable or not

- ❑ Less reliable
- ❑ Average reliable
- ❑ Very reliable

(3-A-9) The information received is useful or not

- ❑ Less useful
- ❑ Average useful
- ❑ Very useful

(3-A-10) Satisfaction towards flood forecast and warning <u>before flooding</u>

- ❑ Not satisfied at all
- ❑ Less satisfied
- ❑ Average satisfied
- ❑ Very satisfied

(3-A-11) Things to get improved in flood forecast and warning <u>before flooding</u>

- ❑ Accuracy of flood forecast and warning
- ❑ Frequency, to increase frequency of data update
    - ❑ More than once per hour

- ❑ Once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly

❑ Advance notification

- ❑ 1 month before water approach
- ❑ 1-4 weeks before water approach
- ❑ 3-7 days before water approach
- ❑ 1 day before water approach

❑ Add more channels of data information,
via ....

❑ Require more information

❑ Change patterns of the data to

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please
specify.. ....
....

(3-B)

(3-B-1) Channel to receive information before flooding

❑ television

❑ radio

❑ telephone (alarm call)

- ❑ telephone (short message)
- ❑ social network i.e. internet
- ❑ word of mouth
- ❑ announcement within community by amplifying car
- ❑ other; please specify ....

(3-B-2) Required information

- ❑ weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ amount of rain over the water basis area or other areas □ amount of rain in the area
- ❑ level of water in rivers, canals, nearby waterways
- ❑ sea level
- ❑ predicted data of rainfalls, in advance of ………….. hours / day
- ❑ predicted of water level, specify certain point of prediction ……………………………………………………………..…in advance of ....hours / day
- ❑ define the period of time to move away from residential areas
- ❑ amount of / Location of evacuation points
- ❑ evacuation routes in case of increasing of water level
- ❑ name list of contact persons or officials or agencies to contact for assistance
- ❑ other; please specify ……………………………………………………………………………………

(3-B-3) Patterns of the require information

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please specify ....
....

(3-B-4) Period of time to receive the information

- ❑ over 1 week before the water reaches the area
- ❑ 1 week before the water reaches the area
- ❑ 3- 7 days before the water reaches the area
- ❑ 1-2 days before the water reaches the area
- ❑ within the day the water reaches the area

(3-B-7) Frequency of information update

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week;
- ❑ please specify

…………………………………………………….…………………
…………..

(4) Channel to receive flood warning uring flooding

Information / warning receive

- ❑ Received information of the situation / warning (skip to **4-B**)
- ❑ Do not receiving any information (skip to **4-B**)

(4-A)

(4-A-1) Receive information from

- ❑ Central government authority; please specify ....
- ❑ Local government authority; please specify ....
- ❑ From local people
- ❑ From local people network
- ❑ Other, please specify ....
....

(4-A-2) Channels of information received

- ❑ Television
- ❑ radio
- ❑ telephone (alarm call)
- ❑ telephone (short message)
- ❑ social network i.e. internet
- ❑ word of mouth
- ❑ announcement within community by amplifying car

- ❑ other; please specify ....

(4-A-3) Information received

- ❑ weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ level of water in rivers, canals, nearby waterways
- ❑ sea level
- ❑ predicted data of rainfalls, in advance of ………….. hours / day
- ❑ predicted of water level, specify certain point of prediction ....in advance of ....hours / day
- ❑ define the period of time to move away from residential areas
- ❑ amount of / Location of evacuation points
- ❑ evacuation routes in case of increasing of water level
- ❑ name list of contact persons or officials or agencies to contact for assistance
- ❑ other; please specify ....

(4-A-4) The received information is sufficient or not

- ❑ sufficient
- ❑ insufficient and require more information

- ❑ weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ level of water in rivers, canals, nearby waterways
- ❑ sea level
- ❑ predicted data of rainfalls, in advance of ………….. hours / day
- ❑ predicted of water level, specify certain point of prediction ………………………………………………in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ evacuation routes in case of increasing of water level
- ❑ name list of contact persons or officials or agencies to contact for assistance
- ❑ other; please specify ……………………………………………………………………………….

(4-A-5) Patterns of the information received

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration

- ❑ other, please specify ....
....

(4-A-6) Period of time to receive the information

- ❑ over 1 week before the water reaches the area
- ❑ 1 week before the water reaches the area
- ❑ 3- 7 days before the water reaches the area
- ❑ 1-2 days before the water reaches the area
- ❑ within the day the water reaches the area

(4-A-7) Frequency of information update

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week;
- ❑ please specify

…………………………………..……………………………..

(4-A-8) Credibility of the information received

- ❑ less reliable
- ❑ average reliable
- ❑ very reliable

(4-A-9) The information received is useful or not

- ❑ less useful
- ❑ average useful
- ❑ very useful

(4-A-10) Satisfaction towards flood forecast and warning <u>during flooding</u>

- ❑ not satisfied at all
- ❑ less satisfied
- ❑ average satisfied
- ❑ very satisfied

(4-A-11) Things to be improved in flood forecast and warning <u>during flooding</u>

- ❑ accuracy of flood forecast and warning
- ❑ frequency, to increase frequency of data update
  - ❑ more than once per hour
  - ❑ once per hour
  - ❑ once per day
  - ❑ more than once per day
  - ❑ weekly
- ❑ advance notification
  - ❑ 1 month before water approach
  - ❑ 1-4 weeks before water approach
  - ❑ 3-7 days before water approach
  - ❑ 1 day before water approach
- ❑ add more channels of data information,
  via ....

- ❑ require more information
- ❑ change patterns of the data to
  - ❑ numeric
  - ❑ graph
  - ❑ footages from the measuring point
  - ❑ animation, simulation of situation and location
  - ❑ narration
  - ❑ other, please specify ....

(4-B)

(4-B-1) Channel to receive information <u>during flooding</u>

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please specify ....

(4-B-2) Required information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure

- ❑ Amount of rain over the water basis area or other areas □ amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction ………………………………………………………
  in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ………………………………………………………………………………………

(4-B-3) Patterns of the required information

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify ....
- ❑ ....

(4-B-4) Period of time to receive the information

- ❑ Over 1 week before flood reaches the area
- ❑ 1 week before flood reaches the area
- ❑ 3- 7 days before flood reaches the area
- ❑ 1-2 days before flood reaches the area
- ❑ Within the day of flood reaches the area

(4-B-5) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify

……………………………………………………………..……………………
…………..

(5) Receiving of the information after / during recovery period

Receiving of the information

- ❑ Receive the information of the situation (skip to **5-A**)
- ❑ Do not receive the information (skip to **5-B**)

(5-A)

(5-A-1) Receive information from

- ❑ Central government authority; please specify
  ……………………………………………………………
- ❑ Local government authority; please specify…………………………………………………………
- ❑ From local people
- ❑ From local people network
- ❑ Other, please specify
  ……………………………………………………………………………
  ………………………..

(5-A-2) Channels to receive information

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please specify ....
  ....

(5-A-3) Information received

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure

- ❑ Amount of rain over the water basis area or other areas □ amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction ……………………………………………

  in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Certain period of time to return to residential area
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ………………………………………………………………………………………

(5-A-4) The received information is sufficient or not

- ❑ Sufficient
- ❑ Insufficient, and need more information
- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day

- ❑ Predicted of water level, specify certain point of prediction ……………………….……… in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Certain period of time to return to residential area
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………………………

(5-A-5) Patterns of information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify.. ....

(5-A-6) Period of time to receive the information

- ❑ the water approach until the water decrease
- ❑ period of time of the water dry out until the situation is back to normal

(5-A-7) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify

…………………………………………………...……………………
…………..

(5-A-8) The information received is reliable or not

- ❑ Less reliable
- ❑ Average reliable
- ❑ Very reliable

(5-A-9) The information received is useful or not

- ❑ Less useful
- ❑ Average useful
- ❑ Very useful

(5-A-10) Satisfaction towards flood forecast and warning <u>after flooding</u>

- ❑ Not satisfied at all
- ❑ Less satisfied
- ❑ Average satisfied
- ❑ Very satisfied

(5-A-11) Things to get improved in flood forecast and warning <u>after flooding</u>

- ❑ Accuracy of flood forecast and warning
- ❑ Frequency, to increase frequency of data update
  - ❑ More than once per hour
  - ❑ Once per hour
  - ❑ Once per day
  - ❑ More than once per day
  - ❑ Weekly
- ❑ Advance notification
  - ❑ 1 month before water approach
  - ❑ 1-4 weeks before water approach
  - ❑ 3-7 days before water approach
  - ❑ 1 day before water approach
- ❑ Add more channels of data information,
  via ....
- ❑ Require more information
- ❑ Change patterns of the data to
  - ❑ Numeric
  - ❑ Graph
  - ❑ Footages from the measuring point
  - ❑ Animation, simulation of situation and location
  - ❑ Narration
  - ❑ Other, please
    specify.. ....
    ....

(5-B)

(5-B-1) Channel of information required <u>after the flood</u>

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please specify ....
  ....

(5-B-2) Required information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction
  ………………………………………………
  in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Certain period of time to return to residential area
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify

……………………………………………………………………………

……………

(5-B-3) Patterns of the information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify... ....
  ....

(5-B-4) Period of time to receive the information

- ❑ The water approach until the water decrease
- ❑ Period of time of the water dry out until the situation is back to normal

(5-B-5) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify
  ………………………………………….…….……………………
  …………..

(6) Flood preparation

Any preparations to handle the flood or not

- ❑ Preparation skip to **6-A**)
- ❑ No preparations (skip to **6-B**)

(6-A)

(6-A-1) Time for preparation

- ❑ Before flood forecasting and warning, because
  - ❑ The area is frequent flooded area
  - ❑ Informed of floods in other areas
  - ❑ Other, please specify ....
- ❑ Once being informed of the forecast and warning
- ❑ After being informed of the forecast and warning ………………………….. day(s)

(6-A-2) Preparations

- ❑ Moving things to higher place
- ❑ Moving things out of the house or targeted area of flood to other places, at …………………………… ……………………………………………………………………………… ……………………………………………………………………………… ……….
- ❑ Evacuate children and elders out of the area to;

- ❑ Evacuation camps, relatives' or acquaintance's accommodations that will not be flooded.
- ❑ Evacuation camps
- ❑ Other, please specify ....

(6-B)

(6-B-1) Reasons to not prepare to handle flood

- ❑ The area has never being flooded
- ❑ Being flooded in the past, but maybe not this time
- ❑ Do not believe the warning
- ❑ Other, please specify
  ....

(7) Preparation for future flooding

Any preparation to handle with future flooding or not

- ❑ Preparation (skip to **7-A**)
- ❑ No preparations (skip to **7-B**)

(7-A)

(7-A-1) Preparation that has been done / ongoing

- ❑ Permanently move out of the area
- ❑ Build new house or level up the current house

- ❑ Build surround walls to prevent water approach
- ❑ Other; please specify ....

(7-A-2) Reason to prepare to handle with flood by yourself

- ❑ Possibility of flood to occur again
- ❑ Cannot rely on government authorities
- ❑ Cannot rely on the warning or information, better prepare to prevent the situation
- ❑ Other, please specify ....

(7-B)

(7-B-1) Reason of not continue preparation in handling with future flooding

- ❑ It might never happen again
- ❑ Can ask for assistance from government authorities if it happens again
- ❑ Will prepare when receive warning from government authorities in flood forecast and warning
- ❑ Will be able to live with flood
- ❑ Other; please specify ....

....

(8) Your feeling to the current forecasting and warning systems

- ❑ Accurate and very reliable
- ❑ Not very good, but better than nothing
- ❑ Not very good, but useful combining with other information
- ❑ Not good, not reliable, and never been useful
- ❑ Other; please specify ....

(9) What you want to have, or to improve the forecasting and warning systems

- ❑ Information display to be more easier to understand
- ❑ More frequency of information update
- ❑ Earlier of warnings
- ❑ Increase accuracy of forecasting
- ❑ Add more channels to approach sources of information and warnings
- ❑ Other; please specify ....

Appendix A-2

Questionnaire Survey

on

2011 Flood Forecasting & Warning System

(Questions to Factory)

- To verify the information received and the flood warning
- To verify the sufficiency of the information received
- To examine the satisfaction of the flood forecasting and warning

(1) Factory / Company Information

(1-1) Factory/Company

………………………………………………………………………..

Industrial District ....

(1-2) Respondent

Name ....

Position

……………………………………………………………………

…..

Duties and Responsibilities during 2011 Flood

…………………………………………………………………

……………………………………………………………………

……………………………………………………………………

…….

(1-3) Size of Factory/Company

- ❑ Single-storied
- ❑ 2 storied
- ❑ More than 2 storied
- ❑ Other, please specify

  ………………………………………………………………………………
  ………….

(2) Severity of the 2011 Flood

(2-1) Damage cased and depth of flood

- ❑ Besiege, but only outside the factory/company
- ❑ Cover 1st floor, but not conceal the whole level
- ❑ Rise to 2nd floor of the factory/company

(2-2) Period of time of the water approach until highest flood water level

- ❑ Less than 3 Hours
- ❑ 3 – 6 Hours
- ❑ 6 – 12 Hours
- ❑ 12 – 24 Hours
- ❑ More than 1 Day

(2-3) Period of time of the water approach until water dry out.

- ❑ Less than 1 week
- ❑ 1 – 2 weeks
- ❑ 2 – 3 weeks
- ❑ 1 – 2 months
- ❑ More than 2 months

(3) Receive of warning during monitoring period / before flood reach the area

Receiving of the information/ warning

- ❑ Receive the information of the situation/ warning (skip to 3-A)
- ❑ Do not receive any information (skip to 3-B)

(3-A)

(3-A-1) Receive information from

- ❑ Central government authority; please specify
  ……………………………………..
- ❑ Local government authority; please specify……………………………………………..
- ❑ From IEAT
- ❑ From local entrepreneur network
- ❑ Other, please specify
  ……………………………………………………………………………………………..

(3-A-2) Channels to receive information

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car

- ❑ Other; please specify ....

(3-A-3) Information received

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction at …………………………………………… in advance of ....hours / day
- ❑ Define period of time to return to factory area
- ❑ Amount of/ Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ………………………………………………………………………………………

(3-A-4) The received information is sufficient or not

- ❑ Sufficient
- ❑ Insufficient, and need more information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of …………. hours / day
- ❑ Predicted of water level, specify certain point of prediction ………………………….……… in advance of ....hours / day
- ❑ Define period of time to return to factory area
- ❑ Amount of/ Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………………………

(3-A-5) Patterns of information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration

- ❑ Other, please specify..

(3-A-6) Period of time to receive the information

- ❑ over 1 week before flood reaches the area
- ❑ 1 week before flood reaches the area
- ❑ 3- 7 days before flood reaches the area
- ❑ 1-2 days before flood reaches the area
- ❑ within the day of flood reaches the area

(3-A-7) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify

……………………………………………………...……………
………………..

(3-A-8) The information received is reliable or not

- ❑ Less reliable
- ❑ Average reliable
- ❑ Very reliable

(3-A-9) The information received is useful or not

- ❑ Less useful

- ❑ Average useful
- ❑ Very useful

(3-A-10) Satisfaction towards flood forecast and warning after flooding

- ❑ Not satisfied at all
- ❑ Less satisfied
- ❑ Average satisfied
- ❑ Very satisfied

(3-A-11) Things to get improved in flood forecast and warning after flooding

- ❑ Accuracy of flood forecast and warning
- ❑ Frequency, to increase frequency of data update
    - ❑ More than once per hour
    - ❑ Once per hour
    - ❑ Once per day
    - ❑ More than once per day
    - ❑ Weekly
- ❑ Advance notification
    - ❑ 1 month before water approach
    - ❑ 1-4 weeks before water approach
    - ❑ 3-7 days before water approach
    - ❑ 1 day before water approach
- ❑ Add more channels of data information, via...
- ❑ Require more information
- ❑ Change patterns of the data to

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please
  specify ....

(3-B)

(3-B-1) Channel to receive information before flooding

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please
  specify ....

(3-B-2) Required information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas □ amount of rain in the area

- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction ……………………………….. in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ………………………………………………………………………………………

(3-B-3) Patterns of the required information

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify...

(3-B-4) Period of time to receive the information

- ❑ Over 1 week before flood reaches the area
- ❑ 1 week before flood reaches the area
- ❑ 3- 7 days before flood reaches the area

- ❑ 1-2 days before flood reaches the area
- ❑ Within the day of flood reaches the area

(3-B-5) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;
- ❑ Please specify

  ……………………………………………………………..……………………
  …………..

(4) Receive flood warning during flood

Receiving of the information/ warning

- ❑ Receive the information of the situation/ warning (skip to 4-A)
- ❑ Do not receive any information (skip to 4-B)

(4-A)

(4-A-1) Receive information from

- ❑ Central government authority; please specify

  …………………………………….
- ❑ Local government authority; please specify……………………………………..
- ❑ From IEAT
- ❑ From local entrepreneur network

- ❑ Other, please specify
  ………………………………………………………………………………
  ……………..

(4-A-2) Channels to receive information

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please
  specify ....
  ...

(4-A-3) Information received

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction at
  …………………………………………… in advance
  of ....hours / day
- ❑ Define period of time to return to factory area

- ❑ Amount of/ Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify
  ………………………………………………………………………………
  ……………

(4-A-4) The received information is sufficient or not

- ❑ Sufficient
- ❑ Insufficient, and need more information
  - ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
  - ❑ Amount of rain over the water basis area or other areas
  - ❑ Amount of rain in the area
  - ❑ Level of water in rivers, canals, nearby waterways
  - ❑ Sea level
  - ❑ Predicted data of rainfalls, in advance of ………….. hours / day
  - ❑ Predicted of water level, specify certain point of prediction ………………………………… in advance of ....hours / day
  - ❑ Define period of time to return to factory area
  - ❑ Amount of/ Location of evacuation points
  - ❑ Evacuation routes in case of increasing of water level
  - ❑ Name list of contact persons or officials or agencies to contact for assistance

- ❑ Other; please specify

  ………………………………………………………………………

  …………………

(4-A-5) Patterns of information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify...

  ....

(4-A-6) Period of time to receive the information

- ❑ over 1 week before flood reaches the area
- ❑ 1 week before flood reaches the area
- ❑ 3- 7 days before flood reaches the area
- ❑ 1-2 days before flood reaches the area
- ❑ within the day of flood reaches the area

(4-A-7) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;

- ❑ Please specify

  …………………………………………………...………………

  ……………..

(4-A-8) The information received is reliable or not

- ❑ Less reliable
- ❑ Average reliable
- ❑ Very reliable

(4-A-9) The information received is useful or not

- ❑ Less useful
- ❑ Average useful
- ❑ Very useful

(4-A-10) Satisfaction towards flood forecast and warning after flooding

- ❑ Not satisfied at all
- ❑ Less satisfied
- ❑ Average satisfied
- ❑ Very satisfied

(4-A-11) Things to get improved in flood forecast and warning after flooding

- ❑ Accuracy of flood forecast and warning
- ❑ Frequency, to increase frequency of data update
  - ❑ More than once per hour
  - ❑ Once per hour
  - ❑ Once per day

- ❑ More than once per day
- ❑ Weekly

❑ Add more channels of data information,
via ....

❑ Require more information

❑ Change patterns of the data to

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify ....

(4-B)

(4-B-1) Channel to receive information during flooding

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please specify ....

(4-B-2) Required information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of …………. hours / day
- ❑ Predicted of water level, specify certain point of prediction …………………… in advance of ....hours / day
- ❑ Define the period of time to move away from residential areas
- ❑ Amount of / Location of evacuation points
- ❑ Evacuation routes in case of increasing of water level
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………………………

(4-B-3) Patterns of the required information

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify...

(4-B-4) Period of time to receive the information

- ❑ Over 1 week before flood reaches the area
- ❑ 1 week before flood reaches the area
- ❑ 3- 7 days before flood reaches the area
- ❑ 1-2 days before flood reaches the area
- ❑ Within the day of flood reaches the area

(4-B-5) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week; Please specify

…………………………………………………………..…………………
…………..

(5) **Receiving of the information after / during recovery period**

Receiving of the information

- ❑ Receive the information of the situation (skip to 5-A)
- ❑ Do not receive the information (skip to 5-B)

(5-A)

(5-A-1) Receive information from

- ❑ Central government authority; please specify
  …………………………………..
- ❑ Local government authority; please
  specify………………………………………..
- ❑ From IEAT
- ❑ From local entrepreneur network
- ❑ Other, please specify
  …………………………………….…………………………………
  ……………..

(5-A-2) Channels to receive information

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please
  specify ....
  ...

(5-A-3) Information received

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways

- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of …………. hours / day
- ❑ Predicted of water level, specify certain point of prediction at …………………………………………. in advance of ....hours / day
- ❑ Certain period of time to return to factory area
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………………………

(5-A-4) The received information is sufficient or not

- ❑ Sufficient
- ❑ Insufficient, and need more information
  - ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
  - ❑ Amount of rain over the water basis area or other areas
  - ❑ Amount of rain in the area
  - ❑ Level of water in rivers, canals, nearby waterways
  - ❑ Sea level
  - ❑ Predicted data of rainfalls, in advance of …………. hours / day
  - ❑ Predicted of water level, specify certain point of prediction ………………………………… in advance of ....hours / day
  - ❑ Certain period of time to return to factory area

- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ………………………………………………………………… …………………

(5-A-5) Patterns of information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify...

(5-A-6) Period of time to receive the information

- ❑ The water approach until the water decrease
- ❑ Period of time of the water dry out until the situation is back to normal

(5-A-7) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week;

- ❑ Please specify

  …………………………………………………………...………………

  ……………..

(5-A-8) The information received is reliable or not

- ❑ Less reliable
- ❑ Average reliable
- ❑ Very reliable

(5-A-9) The information received is useful or not

- ❑ Less useful
- ❑ Average useful
- ❑ Very useful

(5-A-10) Satisfaction towards flood forecast and warning after flooding

- ❑ Not satisfied at all
- ❑ Less satisfied
- ❑ Average satisfied
- ❑ Very satisfied

(5-A-11) Things to get improved in flood forecast and warning after flooding

- ❑ Accuracy of flood forecast and warning
- ❑ Frequency, to increase frequency of data update
  - ❑ More than once per hour
  - ❑ Once per hour
  - ❑ Once per day
  - ❑ More than once per day
  - ❑ Weekly

- ❑ Add more channels of data information,
  via ....
- ❑ Require more information
- ❑ Change patterns of the data to
  - ❑ Numeric
  - ❑ Graph
  - ❑ Footages from the measuring point
  - ❑ Animation, simulation of situation and location
  - ❑ Narration
  - ❑ Other, please
    specify ....
    ....

(5-B)

(5-B-1) Channel of information required after the flood

- ❑ Television
- ❑ Radio
- ❑ Telephone (alarm call)
- ❑ Telephone (short message)
- ❑ Social network i.e. internet
- ❑ Word of mouth
- ❑ Announcement within community by amplifying car
- ❑ Other; please
  specify ....
  ....

(5-B-2) Required information

- ❑ Weather information, i.e. weather such as temperature, humidity, air pressure
- ❑ Amount of rain over the water basis area or other areas
- ❑ Amount of rain in the area
- ❑ Level of water in rivers, canals, nearby waterways
- ❑ Sea level
- ❑ Predicted data of rainfalls, in advance of ………….. hours / day
- ❑ Predicted of water level, specify certain point of prediction ……………………………………………………………………………………
- ❑ in advance of ....hours / day
- ❑ Define the period of time to move away from factory areas
- ❑ Name list of contact persons or officials or agencies to contact for assistance
- ❑ Other; please specify ……………………………………………………………………………………

(5-B-3) Patterns of the information received

- ❑ Numeric
- ❑ Graph
- ❑ Footages from the measuring point
- ❑ Animation, simulation of situation and location
- ❑ Narration
- ❑ Other, please specify ....

(5-B-4) Period of time to receive the information

- ❑ The water approach until the water decrease
- ❑ Period of time of the water dry out until the situation is back to normal

(5-B-5) Frequency of information update

- ❑ Once per hour
- ❑ More than once per hour
- ❑ Once per day
- ❑ More than once per day
- ❑ Weekly
- ❑ Once over a week; please specify ……………………………………………………………..

(6) Flood preparation

Any preparations to handle the flood or not

- ❑ Preparation skip to 6-A)
- ❑ No preparations (skip to 6-B)

(6-A)

(6-A-1) Time for preparation

- ❑ Before flood forecasting and warning, because
  - ❑ The area is frequent flooded area
  - ❑ Informed of floods in other areas
  - ❑ Other, please specify ....

- ❑ Once being informed of the forecast and warning
- ❑ After being informed of the forecast and warning
  ………………………….. day(s)

(6-A-2) Preparations

- ❑ Moving things to higher place
- ❑ Moving things out of the house or targeted area of flood to other places, at …………………………………
- ❑ Prepare sandbags surrounded factory/company area
- ❑ Build prevention wall surrounded factory or industrial estate
- ❑ Other, please specify ....

(6-B)

(6-B-1) Reasons to not prepare to handle flood

- ❑ The area has never being flooded
- ❑ Being flooded in the past, but maybe not this time
- ❑ Do not believe the warning
- ❑ Other, please specify ....

(7) Preparation for future flooding

Any preparation to handle with future flooding or not

- ❑ Preparation (skip to 7-A)
- ❑ No preparations (skip to 7-B)

(7-A)

(7-A-1) Preparation that has been done / ongoing

- ❑ Permanently move out of the area
- ❑ Build surround walls to prevent water approach
- ❑ Build level up the current area to prevent flood
- ❑ Other; please specify ....

(7-A-2) Reason to prepare to handle with flood by yourself

- ❑ Possibility of flood to occur again
- ❑ Cannot rely on government authorities
- ❑ Cannot rely on the warning or information, better prepare to prevent the situation
- ❑ Other, please specify ....

(7-B)

(7-B-1) Reason of not continue preparation in handling with future flooding

- ❑ It might never happen again
- ❑ Can ask for assistance from government authorities if it happens again
- ❑ Will prepare when receive warning from government authorities in flood forecast and warning
- ❑ Will be able to live with flood

- ❑ Other; please specify ....

(8) Your feeling to the current forecasting and warning systems

- ❑ Accurate and very reliable
- ❑ Not very good, but better than nothing
- ❑ Not very good, but useful combining with other information
- ❑ Not good, not reliable, and never been useful
- ❑ Other; please specify ....

(9) What you want to have, or to improve the forecasting and warning systems

- ❑ Information display to be more easier to understand
- ❑ More frequency of information update
- ❑ Earlier of warnings
- ❑ Increase accuracy of forecasting
- ❑ Add more channels to approach sources of information and warnings
- ❑ Other; please specify ....

Appendix A-3

Questionnaire Survey
on
2011 Flood Forecasting & Warning System
(Questions to Local Agency)

(1) Area of responsibility

(1-1) Area of responsibility (Sub-district / District / Province)…………………..…

(1-2) Size of area ……………………………………….. sq. km.

(1-3) Amount of people in the responsible area

……………………………………………………… persons

(2) The role of the Authority in forecasting and flood warning in 2011

- ❑ measure and transfer data (skip to 2A, 2B)
- ❑ receive data from other authorities and transfer to local operational units (skip to 2C)
- ❑ receive data from other authorities and transfer to public sectors, such as industries, industrial estates in the area (skip to 2C)
- ❑ receive data from other authorities and transfer to people in the area (skip to 2C)

(2A) Unit to measure and display data within the unit

(2A-1) Measured and displayed data

- ❑ weather i.e. temperature, humidity, air pressure

- ❑ amount or rainfall
- ❑ water level in water ways, including main and secondary water lines, major canals, and water gates
- ❑ other data, such as soil erosion; please specify ……………..……………..………………………………… ……….

(2A-2) Measuring frequency

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week; Please specify……………………..……………..……………………………… ……………………………..

(2A-3) Displaying of the measured data

- ❑ display the measured data within the unit (skip tp 2A-4)
- ❑ not Display the measured data within the unit but transfer the data (skip to 2C)

(2A-4) Display channels of the measured data

- ❑ Authority's official website; please specify address …..………………………………………….……….…………….

- ❑ other authority's website; please specify address

  ……….…………………………………….……………………….………………

- ❑ other; please specify

  …………………………….……………….…………………………………

  …………………………………………..……

(2A-5) Pattern of the data display

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please
  specify ....……………..………………………………..………

  ……..……...

(2A-5) Immediacy to display data

- ❑ prompt after field measurement
- ❑ not prompt after field measurement

(2A5) Data display frequency

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly

- ❑ Once over a week; Please specify

  ……..…………………..…………………………………………..………

  ……………………..

(2B) Local authority to measure and transfer the data

(2B-1) Authority that the data will be transferred to; please specify

…………………………..…………………………………

(2B-2) Pattern of data transfer

- ❑ electronic file via e-mail
- ❑ facsimile
- ❑ telephone
- ❑ via social network, please specify

  ……………………..……………..……………..……………..………

  ……………………..
- ❑ other; please specify

  …………………………………………..………..………………..

  ……………..……………………………

(2B-3) pattern of the transferred data

- ❑ numeric
- ❑ graph
- ❑ Short Message
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration

- ❑ other, please
  specify ....………..……..
  ……………..…………….……..........

(2B-4) immediacy in transferring the data

- ❑ prompt after field measurement
- ❑ not prompt after field measurement

(2B-5) frequency of data transfer

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week; Please
  specify……………………………..……………….………………
  ..………….……..………………….

(2B-6) Sufficiency of the incurred data

- ❑ sufficient for processing or making decision
- ❑ insufficient, please specify more information required
  ……………………………………………………………
  (if there will not be processing or making decision, skip to 2D)

(2B-7) Processing of

- ❑ water level forecast; please identify period of time
  ……………………………………………………………………
- ❑ water level at the lowest reaches; please specify the farthest
  area to forecast ……………………….

- ❑ erosion or other forms of disaster; please specify forms of disaster ………………………………………..
- ❑ other data, such as soil erosion, please specify ……………..………………..…………………………………………

(2B-8) Objectives of data processing

- ❑ to send the processed results to the federal government authorities to set national guidelines
- ❑ to send the processed results to the central government authorities
- ❑ to send the processed results to the level of local government authorities
- ❑ to send the processed results to the business sectors, such as industrial estates
- ❑ to send the processed results to the citizen
- ❑ to send the processed results to the mass communications
- ❑ other objectives; please specify ....

(2B-9) Frequency of data processing

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly

- ❑ once over a week; Please Specify
  ………………………………………………………………………………
  ……………………

(2B-10) Pattern of the display of data processed

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please
  specify ....
  ....

(2B-11) Accuracy of the data processing

- ❑ 100% accuracy
- ❑ minimal deviation (less than 20%)
- ❑ medium deviation (21% - 50%)
- ❑ maximum deviation (51% - 80%)
- ❑ reliable but need to comply with other information please
  specify …………………………………………
- ❑ (skip to 3A)

(2C) Data unit to receive

(2C-1) receive from (specify authority)

…………………………………………………………………………………………
………………………

(2C-2) Data received

- ❑ weather i.e. temperature, humidity, air pressure
- ❑ amount or rainfall
- ❑ water level in water ways, including main and secondary water lines, major canals, and water gates
- ❑ other; please specify ....

(2C-3) Frequency of data received

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week; Please specify

………………………..…………………………………………………

……………………..

(2C-4) Sufficiency of the incurred or received data

- ❑ sufficient for processing or making decision
- ❑ insufficient, please specify more information required

……………………………………….……………………………

(if there will not be data processing or making decision, please skip to 2D)

(2C-5) Processing of

- ❑ water level forecast; please identify period of time ……………………………………………………………….…
- ❑ water level at the lowest reaches; please specify the farthest area to forecast …………………….
- ❑ erosion or other forms of disaster; please specify forms of disaster …………………………………………..
- ❑ other data, such as soil erosion, please specify ……………………..………………………..…………………………..

(2C-6) Objectives of data processing

- ❑ to send the processed results to the federal government authorities to set national guidelines
- ❑ to send the processed results to the central government authorities
- ❑ to send the processed results to the level of local government authorities
- ❑ to send the processed results to the business sectors, such as industrial estates
- ❑ to send the processed results to the citizen
- ❑ to send the processed results to the mass communications.
- ❑ other objectives; please specify ....

(2C-7) Frequency of data processing

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day

- ❑ weekly
- ❑ once over a week; Please specify…………………………………………………………… ………………………………..

(2C-8) Pattern of the display of data processed

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please specify ....

(2C-9) Accuracy of the data processing

- ❑ 100% accuracy
- ❑ minimal deviation (less than 20%)
- ❑ medium deviation (21% - 50%)
- ❑ maximum deviation (51% - 80%)
- ❑ reliable but need to comply with other information please specify …………………………………………………

(2D) Data transfer

(2D-1) Government authorities to transfer the data to

- ❑ federal government authorities
- ❑ central government authorities

- ❑ local government authorities
- ❑ public sectors and business organizations
- ❑ citizen
- ❑ mass communications

(2D-2) Immediacy of data transfer

- ❑ prompt after field measurement
- ❑ not prompt after field measurement

(2D-3) Frequency of data transfer

- ❑ once per hour
- ❑ more than once per hour
- ❑ once per day
- ❑ more than once per day
- ❑ weekly
- ❑ once over a week; Please specify……………………………………………………………… ……..……………………..…

(2D-4) Pattern of the transferred data

- ❑ numeric
- ❑ graph
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please specify ....

(2D-5) Error incurred from data transfer

- ❑ none
- ❑ occasionally (skip to 2D-6)
- ❑ often (skip to 2D-6)

(2D-6) Identifying source of error

- ❑ human error
- ❑ computer error or from other tools, please specify ....
- ❑ miscommunication
- ❑ natural disruption, such as power outage, lightening, etc.; please specify ....
- ❑ other; please specify ....
  ....

(3) Data displaying

(3A) Data displaying / transferring during monitoring period before flooding in 2011

(3A-1) Data displaying / transferring during monitoring period before flooding in 2011

- ❑ data displaying / transferring - normal case
- ❑ data displaying / transferring - more frequent than normal case, but no emergency alarm
- ❑ data displaying / transferring - more frequent than normal case, and emergency alarm

- ❑ no data displaying / transferring - because
  ……………………………………………………………………………………
  ……

(3A-2) Pattern of displayed/transferred data

- ❑ numeric
- ❑ graph
- ❑ short message
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please
  specify ....
  ....

(3A-3) Data display / data transfer

- ❑ display / transfer only data measured and processed within the unit
- ❑ display / transfer only data measured and processed data that were transferred from other units
- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units
- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units, but display / transfer only selected part of the data (not display/transfer all of them)

Reason of not display/transfer all of the existing data

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

……………………………………………………………………………

………….

(3A-4) Displayed / transferred data

- ❑ rain level outside the responsible area, or above water basis
- ❑ rain level in the responsible area
- ❑ water level outside the responsible area
- ❑ water level in rivers, canals, in the monitoring spots in the responsible areas
- ❑ situation forecast (skip to 3A-5)
- ❑ information for evacuation and assistance during the flood (skip to 3A-6, 3A-7, 3A-8)
- ❑ other; please specify ....

(3A-5) Data of situation forecast to display

- ❑ rain level forecast; please identify period of time ……………………………………………………………..………
- ❑ water level forecast; please identify period of time ....
- ❑ other ....

(3A-6) Displayed and transferred data of flood warning / evacuation

- ❑ amount / locations of evacuation camps
- ❑ evacuation routes if the water level increases
- ❑ name list of contact persons or officials or agencies to contact for assistance when to evacuate

(3A-7) Evacuation time

- ❑ before water level in the area increases
  ………………………………………………… hour(s) / day
- ❑ during the time of water level increase
- ❑ information of water level, but no signal of evacuation

(3A-8) Channels of evacuation information

- ❑ inform via phone call
- ❑ send short message via phone
- ❑ verbal information
- ❑ other; please specify…………………………………………………………… …………………………………………

(3B) Data displaying / transferring during monitoring period during flooding in 2011

(3B-1) Data displaying / transferring during monitoring period during flooding in 2011

- ❑ data displaying / transferring - normal case

- ❑ data displaying / transferring - more frequent than normal case, but no special warning
- ❑ data displaying / transferring - more frequent than normal case, and information of evacuation
- ❑ no data displaying / transferring - because ……………………………………………………………………………………

(3B-2) Pattern of data displaying / transferring during flooding in 2011

- ❑ numeric
- ❑ graph
- ❑ short message
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please specify ....

(3B-3) Data display / data transfer

- ❑ display / transfer only data measured and processed within the unit
- ❑ display / transfer only data measured and processed data that were transferred from other units
- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units

- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units, but display / transfer only selected part of the data (not display/transfer all of them)
  Reason of not display/transfer all of the existing data
  …………………………………………………………………….

(3B-4) Displayed / transferred data

- ❑ rain level outside the responsible area, or above water basis
- ❑ rain level in the responsible area
- ❑ water level outside the responsible area
- ❑ water level in rivers, canals, in the monitoring spots in the responsible areas
- ❑ situation forecast (skip to 3B-5)
- ❑ information for evacuation and assistance during the flood (skip to 3B-6, 3B-7, 3B-8)
- ❑ other; please
  Specify ....
  ....

(3B-5) Data of situation forecast to display

- ❑ rain level forecast; please identify period of time
  ………………………………………………………………………………
- ❑ water level forecast; please identify period of time ....
- ❑ other ....
  ....

(3B-6) Displayed and transferred data of flood warning / evacuation

- ❑ amount / locations of evacuation camps
- ❑ evacuation routes if the water level increases
- ❑ name list of contact persons or officials or agencies to contact for assistance
- ❑ when to evacuate

(3B-7) Evacuation time

- ❑ before water level in the area increases
  ………………………………………………… hour(s) / day
- ❑ during the time of water level increase
- ❑ information of water level, but no signal of evacuation

(3B-8) Channels of evacuation information

- ❑ inform via phone call
- ❑ send short message via phone
- ❑ verbal information
- ❑ other; please
  specify……………………………………………………………
  ………………………………………………….

(3C) Data displaying / transferring during monitoring period after flooding in 2011

(3C-1) Data displaying / transferring during monitoring period after flooding in 2011

- ❑ data displaying / transferring - normal case

- ❑ data displaying / transferring - more frequent than normal case, but no special information
- ❑ data displaying / transferring - more frequent than normal case, and special information of ....
- ❑ no data displaying / transferring - because …………………………………………………..………………… ……

(3C-2) Pattern of data displaying / transferring during recovery after flooding in 2011

- ❑ numeric
- ❑ graph
- ❑ short message
- ❑ footages from the measuring point
- ❑ animation, simulation of situation and location
- ❑ narration
- ❑ other, please specify ....

(3C-3) Data display / data transfer

- ❑ display / transfer only data measured and processed within the unit
- ❑ display / transfer only data measured and processed data that were transferred from other units

- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units
- ❑ display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units, but display / transfer only selected part of the data (not display/transfer all of them)

  Reason of not display/transfer all of the existing data

  …………………………………………………………………

(3C-4) Displayed / transferred data

- ❑ rain level outside the responsible area, or above water basis
- ❑ rain level in the responsible area
- ❑ water level outside the responsible area
- ❑ water level in rivers, canals, in the monitoring spots in the responsible areas
- ❑ situation forecast (skip to 3C-5)
- ❑ information for evacuation and assistance after the flood (skip to 3C-6, 3C-7, 3C-8)
- ❑ other; please

  Specify ....

  ....
- ❑ rain level forecast; please identify period of time

  ……………………………………………………………………………
- ❑ water level forecast; please identify period of

  time ....

- ❑ other

  ……..
  ....

(3C-6) Information of assistance after the flood

- ❑ name list of contact persons or officials or agencies to contact for assistance compensation, monetary aid from the government
- ❑ other; please specify

  ………………………………..……………………………………
  ……………………..……………

(3C-7) Period of information

- ❑ incurred flood in some of responsible areas
- ❑ when the water dries out until

  ………………….. day(s) / month after the situation is back to normal

(3C-8) Channels of information

- ❑ via phone call
- ❑ short message via phone
- ❑ verbal information
- ❑ other; please specify

  ……………………………………………………………………………
  ……………………………………………

(4) Satisfaction towards The role of the authority in forecasting and flood warning in 2011

- ❑ the most useful, maximum satisfactory level towards the authority
- ❑ moderate satisfactory level towards the authority (go to 4A)
- ❑ less satisfactory level towards the authority (go to 4A)

(4A) Reason(s) of moderate or less satisfactory level towards the authority (please specify) ....

....

....

....

....

....

(5) Problem or obstacle in forecasting and flood warning in 2011

- ❑ un-readiness / insufficient of personnel
- ❑ un-readiness / insufficient of tools
- ❑ confusion of hierarchal order of commander
- ❑ no support from other coordinating authorities
- ❑ uncontrollable natural disaster, such as power outage, lightening, etc.

- ❑ other, please specify ....

(6) Suggestion for the authority for responsible role in forecasting and flood warning in the future

....
....
....
....
....
....

Appendix B

(Questionnaire Result: Farmer)

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
1	**Information of the responder**												
	(1-1) Gender												
	Female	16	44.44%	23	54.76%	7	30.43%	12	40.00%	10	33.33%	68	42.24%
	Male	20	55.56%	19	45.24%	16	69.57%	18	60.00%	20	66.67%	93	57.76%
	Sum	36		42		23		30		30		161	
	(1-2) Age												
	Under 20		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	21-30 years old	3	8.33%	1	2.38%		0.00%		0.00%	4	13.33%	8	4.97%
	31-40 years old	5	13.89%	9	21.43%	8	34.78%	3	10.00%	8	26.67%	33	20.50%
	41-50 years old	8	22.22%	15	35.71%	11	47.83%	10	33.33%	11	36.67%	55	34.16%
	51-60 years old	9	25.00%	16	38.10%	0	0.00%	13	43.33%	6	20.00%	44	27.33%
	Over 60 years old	11	30.56%	1	2.38%	4	17.39%	4	13.33%	1	3.33%	21	13.04%
	Sum	36		42		23		30		30		161	
	(1-3) Occupation												
	Farmer, plants	36		42		23		30		30		161	
	Government officer												
	Public sector (organizations, companies)												
	Public sector (in industrial estate ....)												
	Other; please specify												
	Student												
	Employer												
	Merchant												
	House-Wife												
	Etc.												
	Sum	36		42		23		30		30		161	
	(1-4) Type of accommodation during 2011 flood												
	Single story house	20	55.56%	19	45.24%	5	21.74%	27	90.00%	21	70.00%	92	57.14%
	Multi-story house	16	44.44%	23	54.76%	18	78.26%	3	10.00%	9	30.00%	69	42.86%
	Economic building		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Other; please specify		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	36		42		23		30		30		161	
2	**Severity of the 2011 Flood**												
	(2-1) Damage cased and depth of flood												
	Besiege, but only outside the house	4	11.11%	8	19.05%	3	13.04%	4	13.33%	1	3.33%	20	12.42%
	Cover 1st floor, but not conceal the whole level	26	72.22%	31	73.81%	20	86.96%	24	80.00%	27	90.00%	128	79.50%
	Rise to 2nd floor of the house	6	16.67%	3	7.14%		0.00%	2	6.67%	2	6.67%	13	8.07%
	Sum	36		42		23		30		30		161	
	(2-2) Period of time of the water approach until highest flood water level												
	Less than 3 hours	7	19.44%	8	19.05%	3	13.04%		0.00%		0.00%	18	11.18%
	3 – 6 hours	7	19.44%	5	11.90%	3	13.04%	2	6.67%		0.00%	17	10.56%
	6 – 12 hours		0.00%		0.00%		0.00%	2	6.67%	2	6.67%	4	2.48%
	12 – 24 hours	6	16.67%	8	19.05%	6	26.09%	4	13.33%	2	6.67%	26	16.15%
	Over 1 day	16	44.44%	16	38.10%	5	21.74%	22	73.33%	26	86.67%	85	52.80%
	Sum	36		42		23		30		30		161	
	(2-3) Period of time of the water approach until water dry out												
	less than 1 week		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	1 – 2 weeks		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	2 – 3 weeks	1	2.78%	1	2.38%		0.00%	1	3.33%	2	6.67%	5	3.11%
	1 – 2 months	14	38.89%	18	42.86%	3	13.04%	14	46.67%	13	43.33%	62	38.51%
	Over 2 months	21	58.33%	22	52.38%	20	86.96%	15	50.00%	15	50.00%	93	57.76%
	Sum	36		42		23		30		30		161	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
3 Receive of warning during monitoring period / before flood reach the area												
Receive of information / warning												
Received information	29	80.56%	31	73.81%	20	86.96%	24	80.00%	25	83.33%	129	80.12%
Did not receive the information	7	19.44%	11	26.19%	3	13.04%	6	20.00%	5	16.67%	32	19.88%
Sum	36		42		23		30		30		161	
(3-A)												
(3-A-1) Receive information from												
Central government authority	2	6.90%	2	6.45%	1	5.00%	5	20.83%	4	16.00%	14	10.85%
Local government authority	19	65.52%	23	74.19%	17	85.00%	24	100.00%	25	100.00%	108	83.72%
From local people	6	20.69%	9	29.03%	4	20.00%	24	100.00%	3	12.00%	46	35.66%
From local people network	8	27.59%	6	19.35%	1	5.00%	24	100.00%	19	76.00%	58	44.96%
Other sources	2	6.90%	2	6.45%	0	0.00%		0.00%		0.00%	4	3.10%
Sum	37		42		23		77		51		230	
(3-A-2) Channel of information received												
Television	3	10.34%	19	61.29%	13	65.00%	19	79.17%	23	92.00%	77	59.69%
Radio	2	6.90%	3	9.68%	4	20.00%	24	100.00%	25	100.00%	58	44.96%
Telephone (alarm call)				0.00%	2	10.00%	9	37.50%		0.00%	11	8.53%
Telephone (short message)				0.00%		0.00%		0.00%		0.00%		
Social network				0.00%	2	10.00%		0.00%		0.00%	2	1.55%
Word of mouth	20	68.97%	17	54.84%	15	75.00%	22	91.67%	25	100.00%	99	76.74%
Announcement by amplifying car	17	58.62%	13	41.94%	13	65.00%	12	50.00%	5	20.00%	60	46.51%
Other	6	20.69%	9	29.03%	0	0.00%	3	12.50%		0.00%	18	13.95%
Sum	48		61		49		89		78		325	
(3-A-3) Information received												
Weather inf i.e. weather such as temperature, humidity, air pressure			2	6.45%					15	60.00%	17	13.18%
Amount of rain unpstream	10	34.48%	19	61.29%	12	60.00%	18	75.00%	22	88.00%	81	62.79%
Amount of rain in the area	11	37.93%	24	77.42%	12	60.00%	20	83.33%			67	51.94%
Level of water in rivers, canals, nearby waterways	23	79.31%	24	77.42%	12	60.00%	20	83.33%	25	100.00%	104	80.62%
Sea level	1	3.45%			1	5.00%					2	1.55%
Predicted data of rainfalls, in advance of ………….. hours / day											0	0.00%
Predicted of water level, specify certain point of prediction …………. in advance of ....hrs / d											0	0.00%
Define the period of time to move away from residential areas	10	34.48%	4	12.90%							14	10.85%
Amount of / Location of evacuation points	5	17.24%		0.00%							5	3.88%
Evacuation routes in case of increasing of water level	3	10.34%	5	16.13%	2	10.00%			1	4.00%	11	8.53%
Name list of contact persons or officials or agencies to contact for assistance	4	13.79%	5	16.13%	2	10.00%	8	33.33%			19	14.73%
Other; please specify …………………………………………………											0	0.00%
Sum	67		83		41		66		63		320	
(3-A-4) The received information is sufficient or not												
Sufficient	24	82.76%	25	80.65%	15	75.00%	23	95.83%	22	88.00%	109	84.50%
Insufficient and need more information, i.e.	5	17.24%	6	19.35%	5	25.00%	1	4.17%	3	12.00%	20	15.50%
Weather information, i.e. weather such as temperature, humidity, air pressure	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Amount of rain over the water basis area or other areas	1	20.00%	1	16.67%		0.00%		0.00%	3	100.00%	5	25.00%
Amount of rain in the area	0	0.00%	2	33.33%		0.00%		0.00%		0.00%	2	10.00%
Level of water in rivers, canals, nearby waterways	3	60.00%	1	16.67%	1	20.00%		0.00%	3	100.00%	8	40.00%
Sea level	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted data of rainfalls, in advance of ………….. hours / day	0	0.00%	1	16.67%		0.00%		0.00%	1	33.33%	2	10.00%
Predicted of water level, specify certain point of prediction …….in advance of ....hrs / d	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Define the period of time to move away from residential areas	0	0.00%		0.00%	2	40.00%		0.00%	2	66.67%	4	20.00%
Amount of / Location of evacuation points	1	20.00%		0.00%	3	60.00%		0.00%	3	100.00%	7	35.00%
Evacuation routes in case of increasing of water level	1	20.00%	1	16.67%	4	80.00%	1	100.00%	3	100.00%	10	50.00%
Name list of contact persons or officials or agencies to contact for assistance	3	60.00%		0.00%	1	20.00%		0.00%	3	100.00%	7	35.00%
Other; please specify ………………………………………………	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	9		6		11		1		18		45	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(3-A-5) Patterns of the information received	0											
Numeric	1	3.45%	1	3.23%	2	10.00%	24	100.00%	25	100.00%	53	41.09%
Graph	0	0.00%		0.00%	2	10.00%		0.00%		0.00%	2	1.55%
Footages from the measuring point	1	3.45%	8	25.81%	2	10.00%		0.00%		0.00%	11	8.53%
Animation, simulation of situation and location	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Narration	29	100.00%	29	93.55%	15	75.00%	24	100.00%	25	100.00%	122	94.57%
Other, please specify	0	0.00%		0.00%		0.00%	10	41.67%		0.00%	10	7.75%
Sum	31		38		21		58		50		198	
(3-A-6) Period of time in receiving the information	0											
Over 1 week before the water reaches the area	8	27.59%	6	19.35%	2	10.00%		0.00%		0.00%	16	12.40%
1 week before the water reaches the area	7	24.14%	8	25.81%	14	70.00%	8	33.33%	14	56.00%	51	39.53%
3- 7 days before the water reaches the area	9	31.03%	12	38.71%	3	15.00%	11	45.83%	8	32.00%	43	33.33%
1-2 days before the water reaches the area	3	10.34%	4	12.90%	1	5.00%	5	20.83%	3	12.00%	16	12.40%
Within the day the water reaches the area	2	6.90%	1	3.23%		0.00%		0.00%		0.00%	3	2.33%
Sum	29		31		20		24		25		129	
(3-A-7) Frequency of information update												
Once per hour	1	3.45%	2	6.45%		0.00%		0.00%		0.00%	3	2.33%
More than once per hour	6	20.69%		0.00%		0.00%		0.00%		0.00%	6	4.65%
Once per day	11	37.93%	11	35.48%	4	20.00%	24	100.00%	24	96.00%	74	57.36%
More than once per day	9	31.03%	5	16.13%	9	45.00%		0.00%	1	4.00%	24	18.60%
Weekly	2	6.90%	13	41.94%	5	25.00%		0.00%		0.00%	20	15.50%
Once over a week; Please specify…………………………………	0	0.00%		0.00%	2	10.00%		0.00%		0.00%	2	1.55%
Sum	29		31		20		24		25		129	
(3-A-8) The information is reliable or not												
Less reliable	0	0.00%	1	3.23%	1	5.00%	1	4.17%	2	8.00%	5	3.88%
Average reliable	17	58.62%	4	12.90%	8	40.00%	12	50.00%	18	72.00%	59	45.74%
Very reliable	12	41.38%	26	83.87%	11	55.00%	11	45.83%	5	20.00%	65	50.39%
Sum	29		31		20		24		25		129	
(3-A-9) The information received is useful or not											0	
Less useful	2	6.90%	1	3.23%	2	10.00%	3	12.50%		0.00%	8	6.20%
Average useful	13	44.83%	4	12.90%	6	30.00%	7	29.17%	12	48.00%	42	32.56%
Very useful	14	48.28%	26	83.87%	12	60.00%	14	58.33%	13	52.00%	79	61.24%
Sum	29		31		20		24		25		129	
(3-A-10) Satisfaction towards flood forecast and warning <u>before flooding</u>												
Not satisfied at all	2	6.90%	1	3.23%	3	15.00%	1	4.17%		0.00%	7	5.43%
Less satisfied	6	20.69%	2	6.45%	7	35.00%	3	12.50%	3	12.00%	21	16.28%
Average satisfied	10	34.48%	7	22.58%	5	25.00%	13	54.17%	6	24.00%	41	31.78%
Very satisfied	11	37.93%	21	67.74%	5	25.00%	7	29.17%	16	64.00%	60	46.51%
Sum	29		31		20		24		25		129	
(3-A-11) Things to get improved in flood forecast and warning <u>before flooding</u>												
Accuracy of flood forecast and warning	24	82.76%	19	61.29%	9	45.00%	14	58.33%	20	80.00%	86	66.67%
Frequency, to increase frequency of data update	4	13.79%		0.00%		0.00%		0.00%		0.00%	4	3.10%
More than once per hour			2								2	
Once per hour	2				8						10	
Once per day	0		5		4				1		10	
More than once per day	0		2				10		17		29	
Weekly	2		2								4	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(3-A-11)	Advance notification	19	65.52%	19	61.29%	13	65.00%	14	58.33%	24	96.00%	89	68.99%
(Cont'd)	1 month before water approach	11		6		2		14		1		34	
	1-4 weeks before water approach	1		4		5				19		29	
	3-7 days before water approach	7		9		6				4		26	
	1 day before water approach											0	
	Add more channels of data information, via		0.00%		0.00%	4	20.00%		0.00%		0.00%	4	3.10%
	Require more information	18	62.07%	15	48.39%	11	55.00%	24	100.00%	3	12.00%	71	55.04%
	Change patterns of the data	4	13.79%		0.00%	5	25.00%	0	0.00%	27	108.00%	36	27.91%
	Numeric									7		7	
	Graph											0	
	Footages from the measuring point					2				1		3	
	Animation, simulation of situation and location											0	
	Narration	4				3				19		26	
	Other, please specify											0	
												0	
(3-B)												0	
(3-B-1) Channel to receive information before flooding												0	
	television	2	28.57%	1	9.09%		0.00%	4	66.67%	5	100.00%	12	37.50%
	radio	2	28.57%	6	54.55%		0.00%		0.00%	5	100.00%	13	40.63%
	telephone (alarm call)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	telephone (short message)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	social network i.e. internet		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	word of mouth	4	57.14%	6	54.55%	1	33.33%		0.00%	4	80.00%	15	46.88%
	announcement within community by amplifying car	4	57.14%	10	90.91%	2	66.67%	2	33.33%	1	20.00%	19	59.38%
	other; please specify		0.00%	7	63.64%	2	66.67%		0.00%		0.00%	9	28.13%
	Sum	12		30		5		6		15		68	
(3-B-2) Required information													
	weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	amount of rain over the water basis area or other areas □ amount of rain in the area	2	28.57%	8	72.73%	1	33.33%	2	33.33%	4	80.00%	17	53.13%
	level of water in rivers, canals, nearby waterways	5	71.43%	9	81.82%	1	33.33%	2	33.33%	2	40.00%	19	59.38%
	sea level	7	100.00%	10	90.91%	2	66.67%	2	33.33%	2	40.00%	23	71.88%
	predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	predicted of water level, specify certain point of prediction ………..…in advance of ....hrs / d		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	define the period of time to move away from residential areas		0.00%		0.00%		0.00%		0.00%	3	60.00%	3	9.38%
	amount of / Location of evacuation points	3	42.86%	2	18.18%	1	33.33%		0.00%		0.00%	6	18.75%
	evacuation routes in case of increasing of water level	1	14.29%	1	9.09%	1	33.33%		0.00%	5	100.00%	8	25.00%
	name list of contact persons or officials or agencies to contact for assistance		0.00%	2	18.18%	1	33.33%		0.00%	5	100.00%	8	25.00%
	other; please specify ……………………………………………	1	14.29%		0.00%	1	33.33%	4	66.67%	4	80.00%	10	31.25%
	Sum	19		32		8		10		25		94	
(3-B-3) Patterns of the require information													
	numeric		0.00%		0.00%		0.00%	1	16.67%	4	80.00%	5	15.63%
	graph		0.00%		0.00%		0.00%	2	33.33%	4	80.00%	6	18.75%
	footages from the measuring point	2	28.57%	7	63.64%		0.00%		0.00%		0.00%	9	28.13%
	animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	narration	7	100.00%	11	100.00%	3	100.00%	3	50.00%	4	80.00%	28	87.50%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	9		19		3		6		12		49	
(3-B-4) Period of time to receive the information													
	over 1 week before the water reaches the area	4	57.14%	1	9.09%		0.00%		0.00%		0.00%	5	15.63%
	1 week before the water reaches the area		0.00%	5	45.45%	2	66.67%		0.00%	4	80.00%	11	34.38%
	3- 7 days before the water reaches the area	3	42.86%	5	45.45%	1	33.33%	2	33.33%	1	20.00%	12	37.50%
	1-2 days before the water reaches the area		0.00%		0.00%		0.00%	4	66.67%		0.00%	4	12.50%
	within the day the water reaches the area		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	7		11		3		6		5		32	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
	(3-B-5) Frequency of information update												
	once per hour		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	more than once per hour		0.00%	1	9.09%		0.00%		0.00%		0.00%	1	3.13%
	once per day	2	28.57%	5	45.45%	3	100.00%	6	100.00%	3	60.00%	19	59.38%
	more than once per day	3	42.86%	5	45.45%		0.00%		0.00%	2	40.00%	10	31.25%
	weekly	2	28.57%	0	0.00%		0.00%		0.00%		0.00%	2	6.25%
	once over a week;		0.00%	0	0.00%		0.00%		0.00%		0.00%	0	0.00%
	please specify ………………………………………		0.00%	0	0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	7		11		3		6		5		32	
4	**Channel to receive flood warning during flooding**											**0**	
												0	
	Information / warning receive											0	
	Received in (skip to 4-A)	23	63.89%	28	66.67%	19	82.61%	24	80.00%	29	96.67%	123	76.40%
	Did not rece (skip to 4-B)	13	36.11%	14	33.33%	4	17.39%	6	20.00%	1	3.33%	38	23.60%
	Sum	36		42		**23**		30		30		161	
	(4-A)												
	(4-A-1) Receive information from												
	Central government authority	2	8.70%	3	10.71%	2	10.53%	18	75.00%		0.00%	25	20.33%
	Local government authority	16	69.57%	17	60.71%	16	84.21%	22	91.67%	26	89.66%	97	78.86%
	From local people	7	30.43%	13	46.43%	4	21.05%	24	100.00%	23	79.31%	71	57.72%
	From local people network	6	26.09%	6	21.43%	4	21.05%	10	41.67%	18	62.07%	44	35.77%
	other; please specify ……………………………………………	0	0.00%	0	0.00%	3	15.79%		0.00%		0.00%	3	2.44%
	Sum	31		39		29		74		67		240	
	(4-A-2) Channels of information received												
	Television	4	17.39%	16	57.14%	11	57.89%	22	91.67%		0.00%	53	43.09%
	Radio	2	8.70%	4	14.29%	1	5.26%	24	100.00%	29	100.00%	60	48.78%
	telephone (alarm call)	0	0.00%		0.00%	1	5.26%	3	12.50%		0.00%	4	3.25%
	telephone (short message)	0	0.00%		0.00%	1	5.26%		0.00%		0.00%	1	0.81%
	social network i.e. internet	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Word of mouth	21	91.30%	20	71.43%	9	47.37%	24	100.00%	24	82.76%	98	79.67%
	Announcement by amplifying car	11	47.83%	7	25.00%	9	47.37%	12	50.00%		0.00%	39	31.71%
	other; please specify ……………………………………………	2	8.70%	18	64.29%		0.00%		0.00%		0.00%	20	16.26%
	Sum	40		65		32		85		53		275	
	(4-A-3) Information received	0										0	
	weather information, i.e. weather such as temperature, humidity, air pressure	0	0.00%	6	21.43%		0.00%		0.00%		0.00%	6	4.88%
	Amount of rain upstream	10	43.48%	21	75.00%	8	42.11%	15	62.50%	20	68.97%	74	60.16%
	Amount of rain in the area	10	43.48%	9	32.14%	5	26.32%	4	16.67%	7	24.14%	35	28.46%
	Level of water in rivers, canals, nearby waterways	17	73.91%	20	71.43%	7	36.84%	24	100.00%	23	79.31%	91	73.98%
	sea level	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Predicted data of rainfalls, in advance of ………….. hours / day	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	predicted of water level, specify certain point of prediction ....in advance of ....hrs / d	2	8.70%		0.00%		0.00%		0.00%		0.00%	2	1.63%
	define the period of time to move away from residential areas	0	0.00%	3	10.71%	6	31.58%		0.00%	3	10.34%	12	9.76%
	amount of / Location of evacuation points	0	0.00%		0.00%		0.00%		0.00%	23	79.31%	23	18.70%
	Evacuation routes	0	0.00%	5	17.86%		0.00%		0.00%	18	62.07%	23	18.70%
	Name list of contact for assistance	0	0.00%	7	25.00%		0.00%		0.00%	6	20.69%	13	10.57%
	other; please specify ……………………………………………	0	0.00%	1	3.57%		0.00%		0.00%		0.00%	1	0.81%
	Sum	39		72		26		43		100		280	

	Ayutthaya		**Ang Thong**		**Lopburi**		**Chai Nat**		**Sing Buri**		**Total**	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(4-A-4) The received information is sufficient or not											0	
sufficient	19	82.61%	22	78.57%	16	84.21%	20	83.33%	25	86.21%	102	82.93%
insufficient and require more information	4	17.39%	6	21.43%	3	15.79%	4	16.67%	4	13.79%	21	17.07%
Sum	23		28		19		24		29		123	
weather information, i.e. weather such as temperature, humidity, air pressure	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
amount of rain over the water basis area or other areas	0	0.00%	1	16.67%		0.00%		0.00%	3	75.00%	4	19.05%
amount of rain in the area	0	0.00%	1	16.67%		0.00%		0.00%		0.00%	1	4.76%
level of water in rivers, canals, nearby waterways	0	0.00%	2	33.33%		0.00%		0.00%	3	75.00%	5	23.81%
sea level	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
predicted data of rainfalls, in advance of …………. hrs / d	0	0.00%	1	16.67%		0.00%		0.00%	1	25.00%	2	9.52%
predicted of water level, specify certain point of prediction ……in advance of …..hrs / d	0	0.00%	1	16.67%		0.00%		0.00%		0.00%	1	4.76%
Define the period of time to move away from residential areas	0	0.00%		0.00%		0.00%		0.00%	1	25.00%	1	4.76%
amount of / Location of evacuation points	3	75.00%		0.00%	1	33.33%	4	100.00%	3	75.00%	11	52.38%
evacuation routes in case of increasing of water level	3	75.00%		0.00%	3	100.00%	4	100.00%	1	25.00%	11	52.38%
name list of contact persons or officials or agencies to contact for assistance	3	75.00%		0.00%	3	100.00%	4	100.00%		0.00%	10	47.62%
other; please specify ………………………………………………………	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	9		6		7		12		12		46	
(4-A-5) Patterns of the information received											0	
numeric	1	4.35%	1	3.57%		0.00%	24	100.00%	29	100.00%	55	44.72%
graph		0.00%		0.00%		0.00%	2	8.33%	14	48.28%	16	13.01%
footages from the measuring point	2	8.70%	8	28.57%	3	15.79%		0.00%		0.00%	13	10.57%
animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
narration	22	95.65%	19	67.86%	16	84.21%	23	95.83%	28	96.55%	108	87.80%
other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%	1	3.45%	1	0.81%
Sum	25		28		19		49		72		193	
(4-A-6) Period of time to receive the information			0								0	
over 1 weel before the water reaches the area	8	34.78%	4	14.29%	3	15.79%					15	12.20%
1 week before the water reaches the area	4	17.39%	7	25.00%	10	52.63%			17	58.62%	38	30.89%
3- 7 days before the water reaches the area	5	21.74%	3	10.71%	4	21.05%			2	6.90%	14	11.38%
1-2 days before the water reaches the area	3	13.04%					5	20.83%	4	13.79%	12	9.76%
within the day the water reaches the area	3	13.04%	14	50.00%	2	10.53%	19	79.17%	6	20.69%	44	35.77%
Sum	23		28		19		24		29		123	
(4-A-7) Frequency of information update												
once per hour	2	8.70%	2	7.14%	1	5.26%		0.00%		0.00%	5	4.07%
more than once per hour	4	17.39%	16	57.14%	4	21.05%		0.00%		0.00%	24	19.51%
once per day	10	43.48%	8	28.57%	12	63.16%	20	83.33%	27	93.10%	77	62.60%
more than once per day	6	26.09%	0	0.00%		0.00%	4	16.67%	2	6.90%	12	9.76%
weekly	1	4.35%	2	7.14%	2	10.53%		0.00%		0.00%	5	4.07%
once over a week; please specify ……………………….	0	0.00%	0	0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	23		28		19		24		29		123	
(4-A-8) Credibility of the information received												
less reliable	1	4.35%	2	7.14%	1	5.26%	2	8.33%	16	55.17%	22	17.89%
average reliable	9	39.13%	3	10.71%	5	26.32%	19	79.17%	6	20.69%	42	34.15%
very reliable	13	56.52%	23	82.14%	13	68.42%	3	12.50%	7	24.14%	59	47.97%
Sum	23		28		19		24		29		123	
(4-A-9) The information received is useful or not												
less useful	1	4.35%	1	3.57%	1	5.26%	5	20.83%	6	20.69%	14	11.38%
average useful	10	43.48%	4	14.29%	6	31.58%	5	20.83%	10	34.48%	35	28.46%
very useful	12	52.17%	23	82.14%	12	63.16%	14	58.33%	13	44.83%	74	60.16%
Sum	23		28		19		24		29		123	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(4-A-10) Satisfaction towards flood forecast and warning <u>during flooding</u>												
not satisfied at all	1	4.35%	0	0.00%	2	10.53%		0.00%		0.00%	3	2.44%
less satisfied	1	4.35%	2	7.14%	2	10.53%	7	29.17%	9	31.03%	21	17.07%
average satisfied	8	34.78%	4	14.29%	6	31.58%	11	45.83%	15	51.72%	44	35.77%
very satisfied	13	56.52%	22	78.57%	9	47.37%	6	25.00%	5	17.24%	55	44.72%
Sum	23		28		19		24		29		123	
(4-A-11) Things to be improved in flood forecast and warning <u>during flooding</u>												
accuracy of flood forecast and warning	16	69.57%	21	75.00%	10	52.63%	7	29.17%	24	82.76%	78	63.41%
frequency, to increase frequency of data update	5	21.74%	3	10.71%	3	15.79%	3	12.50%	25	86.21%	39	31.71%
more than once per hour	3		2		2				1		8	
once per hour									13		13	
once per day	2				1				11		14	
more than once per day			1				3				4	
weekly											0	
advance notification	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
1 month before water approach											0	
1-4 weeks before water approach											0	
3-7 days before water approach											0	
1 day before water approach											0	
add more channels of data information, via		0.00%	1	3.57%		0.00%		0.00%		0.00%	1	0.81%
require more information	14	60.87%	7	25.00%	8	42.11%	14	58.33%	20	68.97%	63	51.22%
change patterns of the data to	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
numeric									7		7	
graph							3				3	
footages from the measuring point									15		15	
animation, simulation of situation and location											0	
narration			1		3				7		11	
other, please specify											0	
											0	
(4-B)											0	
(4-B-1) Channel to receive information <u>during flooding</u>											0	
Television	9	69.23%	6	42.86%	3	75.00%		0.00%	1	100.00%	19	50.00%
Radio	2	15.38%	7	50.00%	1	25.00%		0.00%	1	100.00%	11	28.95%
Telephone (alarm call)	2	15.38%		0.00%		0.00%		0.00%		0.00%	2	5.26%
Telephone (short message)	2	15.38%		0.00%		0.00%		0.00%	1	100.00%	3	7.89%
Social network i.e. internet		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Word of mouth	4	30.77%	3	21.43%	2	50.00%	6	100.00%		0.00%	15	39.47%
Announcement within community by amplifying car	12	92.31%	12	85.71%	4	100.00%	4	66.67%		0.00%	32	84.21%
other; please specify ……………………………………………		0.00%	3	21.43%	2	50.00%		0.00%		0.00%	5	13.16%
Sum	31		31		15		10		3		90	
(4-B-2) Required information												
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%	1	16.67%		0.00%	1	2.63%
Amount of rain over the water basis area or other areas	3	23.08%	4	28.57%	3	75.00%	1	16.67%	1	100.00%	12	31.58%
amount of rain in the area	9	69.23%	12	85.71%	4	100.00%	1	16.67%	1	100.00%	27	71.05%
Level of water in rivers, canals, nearby waterways	21	161.54%	8	57.14%	4	100.00%	1	16.67%	1	100.00%	35	92.11%
Sea level		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted of water level, specify certain point of prediction ……………in advance of ....hrs / d		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Define the period of time to move away from residential areas	4	30.77%		0.00%		0.00%		0.00%		0.00%	4	10.53%
Amount of / Location of evacuation points	4	30.77%		0.00%		0.00%		0.00%		0.00%	4	10.53%
Evacuation routes in case of increasing of water level	4	30.77%	1	7.14%		0.00%	1	16.67%	1	100.00%	7	18.42%
Name list of contact persons or officials or agencies to contact for assistance	4	30.77%		0.00%		0.00%	1	16.67%		0.00%	5	13.16%
other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	49		25		15		6		4		99	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(4-B-3) Patterns of the required information												
Numeric	1	7.69%		0.00%		0.00%	4	66.67%	1	100.00%	6	15.79%
Graph		0.00%		0.00%		0.00%		0.00%	1	100.00%	1	2.63%
Footages from the measuring point	1	7.69%	2	14.29%		0.00%		0.00%		0.00%	3	7.89%
Animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Narration	13	100.00%	14	100.00%	4	100.00%	5	83.33%	1	100.00%	37	97.37%
other; please specify …………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	15		16		4		9		3		47	
(4-B-4) Period of time to receive the information												
Over 1 week before flood reaches the area	5	38.46%	2	14.29%		0.00%		0.00%		0.00%	7	18.42%
1 week before flood reaches the area	8	61.54%	12	85.71%	4	100.00%		0.00%		0.00%	24	63.16%
3- 7 days before flood reaches the area	0	0.00%		0.00%	2	50.00%		0.00%	1	100.00%	3	7.89%
1-2 days before flood reaches the area	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Within the day of flood reaches the area	0	0.00%		0.00%		0.00%	6	100.00%		0.00%	6	15.79%
Sum	13		14		6		6		1		40	
(4-B-5) Frequency of information update												
Once per hour	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
More than once per hour	0	0.00%	1	7.14%		0.00%		0.00%		0.00%	1	2.63%
Once per day	7	53.85%	11	78.57%	4	100.00%	6	100.00%	1	100.00%	29	76.32%
More than once per day	4	30.77%	2	14.29%	1	25.00%		0.00%		0.00%	7	18.42%
Weekly	2	15.38%		0.00%	1	25.00%		0.00%		0.00%	3	7.89%
Once over a week; Please specify ………………	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	13		14		9		6		1		43	
5 Receiving of the information after / during recovery period												
Receiving of the information												
Receive the (skip to 5-A)	19	52.78%	21	50.00%	14	60.87%	28	93.33%	28	93.33%	110	68.32%
Did not rec (skip to 5-B)	17	47.22%	21	50.00%	9	39.13%	2	6.67%	2	6.67%	51	31.68%
Sum	36		42		23		30		30		161	
(5-A)												
(5-A-1) Receive information from												
Central government authority	2	10.53%	3	14.29%	0	0.00%	14	50.00%	3	10.71%	22	20.00%
Local government authority	10	52.63%	15	71.43%	14	100.00%	28	100.00%	27	96.43%	94	85.45%
From local people	9	47.37%	6	28.57%	4	28.57%	28	100.00%	3	10.71%	50	45.45%
From local people network	3	15.79%	8	38.10%	3	21.43%	12	42.86%	3	10.71%	29	26.36%
other; please specify …………………………………………	0	0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Sum	24		32		21		82		36		195	
(5-A-2) Channels to receive information												
Television		0.00%	14	66.67%	11	78.57%	8	28.57%	22	78.57%	55	50.00%
Radio	2	10.53%	1	4.76%	3	21.43%	14	50.00%	28	100.00%	48	43.64%
Telephone (alarm call)		0.00%		0.00%	0	0.00%	8	28.57%	1	3.57%	9	8.18%
Telephone (short message)		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Social network i.e. internet		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Word of mouth	16	84.21%	11	52.38%	4	28.57%	28	100.00%	28	100.00%	87	79.09%
Announcement by amplifying car	7	36.84%		0.00%	3	21.43%	14	50.00%	26	92.86%	50	45.45%
other; please specify …………………………………………	3	15.79%	12	57.14%	1	7.14%		0.00%		0.00%	16	14.55%
Sum	28		38		22		72		105		265	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(5-A-3) Information received												
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%	1	7.14%		0.00%		0.00%	1	0.91%
Amount of rain over the water basis area or other areas		0.00%	2	9.52%	0	0.00%		0.00%		0.00%	2	1.82%
amount of rain in the area	6	31.58%	10	47.62%	6	42.86%	5	17.86%	14	50.00%	41	37.27%
Level of water inwaterways	6	31.58%	1	4.76%	5	35.71%		0.00%	17	60.71%	29	26.36%
Predicted data of rainfalls	11	57.89%	12	57.14%	5	35.71%	28	100.00%		0.00%	56	50.91%
Predicted of water level, specify certain point of prediction ……………in advance of ....hs / d		0.00%	1	4.76%	0	0.00%		0.00%		0.00%	1	0.91%
Define the period of time to move away from residential areas	2	10.53%	2	9.52%	6	42.86%		0.00%	3	10.71%	13	11.82%
Amount and Location of evacuation points	10	52.63%	3	14.29%	2	14.29%	13	46.43%	26	92.86%	54	49.09%
Certain period of time to return to residential area		0.00%		0.00%	0	0.00%		0.00%	2	7.14%	2	1.82%
Name list of contact		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
other; please specify ……………………………………………		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Sum	35		31		25		46		62		199	
(5-A-4) The received information is sufficient or not												
Sufficient	18	94.74%	21	100.00%	11	78.57%	28	100.00%	21	75.00%	99	90.00%
Insufficient, and need more information	1	5.26%		0.00%	3	21.43%	0	0.00%	7	25.00%	11	10.00%
Sum	19		21		14		28		28		110	
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%			0	0.00%		#DIV/0!		0.00%	0	0.00%
Amount of rain over the water basis area or other areas		0.00%			1	33.33%		#DIV/0!	3	42.86%	4	36.36%
Amount of rain in the area		0.00%			1	33.33%		#DIV/0!		0.00%	1	9.09%
Level of water in rivers, canals, nearby waterways	1	100.00%			1	33.33%		#DIV/0!	4	57.14%	6	54.55%
Sea level					0						0	
Predicted data of rainfalls, in advance of ………….. hours / day					0				1		1	
Predicted of water level, specify certain point of prediction …………… in advance of ....hrs / d					0						0	
Certain period of time to return to residential area					0						0	
Name list of contact persons or officials or agencies to contact for assistance					0		2		1		3	
other; please specify ……………………………………………					0				1		1	
					0						0	
(5-A-5) Patterns of information received					0						0	
Numeric	1	5.26%		0.00%	0	0.00%	28	100.00%	28	100.00%	57	51.82%
Graph		0.00%		0.00%	0	0.00%	2	7.14%	1	3.57%	3	2.73%
Footages from the measuring point		0.00%	6	28.57%	4	28.57%		0.00%		0.00%	10	9.09%
Animation, simulation of situation and location		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Narration	18	94.74%	21	100.00%	14	100.00%	28	100.00%	28	100.00%	109	99.09%
Other, please specify		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Sum	19		27		18		58		57		179	
(5-A-6) Period of time to receive the information												
the water approach until the water decrease	8	42.11%	3	14.29%	5	35.71%	17	60.71%	10	35.71%	43	39.09%
period of time of the water dry out until the situation is back to normal	11	57.89%	18	85.71%	9	64.29%	20	71.43%	28	100.00%	86	78.18%
Sum	19		21		14		37		38		129	
(5-A-7) Frequency of information update												
Once per hour		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
More than once per hour		0.00%		0.00%	2	14.29%		0.00%		0.00%	2	1.82%
Once per day	9	47.37%	15	71.43%	11	78.57%	28	100.00%	27	96.43%	90	81.82%
More than once per day	3	15.79%	4	19.05%	1	7.14%		0.00%		0.00%	8	7.27%
Weekly	7	36.84%	2	9.52%	0	0.00%		0.00%	1	3.57%	10	9.09%
Once over a week;		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Please specify …………………………………………		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Sum	19		21		14		28		28		110	
(5-A-8) The information received is reliable or not												
Less reliable	1	5.26%		0.00%	0	0.00%	2	7.14%	1	3.57%	4	3.64%
Average reliable	5	26.32%	1	4.76%	5	35.71%	16	57.14%	13	46.43%	40	36.36%
Very reliable	13	68.42%	20	95.24%	9	64.29%	10	35.71%	14	50.00%	66	60.00%
Sum	19		21		14		28		28		110	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
(5-A-9) The information received is useful or not												
Less useful	1	5.26%		0.00%	0	0.00%	4	14.29%	1	3.57%	6	5.45%
Average useful	6	31.58%	1	4.76%	4	28.57%	10	35.71%	15	53.57%	36	32.73%
Very useful	12	63.16%	20	95.24%	10	71.43%	14	50.00%	12	42.86%	68	61.82%
Sum	19		21		14		28		28		110	
(5-A-10) Satisfaction towards flood forecast and warning after flooding												
Not satisfied at all	1	5.26%	1	4.76%	0	0.00%		0.00%		0.00%	2	1.82%
Less satisfied	0	0.00%		0.00%	2	14.29%	12	42.86%	2	7.14%	16	14.55%
Average satisfied	7	36.84%	1	4.76%	7	50.00%	12	42.86%	19	67.86%	46	41.82%
Very satisfied	11	57.89%	19	90.48%	4	28.57%	4	14.29%	7	25.00%	45	40.91%
Sum	19		21		13		28		28		109	
(5-A-11) Things to get improved in flood forecast and warning after flooding												
Accuracy of flood forecast and warning	17	89.47%	14	66.67%	7	50.00%	15	53.57%	21	75.00%	74	67.27%
Frequency, to increase frequency of data update	0	0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
More than once per hour					0						0	
Once per hour					4						4	
Once per day					0				12		12	
More than once per day			2		0		5		5		12	
Weekly					0						0	
Add more channels of data information, via	2	10.53%	1	4.76%	1	7.14%		0.00%	2	7.14%	6	5.45%
Require more information	9	47.37%	5	23.81%	4	28.57%	18	64.29%	23	82.14%	59	53.64%
Change patterns of the data to	2	10.53%		0.00%	0	0.00%		0.00%		0.00%	2	1.82%
Numeric					0						0	
Graph					0						0	
Footages from the measuring point					0						0	
Animation, simulation of situation and location					0						0	
Narration	2		2		1				2		7	
Other, please specify					0						0	
					0						0	
(5-B)					0						0	
(5-B-1) Channel of information required after the flood					0						0	
Television	4	23.53%	9	42.86%	4	44.44%		0.00%		0.00%	17	33.33%
Radio	6	35.29%	11	52.38%	3	33.33%		0.00%		0.00%	20	39.22%
Telephone (alarm call)		0.00%	2	9.52%	0	0.00%		0.00%		0.00%	2	3.92%
Telephone (short message)		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Social network i.e. internet		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Word of mouth	13	76.47%	9	42.86%	3	33.33%		0.00%		0.00%	25	49.02%
Announcement within community by amplifying car	17	100.00%	15	71.43%	7	77.78%	2	100.00%	2	100.00%	43	84.31%
other; please specify ……………………………………………	1	5.88%	5	23.81%	1	11.11%		0.00%		0.00%	7	13.73%
Sum	42		51		18		2		2		115	
(5-B-2) Required information												
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%	1	4.76%	0	0.00%		0.00%		0.00%	1	1.96%
Amount of rain over the water basis area or other areas	4	23.53%	13	61.90%	3	33.33%		0.00%	2	100.00%	22	43.14%
Amount of rain in the area	12	70.59%	13	61.90%	7	77.78%		0.00%		0.00%	32	62.75%
Level of water in rivers, canals, nearby waterways	16	94.12%	17	80.95%	8	88.89%	2	100.00%		0.00%	43	84.31%
Sea level		0.00%	1	4.76%	0	0.00%		0.00%		0.00%	1	1.96%
Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Predicted of water level, specify certain point of prediction …………in advance of ....hrs / d		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Certain period of time to return to residential area	9	52.94%	1	4.76%	0	0.00%		0.00%		0.00%	10	19.61%
Name list of contact persons or officials or agencies to contact for assistance	3	17.65%	1	4.76%	0	0.00%		0.00%		0.00%	4	7.84%
other; please specify ……………………………………………		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
Sum	44		47		18		2		2		113	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
	(5-B-3) Patterns of the information received												
	Numeric	5	29.41%		0.00%	0	0.00%		0.00%		0.00%	5	9.80%
	Graph		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
	Footages from the measuring point		0.00%	2	9.52%	0	0.00%		0.00%		0.00%	2	3.92%
	Animation, simulation of situation and location		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
	Narration	17	100.00%	19	90.48%	9	100.00%	2	100.00%	2	100.00%	49	96.08%
	other; please specify ……………………………………………		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
	Sum	23		21		9		2		2		57	
	(5-B-4) Period of time to receive the information												
	The water approach until the water decrease	13	76.47%	10	47.62%	2	22.22%		0.00%	2	100.00%	27	52.94%
	Period of time of the water dry out until the situation is back to normal	3	17.65%	6	28.57%	2	22.22%	2	100.00%		0.00%	13	25.49%
	Sum	16		16		4		2		2		40	
	(5-B-5) Frequency of information update					0						0	
	Once per hour	1	5.88%		0.00%	0	0.00%		0.00%		0.00%	1	1.96%
	More than once per hour	2	11.76%	1	4.76%	0	0.00%		0.00%		0.00%	3	5.88%
	Once per day	14	82.35%	14	66.67%	7	77.78%	2	100.00%	2	100.00%	39	76.47%
	More than once per day		0.00%	6	28.57%	2	22.22%		0.00%	1	50.00%	9	17.65%
	Weekly	1	5.88%		0.00%	0	0.00%		0.00%		0.00%	1	1.96%
	Once over a week;		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
	Please specify ………………………………………………..…		0.00%		0.00%	0	0.00%		0.00%		0.00%	0	0.00%
	Sum	18		21		9		2		3		53	
6	**Flood preparation**												
	Any preparations to handle the flood or not												
	Preparatior 6-A)	21	58.33%	28	66.67%	11	47.83%	28	93.33%	28	93.33%	116	72.05%
	No prepara (skip to 6-B)	15	41.67%	14	33.33%	12	52.17%	2	6.67%	2	6.67%	45	27.95%
	Sum	36		42		23		30		30		161	
	(6-A)												
	(6-A-1) Time for preparation												
	Before flood forecasting and warning, because	17	80.95%	17	60.71%	2	18.18%	25	89.29%	14	50.00%	75	64.66%
	The area is frequent flooded area	12	70.59%	17	100.00%	2	100.00%	10	40.00%	3	21.43%	44	58.67%
	Informed of floods in other areas	5	29.41%	0	0.00%		0.00%	15	60.00%	11	78.57%	31	41.33%
	other; please specify ……………………………………………	0	0.00%	0	0.00%		0.00%		0.00%		0.00%	0	0.00%
	Once being informed of the forecast and warning	6	28.57%	10	35.71%	8	72.73%	8	28.57%	8	28.57%	40	34.48%
	After being informed of the forecast and warning ………….. day(s)	5	23.81%	1	3.57%	1	9.09%		0.00%	6	21.43%	13	11.21%
	Sum	28		28		11		33		28		128	
	(6-A-2) Preparations												
	Moving things to higher place	20	95.24%	25	89.29%	11	100.00%	28	100.00%	28	100.00%	112	96.55%
	Moving things out of the house or targeted area of flood to other places, at …………………	5	23.81%	1	3.57%	2	18.18%	2	7.14%	2	7.14%	12	10.34%
	Evacuate children and elders out of the area to;	3	14.29%	2	7.14%		0.00%		0.00%		0.00%	5	4.31%
	Evacuation camps, relatives' or acquaintance's accommodations that will not be flooded.	3	100.00%									5	100.00%
	Evacuation camps											0	0.00%
	other; please specify ……………………………………………			2	100.00%							2	40.00%
	Sum	28		28		13		28		28		125	
	(6-B)												
	(6-B-1) Reasons to not prepare to handle flood												
	The area has never being flooded	8	53.33%	9	64.29%	4	33.33%	2	100.00%		0.00%	23	51.11%
	Being flooded in the past, but maybe not this time	6	40.00%	3	21.43%	8	66.67%		0.00%	2	100.00%	19	42.22%
	Do not believe the warning	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Other, please specify	1	6.67%	2	14.29%		0.00%		0.00%		0.00%	3	6.67%
	Sum	15		14		12		2		2		45	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmer	%	Farmers	%
7 Preparation for future flooding												
Any preparation to handle with future flooding or not												
Preparation (skip to 7-A)	11	30.56%	20	47.62%	7	30.43%	27	90.00%	29	96.67%	94	58.39%
No preparat (skip to 7-B)	25	69.44%	22	52.38%	16	69.57%	3	10.00%	1	3.33%	67	41.61%
Sum	36		42		23		30		30		161	
(7-A)												
(7-A-1) Preparation that has been done / ongoing												
Permanently move out of the area		0.00%	1	5.00%	2	28.57%	1	3.70%		0.00%	4	4.26%
Build new house or level up the current house	3	27.27%	7	35.00%	2	28.57%	26	96.30%	29	100.00%	67	71.28%
Build surround walls to prevent water approach	6	54.55%	10	50.00%	3	42.86%		0.00%		0.00%	19	20.21%
other	2	18.18%	2	10.00%		0.00%		0.00%		0.00%	4	4.26%
Sum	11		20		7		27		29		94	
(7-A-2) Reason to prepare to handle with flood by yourself												
Possibility of flood to occur again	9	81.82%	19	95.00%	6	85.71%	20	74.07%	29	100.00%	83	88.30%
Cannot rely on government authorities	1	9.09%	1	5.00%		0.00%	4	14.81%		0.00%	6	6.38%
Cannot rely on the warning or information, better prepare to prevent the situation	1	9.09%		0.00%	1	14.29%	3	11.11%		0.00%	5	5.32%
other; please specify …………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	11		20		7		27		29		94	
(7-B)												
(7-B-1) Reason of not continue preparation in handling with future flooding												
It might never happen again	9	36.00%	9	40.91%	6	37.50%		0.00%		0.00%	24	35.82%
Can ask for assistance from government authorities if it happens again	7	28.00%	2	9.09%	2	12.50%	1	33.33%		0.00%	12	17.91%
Will prepare when receive warning from government authorities in flood forecast and warning	6	24.00%	8	36.36%	7	43.75%	1	33.33%		0.00%	22	32.84%
Will be able to live with flood	2	8.00%	1	4.55%	1	6.25%	1	33.33%	1	100.00%	6	8.96%
other; please specify …………………………………………	1	4.00%	2	9.09%		0.00%		0.00%		0.00%	3	4.48%
Sum	25		22		16		3		1		67	
8 Your feeling to the current forecasting and warning systems												
Accurate and very reliable	5	13.89%	21	50.00%	10	43.48%	2	6.67%	1	3.33%	39	24.22%
Not very good, but better than nothing	15	41.67%	8	19.05%	6	26.09%	10	33.33%	2	6.67%	41	25.47%
Not very good, but useful combining with other information	13	36.11%	10	23.81%	5	21.74%	17	56.67%	26	86.67%	71	44.10%
Not good, not reliable, and never been useful	3	8.33%	3	7.14%	2	8.70%	1	3.33%	1	3.33%	10	6.21%
other; please specify …………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	36		42		23		30		30		161	
9 What you want to have, or to improve the forecasting and warning systems												
Information display to be more easier to understand	15	41.67%	15	35.71%	14	60.87%	4	13.33%	27	90.00%	75	46.58%
More frequency of information update	9	25.00%	7	16.67%	3	13.04%	26	86.67%	4	13.33%	49	30.43%
Earlier of warnings	27	75.00%	28	66.67%	17	73.91%	22	73.33%	30	100.00%	124	77.02%
Increase accuracy of forecasting	16	44.44%	27	64.29%	10	43.48%	14	46.67%	23	76.67%	90	55.90%
Add more channels to approach sources of information and warnings	12	33.33%	5	11.90%	10	43.48%	8	26.67%	4	13.33%	39	24.22%
other; please specify …………………………………………	2	5.56%	2	4.76%	0	0.00%		0.00%		0.00%	4	2.48%
Sum	81		84		54		74		88		381	

Appendix C

(Questionnaire Result: C)

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
1	**Information of the responder**												
	(1-1) Gender												
	Female	24	52.17%	12	66.67%	6	40.00%	16	53.33%	16	53.33%	74	53.24%
	Male	22	47.83%	6	33.33%	9	60.00%	14	46.67%	14	46.67%	65	46.76%
	Sum	46		18		15		30		30		139	
	(1-2) Age												
	Under 20	1	2.17%		0.00%		0.00%		0.00%		0.00%	1	0.72%
	21-30 years old	1	2.17%		0.00%	1	6.67%	1	3.33%	2	6.67%	5	3.60%
	31-40 years old	7	15.22%	6	33.33%	2	13.33%	12	40.00%	12	40.00%	39	28.06%
	41-50 years old	16	34.78%	2	11.11%	5	33.33%	10	33.33%	11	36.67%	44	31.65%
	51-60 years old	12	26.09%	5	27.78%		0.00%	5	16.67%	4	13.33%	26	18.71%
	Over 60 years old	9	19.57%	5	27.78%	7	46.67%	2	6.67%	1	3.33%	24	17.27%
	Sum	46		18		15		30		30		139	
	(1-3) Occupation												
	Farmer, plants											0	
	Government officer	2	4.35%		0.00%	2	13.33%	6	20.00%	8	26.67%	18	12.95%
	Public sector (organizations, companies)	6	13.04%		0.00%	1	6.67%	10	33.33%	5	16.67%	22	15.83%
	Public sector (in industrial estate ....)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Other; please specify	38		18		12		14		17		99	
	Student	1	2.17%	4	22.22%		0.00%	4	13.33%	5	16.67%	14	10.07%
	Employer	9	19.57%	7	38.89%	6	40.00%	3	10.00%	5	16.67%	30	21.58%
	Merchant	13	28.26%	5	27.78%	5	33.33%	7	23.33%	6	20.00%	36	25.90%
	House-Wife	3	6.52%	2	11.11%	1	6.67%		0.00%	1	3.33%	7	5.04%
	Etc.	12	26.09%		0.00%		0.00%		0.00%		0.00%	12	8.63%
	Sum	46		18		15		30		30		139	
	(1-4) Type of accommodation during 2011 flood												
	Single story house	21	45.65%	8	44.44%	8	53.33%	15	50.00%	13	43.33%	65	46.76%
	Multi-story house	23	50.00%	9	50.00%	6	40.00%	10	33.33%	9	30.00%	57	41.01%
	Economic building	1	2.17%		0.00%	1	6.67%	5	16.67%	8	26.67%	15	10.79%
	Other; please specify	1	2.17%	1	5.56%		0.00%		0.00%		0.00%	2	1.44%
	Sum	46		18		15		30		30		139	
2	**Severity of the 2011 Flood**												
	(2-1) Damage cased and depth of flood												
	Besiege, but only outside the house	5	10.87%	4	22.22%	6	40.00%	12	40.00%	9	30.00%	36	25.90%
	Cover 1st floor, but not conceal the whole level	33	71.74%	10	55.56%	9	60.00%	17	56.67%	20	66.67%	89	64.03%
	Rise to 2nd floor of the house	8	17.39%	4	22.22%		0.00%	1	3.33%	1	3.33%	14	10.07%
	Sum	46		18		15		30		30		139	
	(2-2) Period of time of the water approach until highest flood water level												
	Less than 3 hours	14	30.43%	3	16.67%	5	33.33%		0.00%		0.00%	22	15.83%
	3 – 6 hours	2	4.35%	2	11.11%		0.00%		0.00%		0.00%	4	2.88%
	6 – 12 hours	2	4.35%	2	11.11%	4	26.67%	2	6.67%	1	3.33%	11	7.91%
	12 – 24 hours	3	6.52%	6	33.33%	2	13.33%	3	10.00%	2	6.67%	16	11.51%
	Over 1 day	25	54.35%	5	27.78%	4	26.67%	25	83.33%	27	90.00%	86	61.87%
	Sum	46		18		15		30		30		139	
	(2-3) Period of time of the water approach until water dry out												
	less than 1 week		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	1 – 2 weeks	1	2.17%		0.00%		0.00%		0.00%		0.00%	1	0.72%
	2 – 3 weeks	1	2.17%		0.00%		0.00%		0.00%	2	6.67%	3	2.16%
	1 – 2 months	14	30.43%	5	27.78%	5	33.33%	9	30.00%	18	60.00%	51	36.69%
	Over 2 months	30	65.22%	13	72.22%	10	66.67%	21	70.00%	10	33.33%	84	60.43%
	Sum	46		18		15		30		30		139	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
3 Receive of warning during monitoring period / before flood reach the area												
Receive of information / warning												
Received information of the current situation / alarm (skip to 3-A)	35	76.09%	8	44.44%	11	73.33%	28	93.33%	29	96.67%	111	79.86%
Did not receive the information (skip to 3-B)	11	23.91%	10	55.56%	4	26.67%	2	6.67%	1	3.33%	28	20.14%
Sum	46		18		15		30		30		139	
(3-A)												
(3-A-1) Receive information from												
Central government authority	1	2.86%	1	12.50%	1	9.09%	11	39.29%	3	10.34%	17	15.32%
Local government authority	22	62.86%	6	75.00%	10	90.91%	27	96.43%	29	100.00%	94	84.68%
From local people	4	11.43%		0.00%	5	45.45%	28	100.00%	18	62.07%	55	49.55%
From local people network	8	22.86%		0.00%	1	9.09%	16	57.14%	16	55.17%	41	36.94%
Other sources		0.00%	1	12.50%		0.00%		0.00%		0.00%	1	0.90%
Sum	35		8		17		82		66		208	
(3-A-2) Channel of information received												
Television	4	11.43%	5	62.50%	8	72.73%	23	82.14%	20	68.97%	60	54.05%
Radio	1	2.86%		0.00%	2	18.18%	25	89.29%	22	75.86%	50	45.05%
Telephone (alarm call)		0.00%		0.00%	3	27.27%		0.00%		0.00%	3	2.70%
Telephone (short message)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Social network		0.00%		0.00%	2	18.18%		0.00%		0.00%	2	1.80%
Word of mouth	18	51.43%	5	62.50%	8	72.73%	25	89.29%	22	75.86%	78	70.27%
Announcement by amplifying car	28	80.00%	3	37.50%	6	54.55%	10	35.71%	6	20.69%	53	47.75%
Other	8	22.86%	3	37.50%		0.00%	20	71.43%	1	3.45%	32	28.83%
Sum	59		16		29		103		71		278	
(3-A-3) Information received												
Weather inf i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%	2	18.18%		0.00%	4	13.79%	6	5.41%
Amount of rain unpstream	5	14.29%	4	50.00%	8	72.73%	13	46.43%	9	31.03%	39	35.14%
Amount of rain in the area	5	14.29%	3	37.50%	3	27.27%	7	25.00%	3	10.34%	21	18.92%
Level of water in rivers, canals, nearby waterways	28	80.00%	3	37.50%	7	63.64%	28	100.00%	23	79.31%	89	80.18%
Sea level	1	2.86%	1	12.50%		0.00%		0.00%		0.00%	2	1.80%
Predicted data of rainfalls, in advance of ………….. hours / day	2	5.71%		0.00%		0.00%		0.00%		0.00%	2	1.80%
Predicted of water level, specify certain point of prediction ………… in advance of ....hrs / d	2	5.71%		0.00%		0.00%		0.00%	1	3.45%	3	2.70%
Define the period of time to move away from residential areas	3	8.57%	1	12.50%	1	9.09%		0.00%		0.00%	5	4.50%
Amount of / Location of evacuation points	3	8.57%	1	12.50%		0.00%		0.00%		0.00%	4	3.60%
Evacuation routes in case of increasing of water level	7	20.00%	2	25.00%		0.00%		0.00%		0.00%	9	8.11%
Name list of contact persons or officials or agencies to contact for assistance	7	20.00%	2	25.00%		0.00%	3	10.71%	1	3.45%	13	11.71%
Other; please specify …………………………………………………	2	5.71%		0.00%	1	9.09%		0.00%		0.00%	3	2.70%
Sum	65		17		22		51		41		196	
(3-A-4) The received information is sufficient or not												
Sufficient	31	88.57%	3	37.50%	8	72.73%	26	92.86%	25	86.21%	93	83.78%
Insufficient and need more information, i.e.	4	11.43%	5	62.50%	3	27.27%	2	7.14%	4	13.79%	18	16.22%
Sum	35		8		11		28		29		111	
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Amount of rain over the water basis area or other areas	1	25.00%	2	40.00%	1	33.33%		0.00%		0.00%	4	22.22%
Amount of rain in the area	1	25.00%	3	60.00%	1	33.33%		0.00%		0.00%	5	27.78%
Level of water in rivers, canals, nearby waterways	5	125.00%		0.00%	2	66.67%		0.00%		0.00%	7	38.89%
Sea level		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted of water level, specify certain point of prediction …….in advance of ….hrs / d		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Define the period of time to move away from residential areas	2	50.00%	2	40.00%	3	100.00%		0.00%		0.00%	7	38.89%
Amount of / Location of evacuation points	1	25.00%	1	20.00%	2	66.67%		0.00%		0.00%	4	22.22%
Evacuation routes in case of increasing of water level	1	25.00%	2	40.00%	2	66.67%		0.00%		0.00%	5	27.78%
Name list of contact persons or officials or agencies to contact for assistance	4	100.00%	2	40.00%		0.00%	2	100.00%	4	100.00%	12	66.67%
Other; please specify ………………………………………………		0.00%		0.00%	1	33.33%		0.00%		0.00%	1	5.56%
Sum	15		12		12		2		4		45	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(3-A-5) Patterns of the information received												
Numeric	8	22.86%		0.00%	2	18.18%	28	100.00%	22	75.86%	60	54.05%
Graph		0.00%		0.00%	1	9.09%		0.00%	2	6.90%	3	2.70%
Footages from the measuring point		0.00%	2	25.00%	6	54.55%		0.00%		0.00%	8	7.21%
Animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Narration	38	108.57%	7	87.50%	11	100.00%	28	100.00%	20	68.97%	104	93.69%
Other, please specify		0.00%		0.00%		0.00%	3	10.71%		0.00%	3	2.70%
Sum	46		9		20		59		44		178	
(3-A-6) Period of time in receiving the information												
Over 1 week before the water reaches the area	12	34.29%	1	12.50%	3	27.27%		0.00%		0.00%	16	14.41%
1 week before the water reaches the area	8	22.86%	4	50.00%	5	45.45%	9	32.14%	8	27.59%	34	30.63%
3- 7 days before the water reaches the area	6	17.14%	2	25.00%		0.00%	10	35.71%	19	65.52%	37	33.33%
1-2 days before the water reaches the area	7	20.00%	1	12.50%	3	27.27%	9	32.14%	2	6.90%	22	19.82%
Within the day the water reaches the area	2	5.71%		0.00%		0.00%		0.00%		0.00%	2	1.80%
Sum	35		8		11		28		29		111	
(3-A-7) Frequency of information update												
Once per hour		0.00%		0.00%	1	9.09%		0.00%		0.00%	1	0.90%
More than once per hour	1	2.86%		0.00%	1	9.09%		0.00%		0.00%	2	1.80%
Once per day	14	40.00%	3	37.50%	4	36.36%	27	96.43%	22	75.86%	70	63.06%
More than once per day	13	37.14%	2	25.00%	1	9.09%	1	3.57%	7	24.14%	24	21.62%
Weekly	7	20.00%	2	25.00%	1	9.09%		0.00%		0.00%	10	9.01%
Once over a week; Please specify…………………………………		0.00%	1	12.50%	3	27.27%		0.00%		0.00%	4	3.60%
Sum	35		8		11		28		29		111	
(3-A-8) The information is reliable or not												
Less reliable	7	20.00%		0.00%	1	9.09%		0.00%		0.00%	8	7.21%
Average reliable	16	45.71%	2	25.00%	6	54.55%	7	25.00%	19	65.52%	50	45.05%
Very reliable	12	34.29%	6	75.00%	4	36.36%	21	75.00%	10	34.48%	53	47.75%
Sum	35		8		11		28		29		111	
(3-A-9) The information received is useful or not											0	
Less useful	7	20.00%	2	25.00%	1	9.09%	2	7.14%		0.00%	12	10.81%
Average useful	15	42.86%	1	12.50%	3	27.27%	8	28.57%	10	34.48%	37	33.33%
Very useful	13	37.14%	5	62.50%	7	63.64%	18	64.29%	19	65.52%	62	55.86%
Sum	35		8		11		28		29		111	
(3-A-10) Satisfaction towards flood forecast and warning before flooding												
Not satisfied at all	1	2.86%		0.00%	2	18.18%	2	7.14%	7	24.14%	12	10.81%
Less satisfied	9	25.71%	1	12.50%	1	9.09%	4	14.29%	2	6.90%	17	15.32%
Average satisfied	15	42.86%	2	25.00%	2	18.18%	17	60.71%	16	55.17%	52	46.85%
Very satisfied	10	28.57%	5	62.50%	6	54.55%	5	17.86%	4	13.79%	30	27.03%
Sum	35		8		11		28		29		111	
(3-A-11) Things to get improved in flood forecast and warning before flooding												
Accuracy of flood forecast and warning	29	82.86%	2	25.00%	6	54.55%	18	64.29%	11	37.93%	66	59.46%
Frequency, to increase frequency of data update	9	25.71%		0.00%		0.00%		0.00%		0.00%	9	8.11%
More than once per hour			1		2						3	
Once per hour	2		1		2						5	
Once per day			3		4						7	
More than once per day	3		1		1		3		4		12	
Weekly	4										4	
Advance notification	13	37.14%	4	50.00%	9	81.82%	19	67.86%	17	58.62%	62	55.86%
1 month before water approach	8		2		3		19		8		40	
1-4 weeks before water approach	2				3				8		13	
3-7 days before water approach	3		2		3				1		9	
1 day before water approach											0	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(3-A-11)	Add more channels of data information, via	3	8.57%		0.00%	2	18.18%		0.00%		0.00%	5	4.50%
(Cont'd)	Require more information	18	51.43%	3	37.50%	5	45.45%	23	82.14%	4	13.79%	53	47.75%
	Change patterns of the data	7	20.00%	2	25.00%	5	45.45%	0	0.00%	1	3.45%	15	13.51%
	Numeric											0	
	Graph											0	
	Footages from the measuring point	1				3						4	
	Animation, simulation of situation and location											0	
	Narration	6		2		2				1		11	
	Other, please specify											0	
												0	
(3-B)												0	
(3-B-1) Channel to receive information before flooding												0	
	television	4	36.36%	2	20.00%	1	25.00%	1	50.00%	1	100.00%	9	32.14%
	radio		0.00%	1	10.00%		0.00%		0.00%	1	100.00%	2	7.14%
	telephone (alarm call)		0.00%		0.00%	1	25.00%		0.00%		0.00%	1	3.57%
	telephone (short message)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	social network i.e. internet		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	word of mouth	8	72.73%	3	30.00%	1	25.00%		0.00%		0.00%	12	42.86%
	announcement within community by amplifying car	9	81.82%	8	80.00%	1	25.00%	1	50.00%	1	100.00%	20	71.43%
	other; please specify		0.00%	2	20.00%	1	25.00%		0.00%		0.00%	3	10.71%
	Sum	21		16		5		2		3		47	
(3-B-2) Required information													
	weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	amount of rain over the water basis area or other areas □ amount of rain in the area		0.00%	3	30.00%		0.00%		0.00%	1	100.00%	4	14.29%
	level of water in rivers, canals, nearby waterways	1	9.09%	2	20.00%		0.00%	1	50.00%		0.00%	4	14.29%
	sea level	10	90.91%	6	60.00%		0.00%	1	50.00%	1	100.00%	18	64.29%
	predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	predicted of water level, specify certain point of prediction …………..in advance of ....hrs / d	1	9.09%	1	10.00%	1	25.00%		0.00%		0.00%	3	10.71%
	define the period of time to move away from residential areas	3	27.27%		0.00%		0.00%		0.00%	1	100.00%	4	14.29%
	amount of / Location of evacuation points	1	9.09%	3	30.00%	2	50.00%		0.00%		0.00%	6	21.43%
	evacuation routes in case of increasing of water level	1	9.09%	2	20.00%	1	25.00%		0.00%		0.00%	4	14.29%
	name list of contact persons or officials or agencies to contact for assistance	3	27.27%	3	30.00%	1	25.00%		0.00%		0.00%	7	25.00%
	other; please specify ……………………………………………	3	27.27%	1	10.00%	1	25.00%	2	100.00%		0.00%	7	25.00%
	Sum	23		21		6		4		3		57	
(3-B-3) Patterns of the require information													
	numeric	1	9.09%		0.00%		0.00%		0.00%	1	100.00%	2	7.14%
	graph		0.00%		0.00%		0.00%		0.00%	1	100.00%	1	3.57%
	footages from the measuring point		0.00%	1	10.00%		0.00%		0.00%		0.00%	1	3.57%
	animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	narration	10	90.91%	10	100.00%	4	100.00%	2	100.00%	1	100.00%	27	96.43%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	11		11		4		2		3		31	
(3-B-4) Period of time to receive the information													
	over 1 week before the water reaches the area	7	63.64%	3	30.00%		0.00%		0.00%		0.00%	10	35.71%
	1 week before the water reaches the area	3	27.27%	5	50.00%	1	25.00%		0.00%	1	100.00%	10	35.71%
	3- 7 days before the water reaches the area	1	9.09%	2	20.00%	3	75.00%		0.00%		0.00%	6	21.43%
	1-2 days before the water reaches the area		0.00%		0.00%		0.00%	2	100.00%		0.00%	2	7.14%
	within the day the water reaches the area		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	11		10		4		2		1		28	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
	(3-B-5) Frequency of information update												
	once per hour	2	18.18%		0.00%	1	25.00%		0.00%		0.00%	3	10.71%
	more than once per hour	2	18.18%	2	20.00%		0.00%		0.00%		0.00%	4	14.29%
	once per day	3	27.27%	7	70.00%	3	75.00%	2	100.00%	1	100.00%	16	57.14%
	more than once per day	3	27.27%	1	10.00%		0.00%		0.00%		0.00%	4	14.29%
	weekly	4	36.36%		0.00%		0.00%		0.00%		0.00%	4	14.29%
	once over a week;		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	please specify ………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	12		10		3		2		1		28	
4	**Channel to receive flood warning during flooding**											0	
												0	
	Information / warning receive											0	
	Received in	33	71.74%	10	55.56%	12	80.00%	28	93.33%	29	96.67%	112	80.58%
	Did not receive the information (skip to 4-B)	13	28.26%	8	44.44%	3	20.00%	2	6.67%	1	3.33%	27	19.42%
	Sum	46		18		15		30		30		139	
	(4-A)												
	(4-A-1) Receive information from												
	Central government authority	10	30.30%	1	10.00%		0.00%	18	64.29%		0.00%	29	25.89%
	Local government authority	18	54.55%	5	50.00%	8	66.67%	13	46.43%	8	27.59%	52	46.43%
	From local people	6	18.18%	3	30.00%	6	50.00%	28	100.00%	20	68.97%	63	56.25%
	From local people network	12	36.36%	2	20.00%	2	16.67%	15	53.57%	19	65.52%	50	44.64%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%	3	10.71%		0.00%	3	2.68%
	Sum	46		11		16		77		47		197	
	(4-A-2) Channels of information received												
	Television	2	6.06%	7	70.00%	9	75.00%	24	85.71%	6	20.69%	48	42.86%
	Radio	2	6.06%		0.00%	3	25.00%	28	100.00%	23	79.31%	56	50.00%
	telephone (alarm call)		0.00%		0.00%	1	8.33%	3	10.71%		0.00%	4	3.57%
	telephone (short message)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	social network i.e. internet		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Word of mouth	23	69.70%	6	60.00%	8	66.67%	28	100.00%	22	75.86%	87	77.68%
	Announcement by amplifying car	21	63.64%	2	20.00%	2	16.67%	17	60.71%		0.00%	42	37.50%
	other; please specify ……………………………………………	6	18.18%	4	40.00%	4	33.33%		0.00%		0.00%	14	12.50%
	Sum	54		19		27		100		51		251	
	(4-A-3) Information received											0	
	weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Amount of rain upstream	4	12.12%	5	50.00%	8	66.67%	8	28.57%	9	31.03%	34	30.36%
	Amount of rain in the area	3	9.09%	5	50.00%	3	25.00%	7	25.00%	1	3.45%	19	16.96%
	Level of water in rivers, canals, nearby waterways	24	72.73%	4	40.00%	8	66.67%	23	82.14%	23	79.31%	82	73.21%
	sea level		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	predicted of water level, specify certain point of prediction ....in advance of ....hrs / d	5	15.15%		0.00%		0.00%		0.00%		0.00%	5	4.46%
	define the period of time to move away from residential areas	4	12.12%	5	50.00%	3	25.00%		0.00%		0.00%	12	10.71%
	amount of / Location of evacuation points	2	6.06%	1	10.00%		0.00%		0.00%	4	13.79%	7	6.25%
	Evacuation routes	3	9.09%	3	30.00%		0.00%	4	14.29%	3	10.34%	13	11.61%
	Name list of contact for assistance	2	6.06%	3	30.00%		0.00%	23	82.14%	12	41.38%	40	35.71%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	47		26		22		65		52		212	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(4-A-4) The received information is sufficient or not											0	
sufficient	25	75.76%	5	50.00%	11	91.67%	28	100.00%	22	75.86%	91	81.25%
insufficient and require more information	8	24.24%	5	50.00%	1	8.33%		0.00%	7	24.14%	21	18.75%
Sum	33		10		12		28		29		112	
weather information, i.e. weather such as temperature, humidity, air pressure		0.00%		0.00%		0.00%				0.00%	0	0.00%
amount of rain over the water basis area or other areas		0.00%	4	80.00%		0.00%				0.00%	4	19.05%
amount of rain in the area		0.00%	4	80.00%		0.00%				0.00%	4	19.05%
level of water in rivers, canals, nearby waterways	2	25.00%	1	20.00%	1	100.00%				0.00%	4	19.05%
sea level		0.00%		0.00%		0.00%				0.00%	0	0.00%
predicted data of rainfalls, in advance of …………. hrs / d	1	12.50%		0.00%		0.00%				0.00%	1	4.76%
predicted of water level, specify certain point of prediction ……in advance of .....hrs / d	1	12.50%		0.00%		0.00%				0.00%	1	4.76%
Define the period of time to move away from residential areas		0.00%		0.00%		0.00%				0.00%	0	0.00%
amount of / Location of evacuation points	4	50.00%		0.00%	1	100.00%				0.00%	5	23.81%
evacuation routes in case of increasing of water level	5	62.50%		0.00%	1	100.00%				0.00%	6	28.57%
name list of contact persons or officials or agencies to contact for assistance	6	75.00%	1	20.00%	1	100.00%				0.00%	8	38.10%
other; please specify ………………………………………………………		0.00%		0.00%		0.00%				0.00%	0	0.00%
Sum	19		10		4		0		0		33	
(4-A-5) Patterns of the information received											0	
numeric	5	15.15%		0.00%		0.00%	28	100.00%	22	75.86%	55	49.11%
graph		0.00%		0.00%		0.00%		0.00%	1	3.45%	1	0.89%
footages from the measuring point		0.00%	1	10.00%	6	50.00%		0.00%		0.00%	7	6.25%
animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
narration	32	96.97%	9	90.00%	12	100.00%	27	96.43%	23	79.31%	103	91.96%
other; please specify ……………………………………………	1	3.03%		0.00%		0.00%		0.00%		0.00%	1	0.89%
Sum	38		10		18		55		46		167	
(4-A-6) Period of time to receive the information											0	
over 1 weel before the water reaches the area	8	24.24%	1	10.00%	1	8.33%		0.00%		0.00%	10	8.93%
1 week befo before the water reaches the area	10	30.30%	3	30.00%	2	16.67%		0.00%	3	10.34%	18	16.07%
3- 7 days be before the water reaches the area	2	6.06%	4	40.00%	2	16.67%	4	14.29%	4	13.79%	16	14.29%
1-2 days be before the water reaches the area	11	33.33%		0.00%	2	16.67%	7	25.00%	5	17.24%	25	22.32%
within the day the water reaches the area	2	6.06%	2	20.00%	5	41.67%	17	60.71%	17	58.62%	43	38.39%
Sum	33		10		12		28		29		112	
(4-A-7) Frequency of information update												
once per hour	3	9.09%	1	10.00%	1	8.33%		0.00%		0.00%	5	4.46%
more than once per hour	1	3.03%		0.00%	4	33.33%		0.00%		0.00%	5	4.46%
once per day	10	30.30%	8	80.00%	4	33.33%	25	89.29%	24	82.76%	71	63.39%
more than once per day	10	30.30%	1	10.00%	2	16.67%	3	10.71%	5	17.24%	21	18.75%
weekly	7	21.21%		0.00%		0.00%		0.00%		0.00%	7	6.25%
once over a week; please specify ………………………	2	6.06%		0.00%	1	8.33%		0.00%		0.00%	3	2.68%
Sum	33		10		12		28		29		112	
(4-A-8) Credibility of the information received												
less reliable	3	9.09%	2	20.00%		0.00%	3	10.71%		0.00%	8	7.14%
average reliable	14	42.42%	2	20.00%	3	25.00%	18	64.29%	10	34.48%	47	41.96%
very reliable	16	48.48%	6	60.00%	9	75.00%	7	25.00%	19	65.52%	57	50.89%
Sum	33		10		12		28		29		112	
(4-A-9) The information received is useful or not												
less useful	4	12.12%	2	20.00%		0.00%	2	7.14%		0.00%	8	7.14%
average useful	15	45.45%	2	20.00%	3	25.00%	10	35.71%	7	24.14%	37	33.04%
very useful	14	42.42%	6	60.00%	9	75.00%	16	57.14%	22	75.86%	67	59.82%
Sum	33		10		12		28		29		112	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(4-A-10) Satisfaction towards flood forecast and warning during flooding												
not satisfied at all	3	9.09%		0.00%		0.00%		0.00%		0.00%	3	2.68%
less satisfied	5	15.15%	2	20.00%		0.00%	8	28.57%	2	6.90%	17	15.18%
average satisfied	15	45.45%	2	20.00%	3	25.00%	12	42.86%	18	62.07%	50	44.64%
very satisfied	10	30.30%	6	60.00%	9	75.00%	8	28.57%	9	31.03%	42	37.50%
Sum	33		10		12		28		29		112	
(4-A-11) Things to be improved in flood forecast and warning during flooding												
accuracy of flood forecast and warning	26	78.79%	3	30.00%	7	58.33%	8	28.57%	9	31.03%	53	47.32%
frequency, to increase frequency of data update	9	27.27%		0.00%		0.00%		0.00%		0.00%	9	8.04%
more than once per hour	1		1								2	
once per hour	3		1		1				1		6	
once per day	1		1						8		10	
more than once per day	2		1				3				6	
weekly	2										2	
advance notification	0	0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
1 month before water approach											0	
1-4 weeks before water approach											0	
3-7 days before water approach			**0.00%**								0	
1 day before water approach											0	
add more channels of data information, via	3	9.09%	3	30.00%	1	8.33%		0.00%		0.00%	7	6.25%
require more information	13	39.39%	3	30.00%	3	25.00%	20	71.43%	17	58.62%	56	50.00%
change patterns of the data to	4	12.12%		0.00%		0.00%		0.00%		0.00%	4	3.57%
numeric											0	
graph							3				3	
footages from the measuring point					1				2		3	
animation, simulation of situation and location											0	
narration	4		2		2				1		9	
other, please specify					1						1	
											0	
(4-B)											0	
(4-B-1) Channel to receive information during flooding											0	
Television	7	87.50%		0.00%		0.00%	2		1	14.29%	10	47.62%
Radio	3	37.50%	3	60.00%	1	100.00%	2			0.00%	9	42.86%
Telephone (alarm call)	2	25.00%	3	60.00%		0.00%				0.00%	5	23.81%
Telephone (short message)		0.00%		0.00%		0.00%				0.00%	0	0.00%
Social network i.e. internet		0.00%		0.00%		0.00%				0.00%	0	0.00%
Word of mouth	6	75.00%	2	40.00%	3	300.00%	2			0.00%	13	61.90%
Announcement within community by amplifying car	10	125.00%	5	100.00%	1	100.00%	2			0.00%	18	85.71%
other; please specify ……………………………………………	1	12.50%	2	40.00%		0.00%				0.00%	3	14.29%
Sum	29		15		5		8		1		58	
(4-B-2) Required information												
Weather information, i.e. weather such as temperature, humidity, air pressure	1	12.50%		0.00%		0.00%				0.00%	1	4.76%
Amount of rain over the water basis area or other areas	2	25.00%		0.00%		0.00%				0.00%	2	9.52%
amount of rain in the area	5	62.50%	4	80.00%	2	200.00%	1			0.00%	12	57.14%
Level of water in rivers, canals, nearby waterways	14	175.00%	6	120.00%	2	200.00%	1		1	14.29%	24	114.29%
Sea level		0.00%		0.00%		0.00%				0.00%	0	0.00%
Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%				0.00%	0	0.00%
Predicted of water level, specify certain point of prediction ……………in advance of ....hrs / d	1	12.50%		0.00%		0.00%				0.00%	1	4.76%
Define the period of time to move away from residential areas		0.00%	1	20.00%		0.00%				0.00%	1	4.76%
Amount of / Location of evacuation points		0.00%	1	20.00%		0.00%				0.00%	1	4.76%
Evacuation routes in case of increasing of water level		0.00%	2	40.00%		0.00%				0.00%	2	9.52%
Name list of contact persons or officials or agencies to contact for assistance		0.00%	1	20.00%		0.00%			1	14.29%	2	9.52%
other; please specify ……………………………………………		0.00%		0.00%		0.00%				0.00%	0	0.00%
Sum	23		15		4		2		2		46	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
	(4-B-3) Patterns of the required information												
	Numeric		0.00%		0.00%		0.00%	2			0.00%	2	9.52%
	Graph		0.00%		0.00%		0.00%				0.00%	0	0.00%
	Footages from the measuring point	1	12.50%		0.00%		0.00%				0.00%	1	4.76%
	Animation, simulation of situation and location		0.00%		0.00%		0.00%				0.00%	0	0.00%
	Narration	14	175.00%	8	160.00%	3	300.00%	2		1	14.29%	28	133.33%
	other; please specify …………………………………………		0.00%		0.00%		0.00%				0.00%	0	0.00%
	Sum	15		8		3		4		1		31	
	(4-B-4) Period of time to receive the information												
	Over 1 week before flood reaches the area	5	62.50%	3	60.00%	1	100.00%				0.00%	9	42.86%
	1 week before flood reaches the area	6	75.00%	5	100.00%	2	200.00%				0.00%	13	61.90%
	3- 7 days before flood reaches the area	2	25.00%		0.00%		0.00%				0.00%	2	9.52%
	1-2 days before flood reaches the area	1	12.50%		0.00%		0.00%			1	14.29%	2	9.52%
	Within the day of flood reaches the area		0.00%		0.00%		0.00%	2			0.00%	2	9.52%
	Sum	14		8		3		2		1		28	
	(4-B-5) Frequency of information update												
	Once per hour	2	25.00%		0.00%		0.00%				0.00%	2	9.52%
	More than once per hour	2	25.00%	1	20.00%		0.00%				0.00%	3	14.29%
	Once per day	3	37.50%	6	120.00%	1	100.00%	2		1	14.29%	13	61.90%
	More than once per day	5	62.50%	1	20.00%		0.00%				0.00%	6	28.57%
	Weekly	2	25.00%		0.00%		0.00%				0.00%	2	9.52%
	Once over a week; Please specify ………………		0.00%		0.00%		0.00%				0.00%	0	0.00%
	Sum	14		8		1		2		1		26	
5	**Receiving of the information after / during recovery period**												
	Receiving of the information												
	Receive the (skip to 5-A)	32	69.57%	7	38.89%	12	80.00%	26	86.67%	27	90.00%	104	74.82%
	Did not rec((skip to 5-B)	14	30.43%	11	61.11%	3	20.00%	4	13.33%	3	10.00%	35	25.18%
	Sum	46		18		15		30		30		139	
	(5-A)												
	(5-A-1) Receive information from												
	Central government authority	1	3.13%	1	14.29%			12	46.15%	8	29.63%	22	21.15%
	Local government authority	19	59.38%	7	100.00%	10	83.33%	26	100.00%	24	88.89%	86	82.69%
	From local people	10	31.25%			6	50.00%	26	100.00%	20	74.07%	62	59.62%
	From local people network	6	18.75%	1	14.29%			17	65.38%	17	62.96%	41	39.42%
	other; please specify …………………………………………												
	Sum	36		9		16		81		69		211	
	(5-A-2) Channels to receive information												
	Television	4	12.50%	3	42.86%	8	66.67%	7	26.92%	7	25.93%	29	27.88%
	Radio	2	6.25%					14	53.85%	23	85.19%	39	37.50%
	Telephone (alarm call)							7	26.92%			7	6.73%
	Telephone (short message)												
	Social network i.e. internet												
	Word of mouth	21	65.63%	5	71.43%			26	100.00%	22	81.48%	74	71.15%
	Announcement by amplifying car	17	53.13%		0.00%	9	75.00%	18	69.23%	18	66.67%	62	59.62%
	other; please specify …………………………………………	4	12.50%	2	28.57%	3	25.00%					9	8.65%
	Sum	48		10		20		72		70		220	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(5-A-3) Information received												
Weather information, i.e. weather such as temperature, humidity, air pressure					3	25.00%					3	2.88%
Amount of rain over the water basis area or other areas												
amount of rain in the area	5	15.63%	2	28.57%	6	50.00%	4	15.38%	1	3.70%	18	17.31%
Level of water inwaterways	4	12.50%	3	42.86%	2	16.67%			18	66.67%	27	25.96%
Predicted data of rainfalls	18	56.25%	2	28.57%	7	58.33%	26	100.00%			53	50.96%
Predicted of water level, specify certain point of prediction …………….in advance of ....hs / d												
Define the period of time to move away from residential areas	5	15.63%	2	28.57%	3	25.00%					10	9.62%
Amount and Location of evacuation points	9	28.13%	4	57.14%	2	16.67%	25	96.15%	15	55.56%	55	52.88%
Certain period of time to return to residential area									4	14.81%	4	3.85%
Name list of contact												
other; please specify ……………………………………………												
Sum	41		13		23		55		38		170	
(5-A-4) The received information is sufficient or not												
Sufficient	28	87.50%	7	100.00%	12	100.00%	26	100.00%	27	100.00%	100	96.15%
Insufficient, and need more information	4	12.50%									4	3.85%
Sum	32		7		12		26		27		104	
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%									0	0.00%
Amount of rain over the water basis area or other areas	1	25.00%									1	25.00%
Amount of rain in the area	1	25.00%									1	25.00%
Level of water in rivers, canals, nearby waterways	2	50.00%									2	50.00%
Sea level											0	
Predicted data of rainfalls, in advance of …………. hours / day											0	
Predicted of water level, specify certain point of prediction ………….. in advance of ....hrs / d											0	
Certain period of time to return to residential area											0	
Name list of contact persons or officials or agencies to contact for assistance							2				2	
other; please specify ……………………………………………											0	
											0	
(5-A-5) Patterns of information received											0	
Numeric	1	3.13%		0.00%		0.00%	26	100.00%	27	100.00%	54	51.92%
Graph		0.00%		0.00%		0.00%	3	11.54%		0.00%	3	2.88%
Footages from the measuring point	1	3.13%	1	14.29%	5	41.67%		0.00%		0.00%	7	6.73%
Animation, simulation of situation and location		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Narration	33	103.13%	7	100.00%	12	100.00%	26	100.00%	27	100.00%	105	100.96%
Other, please specify		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	35		8		17		55		54		169	
(5-A-6) Period of time to receive the information												
the water approach until the water decrease	14	43.75%	1	14.29%	3	25.00%	18	69.23%	15	55.56%	51	49.04%
period of time of the water dry out until the situation is back to normal	18	56.25%	6	85.71%	9	75.00%	20	76.92%	19	70.37%	72	69.23%
Sum	32		7		12		38		34		123	
(5-A-7) Frequency of information update												
Once per hour		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
More than once per hour		0.00%		0.00%	1	8.33%		0.00%		0.00%	1	0.96%
Once per day	12	37.50%	5	71.43%	11	91.67%	26	100.00%	24	88.89%	78	75.00%
More than once per day	2	6.25%	1	14.29%		0.00%		0.00%	1	3.70%	4	3.85%
Weekly	15	46.88%	1	14.29%		0.00%		0.00%	2	7.41%	18	17.31%
Once over a week;	3	9.38%		0.00%		0.00%		0.00%		0.00%	3	2.88%
Please specify …………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	32		7		12		26		27		104	
(5-A-8) The information received is reliable or not												
Less reliable	4	12.50%		0.00%	1	8.33%	7	26.92%		0.00%	12	11.54%
Average reliable	10	31.25%	3	42.86%	3	25.00%	11	42.31%	9	33.33%	36	34.62%
Very reliable	18	56.25%	4	57.14%	8	66.67%	8	30.77%	18	66.67%	56	53.85%
Sum	32		7		12		26		27		104	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
(5-A-9) The information received is useful or not												
Less useful	5	15.63%	1	14.29%		0.00%	9	34.62%		0.00%	15	14.42%
Average useful	10	31.25%	3	42.86%	3	25.00%	6	23.08%	9	33.33%	31	29.81%
Very useful	17	53.13%	3	42.86%	9	75.00%	11	42.31%	18	66.67%	58	55.77%
Sum	32		7		12		26		27		104	
(5-A-10) Satisfaction towards flood forecast and warning after flooding												
Not satisfied at all	4	12.50%		0.00%		0.00%		0.00%		0.00%	4	3.85%
Less satisfied	4	12.50%	2	28.57%		0.00%	4	15.38%		0.00%	10	9.62%
Average satisfied	10	31.25%	2	28.57%	5	41.67%	11	42.31%	15	55.56%	43	41.35%
Very satisfied	14	43.75%	3	42.86%	7	58.33%	11	42.31%	12	44.44%	47	45.19%
Sum	32		7		12		26		27		104	
(5-A-11) Things to get improved in flood forecast and warning after flooding												
Accuracy of flood forecast and warning	25	78.13%	2	28.57%	10	83.33%	13	50.00%	9	33.33%	59	56.73%
Frequency, to increase frequency of data update	4	12.50%		0.00%		0.00%		0.00%		0.00%	4	3.85%
More than once per hour					1						1	
Once per hour											0	
Once per day	3										3	
More than once per day			1				2		3		6	
Weekly	1		1								2	
Add more channels of data information, via	3	9.38%	1	14.29%	2	16.67%		0.00%	2	7.41%	8	7.69%
Require more information	10	31.25%	4	57.14%	6	50.00%	15	57.69%	14	51.85%	49	47.12%
Change patterns of the data to	5	15.63%		0.00%		0.00%		0.00%		0.00%	5	4.81%
Numeric											0	
Graph											0	
Footages from the measuring point											0	
Animation, simulation of situation and location											0	
Narration	5		1		2						8	
Other, please specify											0	
											0	
(5-B)											0	
(5-B-1) Channel of information required after the flood											0	
Television	6	42.86%	5	45.45%		0.00%	2	50.00%		0.00%	13	37.14%
Radio	4	28.57%	4	36.36%		0.00%		0.00%		0.00%	8	22.86%
Telephone (alarm call)	1	7.14%		0.00%		0.00%		0.00%	3	100.00%	4	11.43%
Telephone (short message)		0.00%		0.00%	1	33.33%		0.00%		0.00%	1	2.86%
Social network i.e. internet		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Word of mouth	6	42.86%	1	9.09%	1	33.33%		0.00%		0.00%	8	22.86%
Announcement within community by amplifying car	12	85.71%	7	63.64%	3	100.00%	2	50.00%		0.00%	24	68.57%
other; please specify …………………………………………….	1	7.14%	2	18.18%		0.00%		0.00%		0.00%	3	8.57%
Sum	30		19		5		4		3		61	
(5-B-2) Required information												
Weather information, i.e. weather such as temperature, humidity, air pressure		0.00%	1	9.09%		0.00%		0.00%		0.00%	1	2.86%
Amount of rain over the water basis area or other areas	1	7.14%	4	36.36%		0.00%		0.00%		0.00%	5	14.29%
Amount of rain in the area	3	21.43%	6	54.55%		0.00%		0.00%		0.00%	9	25.71%
Level of water in rivers, canals, nearby waterways	14	100.00%	7	63.64%	3	100.00%	4	100.00%	3	100.00%	31	88.57%
Sea level		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted data of rainfalls, in advance of ………….. hours / day		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Predicted of water level, specify certain point of prediction …………in advance of ....hrs / d		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Certain period of time to return to residential area	4	28.57%	2	18.18%		0.00%		0.00%		0.00%	6	17.14%
Name list of contact persons or officials or agencies to contact for assistance	2	14.29%	2	18.18%		0.00%		0.00%		0.00%	4	11.43%
other; please specify …………………………………………….		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	24		22		3		4		3		56	

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
		City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
	(5-B-3) Patterns of the information received												
	Numeric	3	21.43%		0.00%		0.00%		0.00%		0.00%	3	8.57%
	Graph		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Footages from the measuring point	1	7.14%	1	9.09%		0.00%		0.00%		0.00%	2	5.71%
	Animation, simulation of situation and location	1	7.14%		0.00%		0.00%		0.00%		0.00%	1	2.86%
	Narration	11	78.57%	11	100.00%	3	100.00%	4	100.00%	3	100.00%	32	91.43%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	16		12		3		4		3		38	
	(5-B-4) Period of time to receive the information												
	The water approach until the water decrease	9	64.29%	10	90.91%	2	66.67%		0.00%		0.00%	21	60.00%
	Period of time of the water dry out until the situation is back to normal	8	57.14%	4	36.36%		0.00%	4	100.00%	3	100.00%	19	54.29%
	Sum	17		14		2		4		3		40	
	(5-B-5) Frequency of information update											0	
	Once per hour	2	14.29%		0.00%		0.00%		0.00%		0.00%	2	5.71%
	More than once per hour	2	14.29%	2	18.18%		0.00%		0.00%		0.00%	4	11.43%
	Once per day	4	28.57%	8	72.73%	2	66.67%	4	100.00%	3	100.00%	21	60.00%
	More than once per day	4	28.57%		0.00%	1	33.33%		0.00%		0.00%	5	14.29%
	Weekly	1	7.14%	1	9.09%		0.00%		0.00%		0.00%	2	5.71%
	Once over a week;		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Please specify ………………………………………………..…		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	13		11		3		4		3		34	
6	**Flood preparation**												
	Any preparations to handle the flood or not												
	Preparatior 6-A)	23	50.00%	10	55.56%	8	53.33%	26	86.67%	27	90.00%	94	67.63%
	No prepara (skip to 6-B)	23	50.00%	8	44.44%	7	46.67%	4	13.33%	3	10.00%	45	32.37%
	Sum	46		18		15		30		30		139	
	(6-A)												
	(6-A-1) Time for preparation												
	Before flood forecasting and warning, because	18	78.26%	8	80.00%	1	12.50%	20	76.92%	20	74.07%	67	71.28%
	The area is frequent flooded area	11	61.11%	8	100.00%		0.00%	7	35.00%	6	30.00%	32	47.76%
	Informed of floods in other areas	7	38.89%		0.00%	1	100.00%	13	65.00%	14	70.00%	35	52.24%
	other; please specify ……………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Once being informed of the forecast and warning	6	26.09%	2	20.00%	7	87.50%	6	23.08%	7	25.93%	28	29.79%
	After being informed of the forecast and warning ………….. day(s)		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
	Sum	24		10		8		26		27		95	
	(6-A-2) Preparations												
	Moving things to higher place	20	86.96%	9	90.00%	8	100.00%	26	100.00%	27	100.00%	90	95.74%
	Moving things out of the house or targeted area of flood to other places, at …………………	4	17.39%	1	10.00%		0.00%	4	15.38%		0.00%	9	9.57%
	Evacuate children and elders out of the area to;	3	13.04%		0.00%		0.00%		0.00%		0.00%	3	3.19%
	Evacuation camps, relatives' or acquaintance's accommodations that will not be flooded.	1	33.33%			3				3		7	233.33%
	Evacuation camps	1	33.33%									1	33.33%
	other; please specify ……………………………………………	1	33.33%									1	33.33%
	Sum	27		10		8		26		27		98	
	(6-B)												
	(6-B-1) Reasons to not prepare to handle flood												
	The area has never being flooded	15	65.22%	4	50.00%	5	71.43%	2	50.00%		0.00%	26	57.78%
	Being flooded in the past, but maybe not this time	6	26.09%	3	37.50%	2	28.57%	1	25.00%	3	100.00%	15	33.33%
	Do not believe the warning	3	13.04%		0.00%		0.00%	1	25.00%		0.00%	4	8.89%
	Other, please specify	3	13.04%	1	12.50%		0.00%		0.00%		0.00%	4	8.89%
	Sum	27		8		7		4		3		49	

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Total	
	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%	City Resident	%
7 Preparation for future flooding												
Any preparation to handle with future flooding or not												
Preparation (skip to 7-A)	16	34.78%	9	50.00%	11	73.33%	28	93.33%	30	100.00%	94	67.63%
No preparat (skip to 7-B)	30	65.22%	9	50.00%	4	26.67%	2	6.67%			45	32.37%
Sum	46		18		15		30		30		139	
(7-A)												
(7-A-1) Preparation that has been done / ongoing												
Permanently move out of the area					1	9.09%	2	7.14%	7	23.33%	10	10.64%
Build new house or level up the current house	6	37.50%	3	33.33%	4	36.36%	26	92.86%	20	66.67%	59	62.77%
Build surround walls to prevent water approach	4	25.00%	1	11.11%	4	36.36%					9	9.57%
other	6	37.50%	5	55.56%	2	18.18%			3	10.00%	16	17.02%
Sum	16		9		11		28		30		94	
(7-A-2) Reason to prepare to handle with flood by yourself												
Possibility of flood to occur again	12	75.00%	8	88.89%	9	81.82%	21	75.00%	22	73.33%	72	76.60%
Cannot rely on government authorities	2	12.50%	1	11.11%		0.00%		0.00%	1	3.33%	4	4.26%
Cannot rely on the warning or information, better prepare to prevent the situation	2	12.50%		0.00%	2	18.18%	7	25.00%	7	23.33%	18	19.15%
other; please specify …………………………………………		0.00%		0.00%		0.00%		0.00%		0.00%	0	0.00%
Sum	16		9		11		28		30		94	
(7-B)												
(7-B-1) Reason of not continue preparation in handling with future flooding												
It might never happen again	11	36.67%	6	66.67%	2	50.00%					19	42.22%
Can ask for assistance from government authorities if it happens again	8	26.67%			2	50.00%	1	50.00%			11	24.44%
Will prepare when receive warning from government authorities in flood forecast and warning	6	20.00%									6	13.33%
Will be able to live with flood	5	16.67%	3	33.33%			1	50.00%			9	20.00%
other; please specify …………………………………………												
Sum	30		9		4		2		0		45	
8 Your feeling to the current forecasting and warning systems												
Accurate and very reliable	11	23.91%	3	16.67%	9	60.00%	1	3.33%	3	10.00%	27	19.42%
Not very good, but better than nothing	18	39.13%	8	44.44%	4	26.67%	8	26.67%	7	23.33%	45	32.37%
Not very good, but useful combining with other information	11	23.91%	3	16.67%	2	13.33%	20	66.67%	18	60.00%	54	38.85%
Not good, not reliable, and never been useful	5	10.87%	3	16.67%			1	3.33%	2	6.67%	11	7.91%
other; please specify …………………………………………	1	2.17%	1	5.56%							2	1.44%
Sum	46		18		15		30		30		139	
9 What you want to have, or to improve the forecasting and warning systems												
Information display to be more easier to understand	16	34.78%	7	38.89%	9	60.00%	8	26.67%	7	23.33%	47	33.81%
More frequency of information update	6	13.04%	6	33.33%	1	6.67%	24	80.00%	11	36.67%	48	34.53%
Earlier of warnings	30	65.22%	10	55.56%	12	80.00%	19	63.33%	25	83.33%	96	69.06%
Increase accuracy of forecasting	23	50.00%	10	55.56%	8	53.33%	12	40.00%	18	60.00%	71	51.08%
Add more channels to approach sources of information and warnings	10	21.74%	11	61.11%	3	20.00%	11	36.67%	7	23.33%	42	30.22%
other; please specify …………………………………………	2	4.35%	3	16.67%	2	13.33%		0.00%		0.00%	7	5.04%
Sum	87		47		35		74		68		311	

Appendix D

(Questionnaire Survey: Factory)

			Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
1	**Information of the responder**										
		No. of Responder	4	5	5	5	5	5	6	**35**	
	(1-1)	Factory/Company Name									
		Industrial Estate									
	(1-2)	Respondent Name									
		Position									
		Duties and Responsibilities during 2011 Flood									
	(1-3) Size of Factory/Company										
		Single-storied									
		2 storied									
		More than 2 storied									
		Other, please specify ………………									
2	**Severity of the 2011 Flood**										
	(2-1) Damage cased and depth of flood										
		Besiege, but only outside the factory/company									
		Cover 1st floor, but not conceal the whole level	4	5	5	5	5	5	6	**35**	**100.00%**
		Rise to 2nd floor of the factory/company									
	(2-2) Period of time of the water approach until highest flood water level										
		Less than 3 Hours									
		3 – 6 Hours						1		**1**	**2.86%**
		6 – 12 Hours	4	5	5	5	5	2	6	**32**	**91.43%**
		12 – 24 Hours						2		**2**	**5.71%**
		More than 1 Day									
	(2-3) Period of time of the water approach until water dry out.										
		Less than 1 week									
		1 – 2 weeks									
		2 – 3 weeks									
		1 – 2 months	4	5	5	5	5	5	6	**35**	**100.00%**
		More than 2 months									
3	**Receive of warning during monitoring period / before flood reach the area**										
	Receiving of the information/ warning										
		Receive the information of the situation/ warning (skip to 3-A)	4	5	5	5	5	5	6	**35**	**100.00%**
		Do not receive any information (skip to 3-B)									
	(3-A)										
	(3-A-1) Receive information from										
		Central government authority		1	1			2		**4**	**11.43%**
		Local government authority	2					2		**4**	**11.43%**
		From IEAT		5	3	4	5	5	6	**28**	**80.00%**
		From local entrepreneur network	4	5	5	5	5	5	6	**35**	**100.00%**
		Other, please specify ………………………									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(3-A-2) Channels to receive information									
Television	3	1	1			2		**7**	**20.00%**
Radio	1					2		**3**	**8.57%**
Telephone (alarm call)	4	5	5	5	5	5	6	**35**	**100.00%**
Telephone (SMS)	2	5	5	5	5	5	6	**33**	**94.29%**
Social network	3	1				3		**7**	**20.00%**
Word of mouth	3	5	5	5	5	4	6	**33**	**94.29%**
Announcement by amplifying car	1					2		**3**	**8.57%**
Other; please specify									
(3-A-3) Information received									
Weather inf, i.e. weather such as temperature, humidity, air pressure									
Rain Upstream	1	5	3		3	2	2	**16**	**45.71%**
Rain in the area	3	3	3			2	2	**13**	**37.14%**
Level of water in waterways	4	5	5	5	5	5		**29**	**82.86%**
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
Define period of time to return to factory area	1	5	4	5	5	5	6	**31**	**88.57%**
Amount , location ocation of evacuation points						3		**3**	**8.57%**
Evacuation routes in case of increasing of water level						3		**3**	**8.57%**
Name list o persons or officials or agencies to contact for assistance						2		**2**	**5.71%**
Other; please specify ……………………									
(3-A-4) The received information is sufficient or not									
Sufficient		5	2	5	3	4	5	**24**	**68.57%**
Insufficient, and need more information	4		3		2	1	1	**11**	**31.43%**
Weather information, i.e. weather such as temperature, humidity, air pressure									
Rain Upstream							1	1	9.09%
Rain in the area								0	
Level of water in waterways							1	1	9.09%
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level						1		1	9.09%
Define period of time to return to factory area	4		3					7	63.64%
Amount of/ Location of evacuation points	1		3		2			6	54.55%
Evacuation routes in case of increasing of water level			3					3	27.27%
Name list of contact persons			1					1	9.09%
Other; please specify ……………………									
(3-A-5) Patterns of information received									
Numeric	2	5	2	5		4		**18**	**51.43%**
Graph	2	5				4		**11**	**31.43%**
Footages from the measuring point									
Animation, simulation of situation and location									
Narration	2	5	5	5	5	5	6	**33**	**94.29%**
Other, please specify...									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(3-A-6) Period of time to receive the information									
over 1 week before flood reaches the area									
1 week before flood reaches the area	2		2					**4**	**11.43%**
3- 7 days before flood reaches the area	2	4	3		5		2	**16**	**45.71%**
1-2 days before flood reaches the area		1		5		5	4	**15**	**42.86%**
within the day of flood reaches the area									
(3-A-7) Frequency of information update									
Once per hour									
More than once per hour									
Once per day	3	5	5	5	5	5	6	**34**	**97.14%**
More than once per day	1							**1**	**2.86%**
Weekly									
Once over a week;									
Other; please specify ……………………									
(3-A-8) The information received is reliable or not									
Less reliable	3		3	5	5	1	4	**21**	**60.00%**
Average reliable	1	5				2	2	**10**	**28.57%**
Very reliable			2			2		**4**	**11.43%**
(3-A-9) The information received is useful or not									
Less useful	3		3	5	5	1	4	**21**	**60.00%**
Average useful	1	5				2	2	**10**	**28.57%**
Very useful			2			2		**4**	**11.43%**
(3-A-10) Satisfaction towards flood forecast and warning before flooding									
Not satisfied at all	2		4	5	5	2	4	**22**	**62.86%**
Less satisfied	1		1			1	2	**5**	**14.29%**
Average satisfied	1	5				1		**7**	**20.00%**
Very satisfied						1		**1**	**2.86%**
(3-A-11) Things to get improved in flood forecast and warning before flooding									
Accuracy of flood forecast and warning	4	5	5	5	5	5	6	**35**	**100.00%**
Frequency, to increase frequency of data update	2	0	1	0	0	4	0	**7**	**20.00%**
More than once per hour						2		2	28.57%
Once per hour						2		2	28.57%
Once per day									
More than once per day	2		1					3	42.86%
Weekly									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(3-A-11) Advance notification	4	4	0	4	2	5	5	**24**	**68.57%**
(Cont'd) 1 month before water approach									0.00%
1-4 weeks before water approach	2	2		1	2		3	10	41.67%
3-7 days before water approach	2	2		3		5	2	14	58.33%
1 day before water approach									
Add more channels of data information, via..									
Require more information									
Change patterns of the data to	3	3	0	0	0	3	0	**9**	**25.71%**
Numeric									
Graph									
Footages from the measuring point						1		1	11.11%
Animation, simulation of situation and location						2		2	22.22%
Narration	3	3						6	66.67%
Other; please specify ……………………									
(3-B)									
(3-B-1) Channel to receive information before flooding									
Television									
Radio									
Telephone (alarm call)									
Telephone (short message)									
Social network i.e. internet									
Word of mouth									
Announcement within community by amplifying car									
Other; please specify ……………………									
(3-B-2) Required information									
Weather information, i.e. weather such as temperature, humidity, air pressure									
Amount of rain over the water basis area or other areas									
amount of rain in the area									
Level of water in rivers, canals, nearby waterways									
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
Define the period of time to move away from residential areas									
Amount of / Location of evacuation points									
Evacuation routes in case of increasing of water level									
Name list of contact persons or officials or agencies to contact for assistance									
Other; please specify ……………………									
(3-B-3) Patterns of the required information									
Numeric									
Graph									
Footages from the measuring point									
Animation, simulation of situation and location									
Narration									
Other; please specify ……………………									

		Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
	(3-B-4) Period of time to receive the information									
	Over 1 week before flood reaches the area									
	1 week before flood reaches the area									
	3- 7 days before flood reaches the area									
	1-2 days before flood reaches the area									
	Within the day of flood reaches the area									
	(3-B-5) Frequency of information update									
	Once per hour									
	More than once per hour									
	Once per day									
	More than once per day									
	Weekly									
	Once over a week;									
	Other; please specify ……………………									
4	**Receive flood warning <u>during flood</u>**									
	Receiving of the information/ warning									
	Receive the information of the situation/ warning (skip to 4-A)	3	5	5	4	4	4	6	**31**	**88.57%**
	Do not receive any information (skip to 4-B)	1			1	1	1		**4**	**11.43%**
	(4-A)									
	(4-A-1) Receive information from									
	Central government authority	1		1	1	2	1		**6**	**19.35%**
	Local government authority	1							**1**	**3.23%**
	From IEAT		5	5	4	4	4	1	**23**	**74.19%**
	From local entrepreneur network	3	5	5	4	4	4	6	**31**	**100.00%**
	Other; please specify ……………………									
	(4-A-2) Channels to receive information									
	Television	1		1	1	2	1		**6**	**19.35%**
	Radio				1				**1**	**3.23%**
	Telephone (alarm call)	3	5	5	4	4	4	6	**31**	**100.00%**
	Telephone (short message)	3	5	5	4	4	4	6	**31**	**100.00%**
	Social Network	2		1		3			**6**	**19.35%**
	Word of mouth	3	5	5	4	4	4	6	**31**	**100.00%**
	Announcement by amplifying car		1						**1**	**3.23%**
	Other; please specify ……………………									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(4-A-3) Information received									
Weather inf, i.e. weather such as temperature, humidity, air pressure									
Rain Upstream	2	5	5		4			**16**	**51.61%**
Rain in the area	2	4	4		4	3		**17**	**54.84%**
Level of water in waterways			4	4	4	4		**16**	**51.61%**
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
Define period of time to return to factory area	2	5	5	4	4		6	**26**	**83.87%**
Amount , location ocation of evacuation points			3	3	4			**10**	**32.26%**
Evacuation routes in case of increasing of water level			3	1	3			**7**	**22.58%**
Name list o persons or officials or agencies to contact for assistance									
Other; please specify ……………………									
(4-A-4) The received information is sufficient or not									
Sufficient	3	5	3	4	4	1	1	**21**	**67.74%**
Insufficient, and need more information			2			3	5	**10**	**32.26%**
Weather information, i.e. weather such as temperature, humidity, air pressure									
Amount of rain over the water basis area or other areas									
Amount of rain in the area							2	2	20.00%
Level of water in rivers, canals, nearby waterways							3	3	30.00%
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d						2		2	20.00%
Define period of time to return to factory area									
Amount of/ Location of evacuation points									
Evacuation routes in case of increasing of water level									
Name list of contact persons or officials or agencies to contact for assistance			2			2	3	7	70.00%
Other; please specify ……………………									
(4-A-5) Patterns of information received									
Numeric	1			4	3	4		**12**	**38.71%**
Graph									
Footages from the measuring point									
Animation, simulation of situation and location									
Narration	3	5	5	4	4	4	6	**31**	**100.00%**
Other; please specify ……………………									
(4-A-6) Period of time to receive the information									
over 1 week before flood reaches the area	1							**1**	**3.23%**
1 week before flood reaches the area	2				3	1	1	**7**	**22.58%**
3- 7 days before flood reaches the area		5	2		1	3	2	**13**	**41.94%**
1-2 days before flood reaches the area			3	4			3	**10**	**32.26%**
within the d within the day of flood reaches the area									**0.00%**

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(4-A-7) Frequency of information update									
Once per hour						4		**4**	**12.90%**
More than once per hour								**0**	**0.00%**
Once per day	3	5	5	4	4		6	**27**	**87.10%**
More than once per day									
Weekly									
Once over a week;									
Other; please specify ……………………									
(4-A-8) The information received is reliable or not									
Less reliable		4	3	4	3	1	5	**20**	**64.52%**
Average reliable	3	1	2		1	3	1	**11**	**35.48%**
Very reliable									
(4-A-9) The information received is useful or not									
Less useful		4	3	4	3	1	5	**20**	**64.52%**
Average useful	3	1	2		1	3	1	**11**	**35.48%**
Very useful									
(4-A-10) Satisfaction towards flood forecast and warning <u>after flooding</u>									
Not satisfied at all		3	2	4	4	1	5	**19**	**61.29%**
Less satisfied	3	1	2			1	1	**8**	**25.81%**
Average satisfied		1	1			2		**4**	**12.90%**
Very satisfied									
(4-A-11) Things to get improved in flood forecast and warning after flooding									
Accuracy of flood forecast and warning	3	5	5	4	4	4	6	**31**	**100.00%**
Frequency, to increase frequency of data update			2			2		**4**	**12.90%**
More than once per hour						2		2	50.00%
Once per hour			2					2	50.00%
Once per day									
More than once per day	2							2	50.00%
Weekly									
Add more channels of data information, via									
Require more information									
Change patterns of the data to	0	0	0	0	4	1	0	**5**	**16.13%**
Numeric					2			2	40.00%
Graph					2			2	40.00%
Footages from the measuring point									0.00%
Animation, simulation of situation and location						1		1	20.00%
Narration									
Other; please specify ……………………									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(4-B)									
(4-B-1) Channel to receive information during flooding									
Television	1			1	1			**3**	**75.00%**
Radio									
Telephone (alarm call)	1			1	1	1		**4**	**100.00%**
Telephone (short message)	1			1	1	1		**4**	**100.00%**
Social network i.e. internet									
Word of mouth									
Announcement within community by amplifying car									
Other; please specify ……………………									
(4-B-2) Required information									
Weather inf , i.e. weather such as temperature, humidity, air pressure									
Rain Upstream				1				**1**	**25.00%**
Rain in the area				1				**1**	**25.00%**
Level of water in waterways				1				**1**	**25.00%**
Sea level									
Predicted data of rainfalls, in advance of ………….. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
Define period of time to return to factory area	1					1		**2**	**50.00%**
Amount , location ocation of evacuation points	1			1				**2**	**50.00%**
Evacuation routes in case of increasing of water level	1				1			**2**	**50.00%**
Name list o persons or officials or agencies to contact for assistance				1	1			**2**	**50.00%**
Other; please specify ……………………									
(4-B-3) Patterns of the required information									
Numeric	1				1	1		**3**	**75.00%**
Graph	1							**1**	**25.00%**
Footages from the measuring point									
Animation, simulation of situation and location									
Narration				1	1	1		**3**	**75.00%**
Other; please specify ……………………									
(4-B-4) Period of time to receive the information									
Over 1 week before flood reaches the area									
1 week before flood reaches the area	1				1	1		**3**	**75.00%**
3- 7 days before flood reaches the area									
1-2 days before flood reaches the area				1				**1**	**25.00%**
Within the day of flood reaches the area									
(4-B-5) Frequency of information update									
Once per hour									
More than once per hour									
Once per day				1	1	1		**3**	**75.00%**
More than once per day	1							**1**	**25.00%**
Weekly									
Other; please specify ……………………									

		Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
5	**Receiving of the information after flood / during recovery period**									
	Receiving of the information									
	Receive the information of the situation (skip to 5-A)	4	5	5	5	5	5	6	**35**	**100.00%**
	Do not receive the information (skip to 5-B)									
	(5-A)									
	(5-A-1) Receive information from									
	Central government authority	1	1			3	2	1	**8**	**22.86%**
	Local government authority	1					2		**3**	**8.57%**
	From IEAT		5	5	5	5	5	6	**31**	**88.57%**
	From local entrepreneur network	4	5	5	5	5	5	6	**35**	**100.00%**
	Other; please specify ……………………									
	(5-A-2) Channels to receive information									
	Television	1	1			3	2	1	**8**	**22.86%**
	Radio						2	1	**3**	**8.57%**
	Telephone (alarm call)	4	5	5	5	5	5	6	**35**	**100.00%**
	Telephone (short message)	2	5	5	5	5	5	6	**33**	**94.29%**
	Social network		1			2	3		**6**	**17.14%**
	Word of mouth	4	5	5	5	5	5	6	**35**	**100.00%**
	Announcement by amplifying car				1				**1**	**2.86%**
	Other; please specify									**0.00%**
	(5-A-3) Information received									
	Weather information, i.e. weather such as temperature, humidity, air pressure									
	Rain Upstream		2			4		1	**7**	**20.00%**
	Rain in the Area	1	1			4			**6**	**17.14%**
	Level of water in waterways	4	4	3	5	5	5	1	**27**	**77.14%**
	Sea level									
	Predicted of Rainfall, specify certain point of prediction at ……… in advance of ....hrs / d									
	Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
	Certain period of time to return to factory area	3	5	5	5	5	5	6	**34**	**97.14%**
	Name list o persons or officials or agencies to contact for assistance		2			3			**5**	**14.29%**
	Other; please specify ……………………									
	(5-A-4) The received information is sufficient or not									
	Sufficient	4	5	2	5	4	4	6	**30**	**85.71%**
	Insufficient, and need more information			3		1	1		**5**	**14.29%**
	Weather information, i.e. weather such as temperature, humidity, air pressure									
	Amount of rain over the water basis area or other areas									
	Amount of rain in the area									
	Level of water in rivers, canals, nearby waterways									
	Sea level									
	Predicted data of rainfalls, in advance of ………….. hours / day									
	Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
	Certain period of time to return to factory area									
	Name list of contact persons or officials or agencies to contact for assistance			3		1	1		5	100.00%
	Other; please specify ……………………									

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(5-A-5) Patterns of information received									
Numeric	3	5			4	3		**15**	**42.86%**
Graph									
Footages from the measuring point									
Animation, simulation of situation and location									
Narration	4	5	5	5	5	5	6	**35**	**100.00%**
Other; please specify ……………………									
(5-A-6) Period of time to receive the information									
The water approach until the water decrease	4	5	5	5	5	5	6	**35**	**100.00%**
Period of time of the water dry out until the situation is back to normal	4	5	5	5	5	5	6	**35**	**100.00%**
(5-A-7) Frequency of information update									
Once per hour						3		**3**	**8.57%**
More than once per hour						2		**2**	**5.71%**
Once per day	4	5	5	5	5		6	**30**	**85.71%**
More than once per day									
Weekly									
Once over a week;									
Other; please specify ……………………									
(5-A-8) The information received is reliable or not									
Less reliable			2	5	4	1	4	**16**	**45.71%**
Average reliable	3	5	3		1	3	2	**17**	**48.57%**
Very reliable	1					1		**2**	**5.71%**
(5-A-9) The information received is useful or not									
Less useful			2	5	4	1	4	**16**	**45.71%**
Average useful	3	5	3		1	3	2	**17**	**48.57%**
Very useful	1					1		**2**	**5.71%**
(5-A-10) Satisfaction towards flood forecast and warning after flooding									
Not satisfied at all			2	5	4	1	4	**16**	**45.71%**
Less satisfied			3		1	3	2	**9**	**25.71%**
Average satisfied	3	5				1		**9**	**25.71%**
Very satisfied	1							**1**	**2.86%**

	Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
(5-A-11) Things to get improved in flood forecast and warning after flooding									
Accuracy of flood forecast and warning	3	5	5	5	5	5	6	**34**	**97.14%**
Frequency, to increase frequency of data update						2		**2**	**5.71%**
More than once per hour						2		2	100.00%
Once per hour									
Once per day									
More than once per day									
Weekly									
Add more channels of data information, via									
Require more information									
Change patterns of the data to	0	0	0	1	0	1	0	**2**	**5.71%**
Numeric									
Graph									
Footages from the measuring point									
Animation, simulation of situation and location				1		1		2	100.00%
Narration									
Other; please specify ……………………									
(5-B)									
(5-B-1) Channel of information required after the flood									
Television									
Radio									
Telephone (alarm call)									
Telephone (short message)									
Social network i.e. internet									
Word of mouth									
Announcement within community by amplifying car									
Other; please specify ……………………									
(5-B-2) Required information									
Weather information, i.e. weather such as temperature, humidity, air pressure									
Amount of rain over the water basis area or other areas									
Amount of rain in the area									
Level of water in rivers, canals, nearby waterways									
Sea level									
Predicted data of rainfalls, in advance of …………. hours / day									
Predicted of water level, specify certain point of prediction at ……… in advance of ....hrs / d									
Define the period of time to move away from factory areas									
Name list of contact persons or officials or agencies to contact for assistance									
Other; please specify ……………………									
(5-B-3) Patterns of the information received									
Numeric									
Graph									
Footages from the measuring point									
Animation, simulation of situation and location									
Narration									
Other; please specify ……………………									

		Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
	(5-B-4) Period of time to receive the information									
	The water approach until the water decrease									
	Period of time of the water dry out until the situation is back to normal									
	(5-B-5) Frequency of information update									
	Once per hour									
	More than once per hour									
	Once per day									
	More than once per day									
	Weekly									
	Once over a week; please specify ………………………………									
6	**Flood preparation**									
	Any preparations to handle the flood or not									
	Preparation skip to 6-A)	4	5	5	5	5	4	6	**34**	**97.14%**
	No preparations (skip to 6-B)						1		**1**	**2.86%**
	(6-A)									
	(6-A-1) Time for preparation									
	Before the water reached the area	4	5	5	5	5	4	6	**34**	**100.00%**
	The area is frequent flooded area									
	Informed of floods in other areas	4	5	5	5	5	4	6	34	100.00%
	Other, please specify									
	Once being informed of the forecast and warning									
	After being informed of the forecast and warning ………………….. day(s)									
	(6-A-2) Preparations									
	Moving things to higher place	3	5	5	5	5	4	5	**32**	**94.12%**
	Moving things out of the house or targeted area of flood to other places						2	1	**3**	**8.82%**
	Prepare sandbags surrounded factory/company area	4	5	5	5	5	4	4	**32**	**94.12%**
	Build prevention wall surrounded factory or industrial estate						1	2	**3**	**8.82%**
	Other; please specify ……………………	3						1	**4**	**11.76%**
	(6-B)									
	(6-B-1) Reasons to not prepare to handle flood									
	The area has never being flooded									
	Being flooded in the past, but maybe not this time									
	Do not believe the warning									
	Other; please specify ……………………						1		**1**	**100.00%**

		Factory land	Rojjana	Navanakorn	Saharattana	Bangkadi	Bang Pa-In	Hi-tech	Tatal	%
7	**Preparation for future flooding**									
	Any preparation to handle with future flooding or not									
	Preparation (skip to 7-A)	2	2	5	2	4	3	6	**24**	**68.57%**
	No preparations (skip to 7-B)	2	3		3	1	2		**11**	**31.43%**
	(7-A)									
	(7-A-1) Preparation that has been done / ongoing									
	Permanently move out of the area		1			1		1	**3**	**12.50%**
	Build surround walls to prevent water approach	1	2			2	1	1	**7**	**29.17%**
	Build level up the current area to prevent flood				1		1	2	**4**	**16.67%**
	Setting flood prevention and mitigation plan	2	2	5	2	3	1	2	**17**	**70.83%**
	(7-A-2) Reason to prepare to handle with flood by yourself									
	Possibility of flood to occur again			1			2		**3**	**12.50%**
	Cannot rely on government authorities	2				1	2	1	**6**	**25.00%**
	Cannot rely on the warning or information, better prepare to prevent the situation	1	2	4	2	3		5	**17**	**70.83%**
	Other; please specify ……………………		1				1		**2**	**8.33%**
	(7-B)									
	(7-B-1) Reason of not continue preparation in handling with future flooding									
	It might never happen again		1		1		2		**4**	**36.36%**
	Can ask for assistance from government authorities if it happens again	2	2		1				**5**	**45.45%**
	Will prepare when receive warning from government authorities in flood forecast and warning									
	Will be able to live with flood									
	Other; please specify ……………………				1	1			**2**	**18.18%**
8	Your feeling to the current forecasting and warning systems									
	Accurate and very reliable						1		**1**	**2.86%**
	Not very good, but better than nothing	2	2				2		**6**	**17.14%**
	Not very good, but useful combining with other information	1	1		1	1		3	**7**	**20.00%**
	Not good, not reliable, and never been useful	1	1	5	4	4	2	3	**20**	**57.14%**
	Other; please specify ……………………									
9	What you want to have, or to improve the forecasting and warning systems									
	Information display to be more easier to understand	4	5	3	5	5		6	**28**	**80.00%**
	More frequency of information update	1			5				**6**	**17.14%**
	Earlier of warnings	3	2	1	3	2	2	2	**15**	**42.86%**
	Increase accuracy of forecasting	3	3	5	2	3	5	6	**27**	**77.14%**
	Add more channels to approach sources of information and warnings	3	1						**4**	**11.43%**
	Other; please specify ……………………									

Appendix E

(Questionnaire Survey: Local Authority)

		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
			%		%		%		%		%		%
1	**Area of responsibility**												
	No. of Responder	**40**		**36**		**28**		**42**		**42**		**188**	
	(1-1) Area of responsibility (Sub-district / District / Province)………………..…												
	(1-2) Size of area ………………….. sq. km.												
	(1-3) Amount of people in the responsible area ……………… persons												
2	**The role of the Authority in forecasting and flood warning in 2011**												
	measure and transfer data (skip to 2A, 2B)												
	receive data from other authorities and transfer to local operational units (skip to 2C)	28	70.00%	16	44.44%	9	32.14%	25	59.52%	27	64.29%	**105**	55.85%
	receive data from other authorities and transfer to public sectors, such as industries, industrial estates in the area (skip to 2C)												
	receive data from other authorities and transfer to people in the area (skip to 2C)	35	87.50%	20	55.56%	22	78.57%	38	90.48%	35	83.33%	**150**	79.79%
	(2A) Unit to measure and display data within the unit												
	(2A-1) Measured and displayed data												
	weather i.e. temperature, humidity, air pressure												
	amount or rainfall												
	water level in water ways, including main and secondary water lines, major canals, and water gates												
	other data, such as soil erosion; please specify …..…………….……….												
	(2A-2) Measuring frequency												
	once per hour												
	more than once per hour												
	once per day												
	more than once per day												
	weekly												
	once over a week; Please specify………………………..……………..……												
	(2A-3) Displaying of the measured data												
	display the measured data within the unit (skip tp 2A-4)												
	not Display the measured data within the unit but transfer the data (skip to 2C)												
	(2A-4) Display channels of the measured data												
	authority's official website; please specify address ……….………….												
	other authority's website; please specify address ……………..…………….…………….												
	other; please specify ……………………………………												
	(2A-5) Pattern of the data display												
	numeric												
	graph												
	footages from the measuring point												
	animation, simulation of situation and location												
	narration												
	other, please specify												
	(2A-6) Immediacy to display data												
	prompt after field measurement												
	not prompt after field measurement												
	(2A-7) Data display frequency												
	once per hour												
	more than once per hour												
	once per day												
	more than once per day												
	weekly												
	Once over a week; Please specify…………………..…………….												

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
		%		%		%		%		%		%
(2B) Local authority to measure and transfer the data												
(2B-1) Authority that the data will be transferred to; please specify………………												
(2B-2) Pattern of data transfer												
electronic file via e-mail												
facsimile												
telephone												
via social network, please specify ………………												
other; please specify ……………………												
(2B-3) pattern of the transferred data												
numeric												
graph												
Short Message												
footages from the measuring point												
animation, simulation of situation and location												
narration												
other, please specify												
(2B-4) immediacy in transferring the data												
prompt after field measurement												
not prompt after field measurement												
(2B-5) frequency of data transfer												
once per hour												
more than once per hour												
once per day												
more than once per day												
weekly												
once over a week; Please specify……………………………												
(2B-6) Sufficiency of the incurred data												
sufficient for processing or making decision												
insufficient, please specify more information required …………………												
(if there will not be processing or making decision, skip to 2D)												
(2B-7) Processing of												
water level forecast; please identify period of time ……………												
water level at the lowest reaches; please specify the farthest area to forecast ……………												
erosion or other forms of disaster; please specify forms of disaster ……………												
other data, such as soil erosion, please specify ………………												
(2B-8) Objectives of data processing												
to send the processed results to the federal government authorities to set national guidelines												
to send the processed results to the central government authorities												
to send the processed results to the level of local government authorities												
to send the processed results to the business sectors, such as industrial estates												
to send the processed results to the citizen												
to send the processed results to the mass communications												
other objectives; please specify												
(2B-9) Frequency of data processing												
once per hour												
more than once per hour												
once per day												
more than once per day												
weekly												
once over a week; Please specify………………………												

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
		%		%		%		%		%		%
(2B-10) pattern of the display of data processed												
numeric												
graph												
footages from the measuring point												
animation, simulation of situation and location												
narration												
other, please specify												
(2B-11) Accuracy of the data processing												
100% accuracy												
minimal deviation (less than 20%)												
medium deviation (21% - 50%)												
maximum deviation (51% - 80%)												
reliable but need to comply with other information please specify …………………												
(skip to 3A)												
(2C) Data unit to receive												
(2C-1) receive from (specify authority) …………………												
Provincial Officer	5	12.50%									**5**	2.66%
District Officer	12	30.00%			10	35.71%					**22**	11.70%
CPY Dam Operator / Marine Dept.							8	19.05%	2	4.76%	**10**	5.32%
RID and DDPM	17	42.50%	19	52.78%	18	64.29%	26	61.90%	24	57.14%	**104**	55.32%
DDPM	8	20.00%	12	33.33%			5	11.90%	11	26.19%	**36**	19.15%
RID	10	25.00%	8	22.22%			3	7.14%	5	11.90%	**26**	13.83%
(2C-2) Data received												
weather i.e. temperature, humidity, air pressure	19	47.50%	6	16.67%	9	32.14%	7	16.67%	3	7.14%	**44**	23.40%
amount or rainfall	26	65.00%	19	52.78%	15	53.57%	19	45.24%	17	40.48%	**96**	51.06%
water level in water ways	40	100.00%	33	91.67%	26	92.86%	40	95.24%	42	100.00%	**181**	96.28%
other; please specify			9	25.00%			18	42.86%	12	28.57%	**39**	20.74%
(2C-3) Frequency of data received												
once per hour												
more than once per hour												
once per day	21	52.50%	18	50.00%	18	64.29%	33	78.57%	35	83.33%	**125**	66.49%
more than once per day	19	47.50%	15	41.67%	10	35.71%	6	14.29%	4	9.52%	**54**	28.72%
weekly			3	8.33%			3	7.14%	2	4.76%	**8**	4.26%
once over a week; Please specify………………												
(2C-4) Sufficiency of the incurred or received data												
sufficient for processing or making decision	34	85.00%	24	66.67%	28	100.00%	39	92.86%	42	100.00%	**167**	88.83%
insufficient, please specify more information required ………………………	6	15.00%	12	33.33%		0.00%	3	7.14%		0.00%	**21**	11.17%
(if there will not be data processing or making decision, please skip to 2D)												
(2C-5) Processing of												
water level forecast	37	92.50%	25	69.44%	19	67.86%	27	64.29%	25	59.52%	**133**	70.74%
water level at the lowest reaches	22	55.00%	8	22.22%	9	32.14%	3	7.14%	2	4.76%	**44**	23.40%
erosion or other forms of disaster												
other data												
(2C-6) Objectives of data processing												
to send the processed results to the federal government authorities to set national guidelines			1	2.78%			2	4.76%	2	4.76%	**5**	2.66%
to send the processed results to the central government authorities	13	32.50%	3	8.33%	10	35.71%	17	40.48%	13	30.95%	**56**	29.79%
to send the processed results to the level of local government authorities	21	52.50%	18	50.00%	7	25.00%	2	4.76%	1	2.38%	**49**	26.06%
to send the processed results to the business sectors, such as industrial estates	6	15.00%	9	25.00%	5	17.86%	27	64.29%	23	54.76%	**70**	37.23%
to send the processed results to the citizen	34	85.00%	23	63.89%	17	60.71%	1	2.38%	3	7.14%	**78**	41.49%
to send the processed results to the mass communications.												
other objectives; please specify												

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
		%		%		%		%		%		%
(2C-7) Frequency of data processing												
once per hour												
more than once per hour												
once per day	25	62.50%	11	30.56%	20	71.43%	23	54.76%	22	52.38%	**101**	53.72%
more than once per day	12	30.00%	19	52.78%	8	28.57%	5	11.90%	3	7.14%	**47**	25.00%
weekly			6	16.67%			2	4.76%			**8**	4.26%
once over a week; Please specify…………………												
(2C-8) Pattern of the display of data processed												
numeric	18	45.00%	12	33.33%	8	28.57%	23	54.76%	23	54.76%	**84**	44.68%
graph												
footages from the measuring point												
animation, simulation of situation and location												
narration	37	92.50%	24	66.67%	20	71.43%	27	64.29%	24	57.14%	**132**	70.21%
other, please specify												
(2C-9) Accuracy of the data processing												
100% accuracy	2	5.00%	18	50.00%	15	53.57%					**35**	18.62%
minimal deviation (less than 20%)	22	55.00%	10	27.78%	6	21.43%	22	52.38%	20	47.62%	**80**	42.55%
medium deviation (21% - 50%)	3	7.50%	8	22.22%	7	25.00%	11	26.19%	10	23.81%	**39**	20.74%
maximum deviation (51% - 80%)	10	25.00%					6	14.29%	10	23.81%	**26**	13.83%
reliable but need to comply with other information							3	7.14%	2	4.76%	**5**	2.66%
(2D) Data transfer												
(2D-1) Government authorities to transfer the data to												
federal government authorities												
central government authorities	13	32.50%	3	8.33%		0.00%	3	7.14%	2	4.76%	**21**	11.17%
local government authorities	27	67.50%	18	50.00%	15	53.57%	22	52.38%	18	42.86%	**100**	53.19%
public sectors and business organizations			12	33.33%	10	35.71%	5	11.90%	8	19.05%	**35**	18.62%
citizen	37	92.50%	30	83.33%	26	92.86%	40	95.24%	42	100.00%	**175**	93.09%
mass communications												
(2D-2) Immediacy of data transfer												
prompt after field measurement	26	65.00%	7	19.44%	28	100.00%	11	26.19%	8	19.05%	**80**	42.55%
not prompt after field measurement	14	35.00%	29	80.56%			31	73.81%	34	80.95%	**108**	57.45%
(2D-3) Frequency of data transfer												
once per hour												
more than once per hour												
once per day	34	85.00%	27	75.00%	22	78.57%	34	80.95%	35	83.33%	**152**	80.85%
more than once per day	6	15.00%	8	22.22%	6	21.43%	7	16.67%	8	19.05%	**35**	18.62%
weekly			1				1	2.38%			**2**	1.06%
once over a week												
(2D-4) Pattern of the transferred data												
numeric	11	27.50%	18	50.00%	14	50.00%	39	92.86%	42	100.00%	**124**	65.96%
graph												
footages from the measuring point												
animation, simulation of situation and location												
narration	40	100.00%	36	100.00%	26	92.86%	42	100.00%	41	97.62%	**185**	98.40%
other, please specify												
(2D-5) Error incurred from data transfer												
none	8	20.00%	7	19.44%	6	21.43%	9	21.43%	6	14.29%	**36**	19.15%
occasionally (skip to 2D-6)	32	80.00%	29	80.56%	22	78.57%	33	78.57%	34	80.95%	**150**	79.79%
often (skip to 2D-6)												

			Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
				%		%		%		%		%		%
	(2D-6) Identifying source of error													
		human error	23	57.50%	19	52.78%	12	42.86%	15	35.71%	20	47.62%	**89**	47.34%
		computer error or from other tools	29	72.50%	11	30.56%	10	35.71%	20	47.62%	18	42.86%	**88**	46.81%
		miscommunication	14	35.00%	6	16.67%	10	35.71%	4	9.52%	5	11.90%	**39**	20.74%
		natural disruption..					2	7.14%					**2**	1.06%
		other; please specify												
3	**To verify the role of the organization to put on alarm before-during-after the flood**													
	(3A) Data displaying / transferring during monitoring period <u>before</u> flooding in 2011													
	(3A-1) Data displaying / transferring during monitoring period <u>before</u> flooding in 2011													
		data displaying / transferring - normal case	13	32.50%	11	30.56%	8	28.57%	16	38.10%	15	35.71%	**63**	33.51%
		data displaying / transferring - more frequent than normal case, but no emergency alarm	22	55.00%	21	58.33%	20	71.43%	22	52.38%	25	59.52%	**110**	58.51%
		data displaying / transferring - more frequent than normal case, and emergency alarm	5	12.50%	4	11.11%			4	9.52%	2	4.76%	**15**	7.98%
		no data displaying / transferring												
	(3A-2) Pattern of displayed/transferred data													
		numeric	21	52.50%	19	52.78%	12	42.86%	36	85.71%	40	95.24%	**128**	68.09%
		graph												
		short message	25	62.50%	5	13.89%		0.00%	11	26.19%	7	16.67%	**48**	25.53%
		footages from the measuring point												
		animation, simulation of situation and location												
		narration	40	100.00%	36	100.00%	24	85.71%	41	97.62%	42	100.00%	**183**	97.34%
		other, please specify												
	(3A-3) Data display / data transfer													
		display / transfer only data measured and processed within the unit												
		display / transfer only data measured and processed data that were transferred from other units	15	37.50%	27	75.00%	28	100.00%	24	57.14%	21	50.00%	**115**	61.17%
		display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units	25	62.50%	9	25.00%		0.00%	18	42.86%	20	47.62%	**72**	38.30%
		display / transfer only selected part of the data (not display/transfer all of them)									1	2.38%	**1**	0.53%
		Reason of not display/transfer all of the existing data………………….												
	(3A-4) Displayed / transferred data													
		rain upstream	5	12.50%	12	33.33%	6	21.43%	25	59.52%	29	69.05%	**77**	40.96%
		rain within the area	9	22.50%	14	38.89%	15	53.57%	15	35.71%	16	38.10%	**69**	36.70%
		water level outside the responsible area	11	27.50%	2	5.56%		0.00%	9	21.43%	7	16.67%	**29**	15.43%
		water level in rivers, canals, in the monitoring spots in the responsible areas	39	97.50%	30	83.33%	28	100.00%	38	90.48%	40	95.24%	**175**	93.09%
		situation forecast	20	50.00%	12	33.33%	17	60.71%	9	21.43%	8	19.05%	**66**	35.11%
		information for evacuation and assistance during the flood	12	30.00%	8	22.22%		0.00%	14	33.33%	12	28.57%	**46**	24.47%
		other; please specify...........................												
	(3A-5) Data of situation forecast to display													
		rain level forecast	6	15.00%	3	8.33%	4	14.29%	2	4.76%			**15**	
		water level forecast	20	50.00%	12	33.33%	13	46.43%	7	16.67%	8	19.05%	**60**	31.91%
		other	5	12.50%					1	2.38%	1	2.38%	**7**	3.72%
	(3A-6) Displayed and transferred data of flood warning / evacuation													
		amount / locations of evacuation camps			3				4	9.52%	3		**10**	5.32%
		evacuation routes if the water level increases	12	30.00%	7	19.44%			14	33.33%	12	28.57%	**45**	23.94%
		name list to contact for assistance when to evacuate	3	7.50%	3	8.33%			5	11.90%	4	9.52%	**15**	7.98%
	(3A-7) Evacuation time													
		before water level in the area increases …………………… hrs / d												
		during the time of water level increase	12	30.00%	8	22.22%			11	26.19%	12	28.57%	**43**	22.87%
		information of water level, but no signal of evacuation							6		5	11.90%	**11**	5.85%

	Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
		%		%		%		%		%		%
(3A-8) Channels of evacuation information												
inform via phone call							6		5	11.90%	**11**	5.85%
send short message via phone	4	10.00%					8	19.05%	7	16.67%	**19**	10.11%
verbal information	9	22.50%	8	22.22%			12	28.57%	11	26.19%	**40**	21.28%
other; please specify……………………………………	12	30.00%	6	16.67%			3	7.14%	1	2.38%	**22**	11.70%
(3B) Data displaying / transferring during monitoring period <u>during</u> flooding in 2011												
(3B-1) Data displaying / transferring during monitoring period <u>during</u> flooding in 2011												
data displaying / transferring - normal case	15	37.50%	8	22.22%	22	78.57%	4	9.52%			**49**	26.06%
data displaying / transferring - more frequent than normal case, but no special warning	25	62.50%	15	41.67%	6	21.43%	10	23.81%	11	26.19%	**67**	35.64%
data displaying / transferring - more frequent than normal case, and information of evacuation			13				28	66.67%	31	73.81%	**72**	38.30%
no data displaying / transferring - because ……………………………												
(3B-2) Pattern of data displaying / transferring during flooding in 2011												
numeric	23	57.50%	22	61.11%	14	50.00%	39	92.86%	41	97.62%	**139**	73.94%
graph												
short message	8	20.00%	7	19.44%			20	47.62%	27	64.29%	**62**	32.98%
footages from the measuring point												
animation, simulation of situation and location												
narration	40	100.00%	36	100.00%	28	100.00%	42	100.00%	42	100.00%	**188**	100.00%
other, please specify ....(discharge, flow)................	4	10.00%		0.00%			10	23.81%	2	4.76%	**16**	8.51%
(3B-3) Data display / data transfer												
display / transfer only data measured and processed within the unit	1	2.50%		0.00%		0.00%	5	11.90%			**6**	3.19%
display / transfer only data measured and processed data that were transferred from other units	11	27.50%	10	27.78%	28	100.00%	9	21.43%	11	26.19%	**69**	36.70%
display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units	25	62.50%	26	72.22%		0.00%	28	66.67%	31	73.81%	**110**	58.51%
display / transferonly selected part of the data (not display/transfer all of them)												
Reason of not display/transfer all of the existing data ……………………												
(3B-4) Displayed / transferred data												
rain upstream	4	10.00%	5	13.89%		0.00%	15	35.71%	14	33.33%	**38**	20.21%
rain witihn the area	26	65.00%	13	36.11%	8	28.57%	7	16.67%	8	19.05%	**62**	32.98%
water level outside the responsible area	14	35.00%	4	11.11%	12	42.86%	4	9.52%	3	7.14%	**37**	19.68%
water level in rivers, canals, in the monitoring spots in the responsible areas	35	87.50%	24	66.67%	28	100.00%	38	90.48%	41	97.62%	**166**	88.30%
situation forecast	20	50.00%	9	25.00%	10	35.71%	9	21.43%	9	21.43%	**57**	30.32%
information for evacuation and assistance during the flood	12	30.00%	10	27.78%			34	80.95%	32	76.19%	**88**	46.81%
other; please specify...........................							7	16.67%	3	7.14%	**10**	5.32%
(3B-5) Data of situation forecast to display												
rain level forecast; please identify period of time ………………………………												
water level forecast; please identify period of time	20	50.00%	9	25.00%	10	35.71%	8	19.05%	10	23.81%	**57**	30.32%
other	12	30.00%	4	11.11%	10	35.71%	4	9.52%	1	2.38%	**31**	16.49%
(3B-6) Displayed and transferred data of flood warning / evacuation												
amount / locations of evacuation camps			1	2.78%			5	11.90%	7	16.67%	**13**	6.91%
evacuation routes if the water level increases	12	30.00%	8	22.22%			26	61.90%	30	71.43%	**76**	40.43%
name list of contact persons or officials or agencies to contact for assistance	11	27.50%	1	2.78%			12	28.57%	9	21.43%	**33**	17.55%
when to evacuate	4	10.00%		0.00%						0.00%	**4**	2.13%
(3B-7) Evacuation time												
before water level in the area increases ……… hrs / d												
during the time of water level increase	12	30.00%	8	22.22%		0.00%	24	57.14%	30	71.43%	**74**	39.36%
information of water level, but no signal of evacuation	1	2.50%	2	5.56%		0.00%	12	28.57%	15	35.71%	**30**	15.96%
(3B-8) Channels of evacuation information												
inform via phone call			1				12	28.57%	23	54.76%	**36**	19.15%
send short message via phone	4	10.00%	1	2.78%		0.00%	10	23.81%	7	16.67%	**22**	11.70%
verbal information	16	40.00%	3	8.33%		0.00%	31	73.81%	32	76.19%	**82**	43.62%
other; please specify………	15	37.50%	5	13.89%		0.00%	9	21.43%	2	4.76%	**31**	16.49%

			Ayutthaya		**Ang Thong**		**Lopburi**		**Chai Nat**		**Sing Buri**		**Sum**	
				%		%		%		%		%		%
	(3C) Data displaying / transferring during monitoring period after flooding in 2011													
	(3C-1) Data displaying / transferring during monitoring period after flooding in 2011													
		data displaying / transferring - normal case	28	70.00%	25	69.44%	18	64.29%	27	64.29%	31	73.81%	**129**	68.62%
		data displaying / transferring - more frequent than normal case, but no special information	12	30.00%	11	30.56%	10	35.71%	7	16.67%	7	16.67%	**47**	25.00%
		data displaying / transferring - more frequent than normal case							8	19.05%	4	9.52%	**12**	6.38%
		no data displaying / transferring - because …………………………												
	(3C-2) Pattern of data displaying / transferring during recovery after flooding in 2011													
		numeric	16	40.00%	25	69.44%	18	64.29%	38	90.48%	39	92.86%	**136**	72.34%
		graph												
		short message	5	12.50%	4	11.11%			4	9.52%	2	4.76%	**15**	7.98%
		footages from the measuring point												
		animation, simulation of situation and location												
		narration	40	100.00%	36	100.00%	28	100.00%	41	97.62%	40	95.24%	**185**	98.40%
		other, please specify												
	(3C-3) Data display / data transfer													
		display / transfer only data measured and processed within the unit												
		display / transfer only data measured and processed data that were transferred from other units	23	57.50%	7	19.44%	28	100.00%	16	38.10%	14	33.33%	**88**	46.81%
		display / transfer all existing data, including data that were measured and processed within the unit and were transferred from other units	17	42.50%	26	72.22%		0.00%	26	61.90%	28	66.67%	**97**	51.60%
		display / transfer only selected part of the data (not display/transfer all of them)			3								**3**	1.60%
		Reason of not display/transfer all of the existing data …………………………												
	(3C-4) Displayed / transferred data													
		rain level outside the responsible area, or above water basis	7	17.50%	7	19.44%			10	23.81%	5	11.90%	**29**	15.43%
		rain level in the responsible area	21	52.50%	9	25.00%	17	60.71%	6	14.29%	4	9.52%	**57**	30.32%
		water level outside the responsible area	6	15.00%					2	4.76%			**8**	4.26%
		water level in rivers, canals, in the monitoring spots in the responsible areas	40	100.00%	17	47.22%	28	100.00%	28	66.67%	22	52.38%	**135**	71.81%
		situation forecast									1	2.38%	**1**	0.53%
		information for evacuation and assistance after the flood	40	100.00%	36	100.00%	28	100.00%	39	92.86%	39	92.86%	**182**	96.81%
		other; please specify................................												
	(3C-6) Information of assistance after the flood													
		name list of contact persons/ officials / agencies to contact for assistance compensation, monetary aid from the government	21	52.50%	22	61.11%	10	35.71%	39	92.86%	38	90.48%	**130**	69.15%
		other; please specify …………………	35	87.50%	20	55.56%	28	100.00%	35	83.33%	35	83.33%	**153**	81.38%
	(3C-7) Period of information													
		incurred flood in some of responsible areas	23	57.50%	16	44.44%	12	42.86%	16	38.10%	29	69.05%	**96**	51.06%
		when the water dries out until …… day(s) / month after the situation is back to normal	17	42.50%	20	55.56%	10	35.71%	23	54.76%	10	23.81%	**80**	42.55%
	(3C-8) Channels of information													
		via phone call	6	15.00%	14	38.89%		0.00%	27	64.29%	32	76.19%	**79**	42.02%
		short message via phone	21	52.50%	4	11.11%		0.00%	9	21.43%	7	16.67%	**41**	21.81%
		verbal information	37	92.50%	36	100.00%	28	100.00%	36	85.71%	37	88.10%	**174**	92.55%
		other; please specify …………………………												
4	**Satisfaction towards The role of the authority in forecasting and flood warning in 2011**													
	the most useful, maximum satisfactory level towards the authority		26	65.00%	15	41.67%		0.00%	17	40.48%	19	45.24%	**77**	40.96%
	moderate satisfactory level towards the authority (go to 4A)		11	27.50%	20	55.56%	28	100.00%	22	52.38%	21	50.00%	**102**	54.26%
	less satisfactory level towards the authority (go to 4A)		3	7.50%	1	2.78%		0.00%	3	7.14%	2	4.76%	**9**	4.79%
	(4A) Reason(s) of moderate or less satisfactory level towards the authority (please specify)													
		Need more accurate informaion							9	21.43%	9	21.43%	**18**	9.57%
		Receiving of information with error caused the delay preparation							10	23.81%	10	23.81%	**20**	10.64%
		Increase more rapid channel of information transfer							6	14.29%	4	9.52%	**10**	5.32%

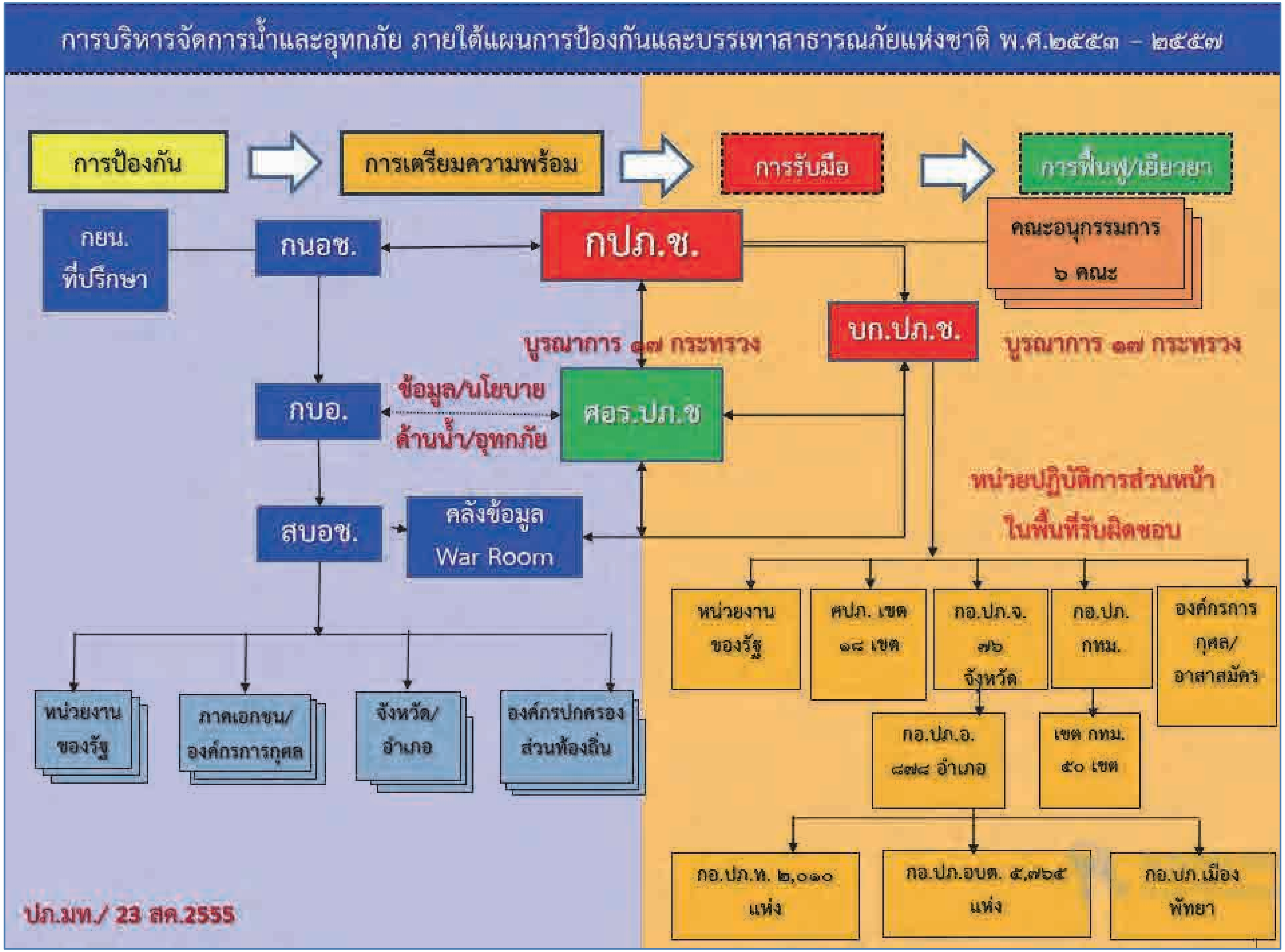
		Ayutthaya		Ang Thong		Lopburi		Chai Nat		Sing Buri		Sum	
			%		%		%		%		%		%
5	**Problem or obstacle in forecasting and flood warning in 2011**												
	un-readiness / insufficient of personnel	15	37.50%	17	47.22%	15	53.57%	26	61.90%	27	64.29%	**100**	53.19%
	un-readiness / insufficient of tools	24	60.00%	19	52.78%	18	64.29%	24	57.14%	19	45.24%	**104**	55.32%
	confusion of hierarchal order of commander	11	27.50%	1	2.78%	6	21.43%	1	2.38%	1	2.38%	**20**	10.64%
	no support from other coordinating authorities	1	2.50%	1	2.78%							**2**	1.06%
	uncontrollable natural disaster, such as power outage, lightening, etc.	6	15.00%	5	13.89%			2	4.76%	2	4.76%	**15**	7.98%
	other, please specify							11	26.19%	8	19.05%	**19**	10.11%
6	**Suggestion for the authority for responsible role in forecasting and flood warning in the future**												

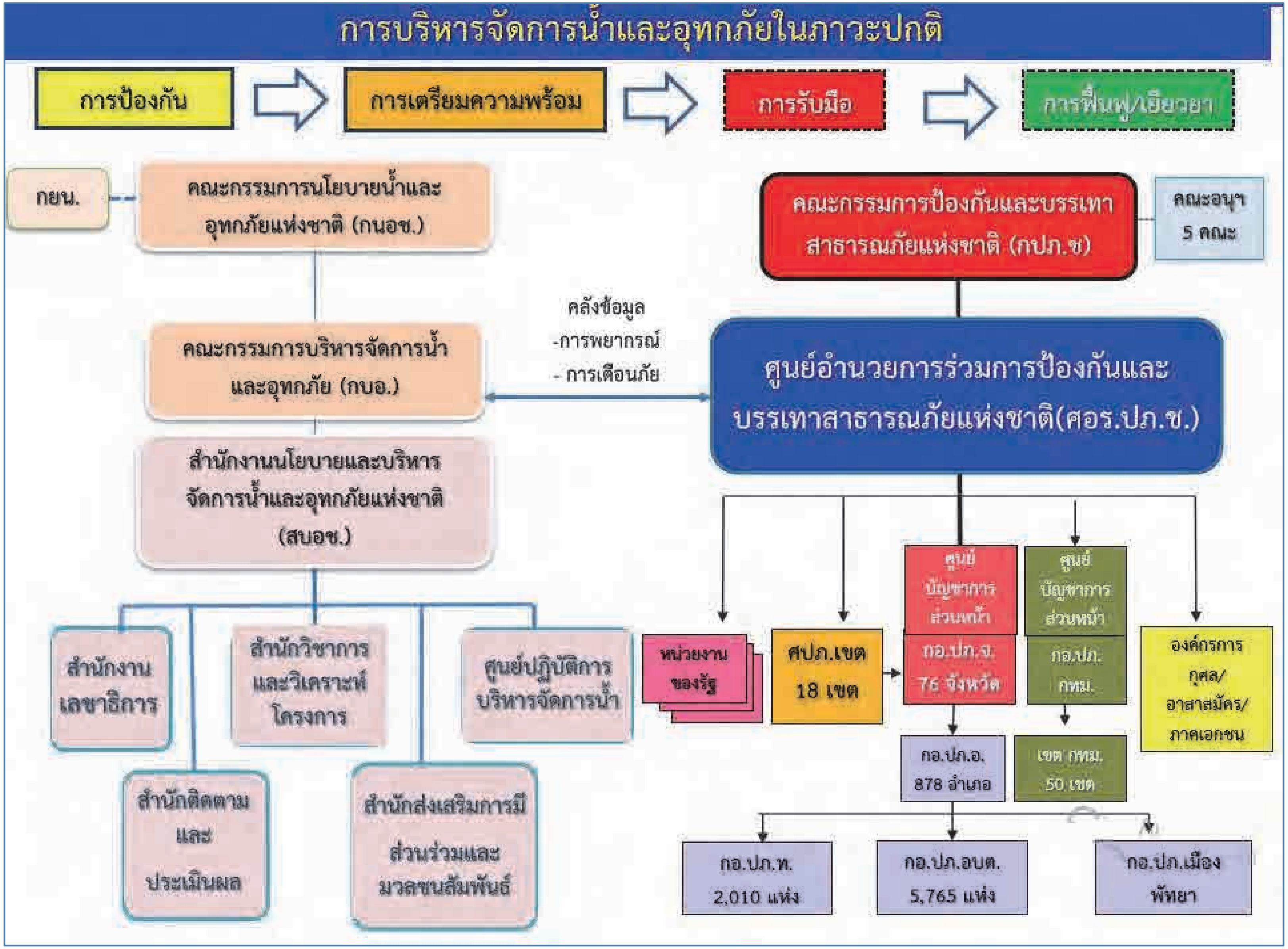
Appendix F

(Existing Natural Disaster Management Planning & Single Command Structure and Management)


DDPM
โครงสร้างและการบริหารจัดการภัยพิบัติ
ตามระบบ SINGLE COMMAND
30 สิงหาคม 2555
ก.พ.ร.
ปภ.

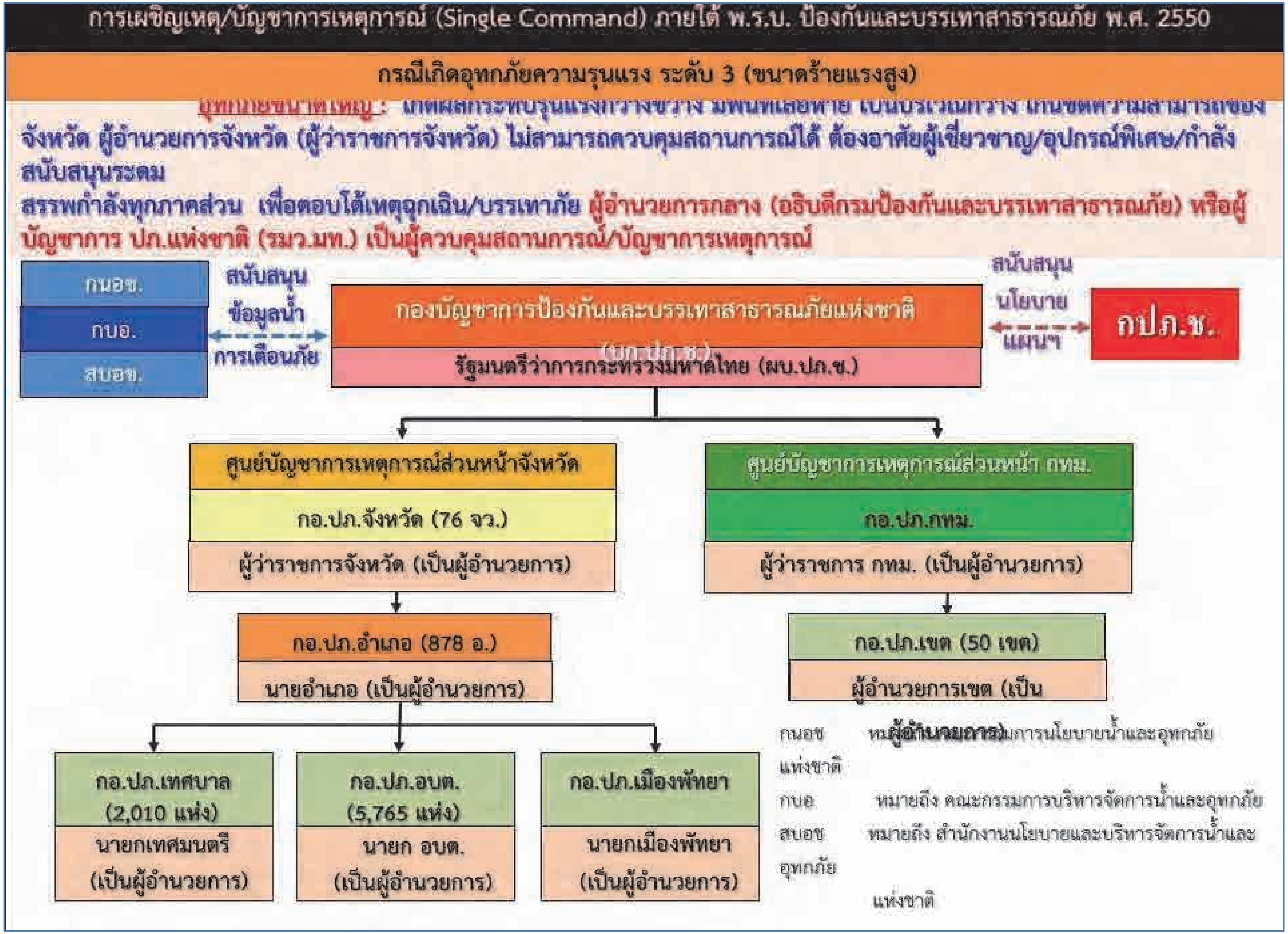

DDPM
สำนักนายกรัฐมนตรี
ก.พ.ร.
สำนักงานคณะกรรมการพัฒนาระบบราชการ
ปภ.
กรมป้องกันและบรรเทาสาธารณภัย
สถาบันสารสนเทศทรัพยากรน้ำและการเกษตร
(องค์การมหาชน)

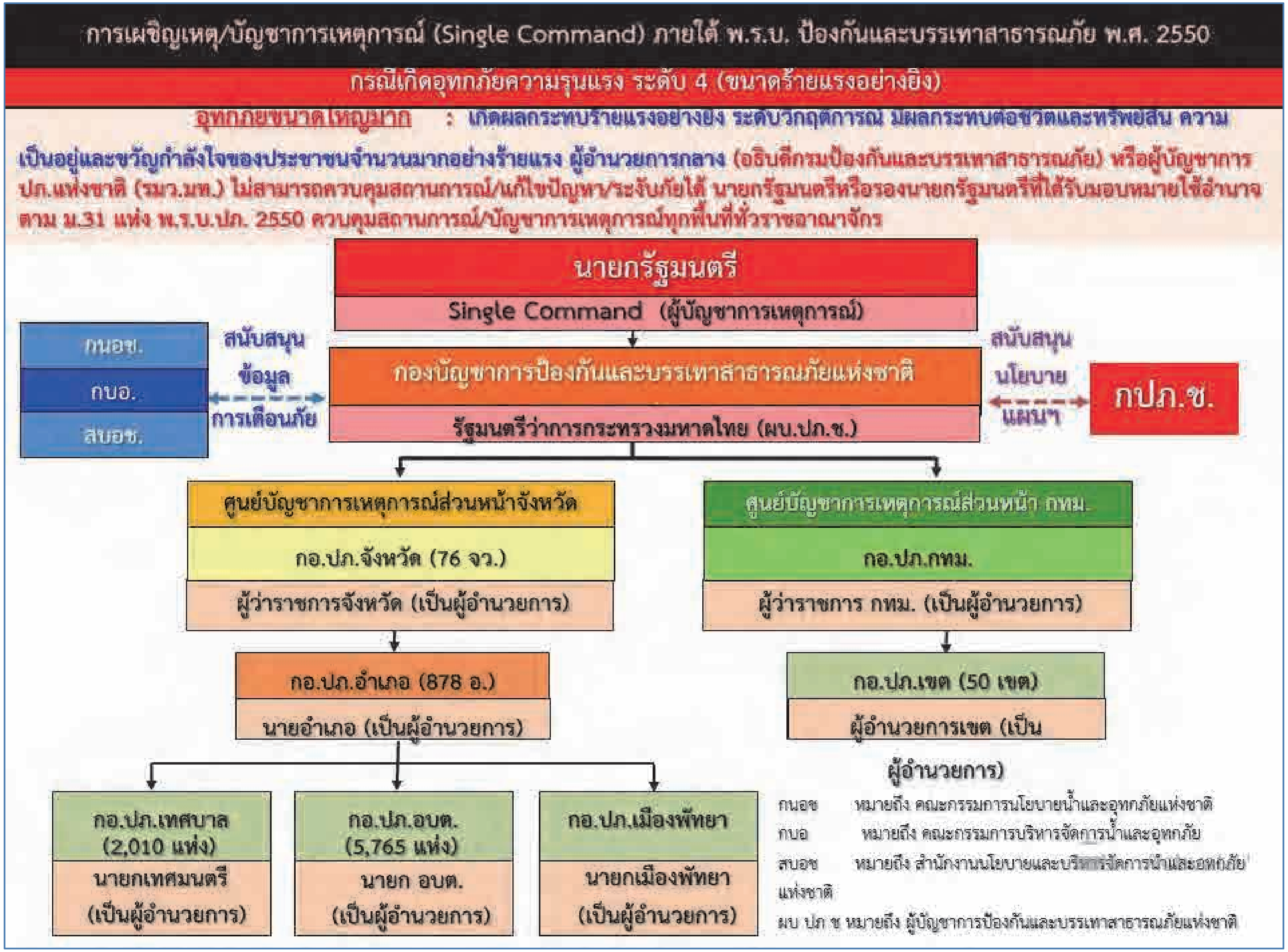

การบริหารจัดการน้ำและอุทกภัย ภายใต้แผนการป้องกันและบรรเทาสาธารณภัยแห่งชาติ พ.ศ.๒๕๕๓ – ๒๕๕๗
การป้องกัน
การเตรียมความพร้อม
การรับมือ
การฟื้นฟู/เยียวยา
กยน.
ที่ปรึกษา
กนอช.
กปภ.ช.
คณะอนุกรรมการ
๖ คณะ
บก.ปภ.ช.
บูรณาการ ๑๗ กระทรวง
บูรณาการ ๑๗ กระทรวง
กบอ.
ข้อมูล/นโยบาย
ด้านน้ำ/อุทกภัย
ศอร.ปภ.ช
สบอช.
คลังข้อมูล
War Room
หน่วยปฏิบัติการส่วนหน้า
ในพื้นที่รับผิดชอบ
หน่วยงาน
ของรัฐ
ภาคเอกชน/
องค์กรการกุศล
จังหวัด/
อำเภอ
องค์กรปกครอง
ส่วนท้องถิ่น
หน่วยงาน
ของรัฐ
ศปภ. เขต
๑๘ เขต
กอ.ปภ.จ.
๗๖
จังหวัด
กอ.ปภ.
กทม.
องค์กรการ
กุศล/
อาสาสมัคร
กอ.ปภ.อ.
๘๗๘ อำเภอ
เขต กทม.
๕๐ เขต
กอ.ปภ.ท. ๒,๐๑๐
แห่ง
กอ.ปภ.อบต. ๕,๗๖๕
แห่ง
กอ.บภ.เมือง
พัทยา
ปภ.มท./ 23 สค.2555


การบริหารจัดการน้ำและอุทกภัยในภาวะปกติ
การป้องกัน
การเตรียมความพร้อม
การรับมือ
การฟื้นฟู/เยียวยา
กยน.
คณะกรรมการนโยบายน้ำและอุทกภัยแห่งชาติ (กนอช.)
คณะกรรมการป้องกันและบรรเทาสาธารณภัยแห่งชาติ (กปภ.ช)
คณะอนุฯ 5 คณะ
คลังข้อมูล
-การพยากรณ์
- การเตือนภัย
คณะกรรมการบริหารจัดการน้ำและอุทกภัย (กบอ.)
ศูนย์อำนวยการร่วมการป้องกันและบรรเทาสาธารณภัยแห่งชาติ(ศอร.ปภ.ช.)
สำนักงานนโยบายและบริหารจัดการน้ำและอุทกภัยแห่งชาติ (สบอช.)
สำนักงานเลขาธิการ
สำนักวิชาการและวิเคราะห์โครงการ
ศูนย์ปฏิบัติการบริหารจัดการน้ำ
สำนักติดตามและประเมินผล
สำนักส่งเสริมการมีส่วนร่วมและมวลชนสัมพันธ์
หน่วยงานของรัฐ
ศปภ.เขต 18 เขต
ศูนย์บัญชาการส่วนหน้า
กอ.ปภ.จ. 76 จังหวัด
ศูนย์บัญชาการส่วนหน้า
กอ.ปภ.กทม.
องค์กรการกุศล/อาสาสมัคร/ภาคเอกชน
กอ.ปภ.อ. 878 อำเภอ
เขต กทม. 50 เขต
กอ.ปภ.ท. 2,010 แห่ง
กอ.ปภ.อบต. 5,765 แห่ง
กอ.ปภ.เมืองพัทยา


กรณีเกิดอุทกภัยความรุนแรง ระดับ 1 (ขนาดร้ายแรงน้อย)
อุทกภัยขนาดเล็ก : องค์กรปกครองส่วนท้องถิ่น (เทศบาล / อบต./ เมืองพัทยา) สามารถควบคุมสถานการณ์ ระงับภัยได้โดยลำพังตามขีดความสามารถไม่ต้องการกำลังสนับสนุนจากภายนอก
ผู้อำนวยการท้องถิ่น/ผู้อำนวยการอำเภอ เป็นผู้ควบคุมสถานการณ์/บัญชาการเหตุการณ์
กอ.ปภ.อำเภอ
(878 อ.)
นายอำเภอ (เป็นผู้อำนวยการ)
กอ.ปภ.เทศบาล
(2,010 แห่ง)
นายกเทศมนตรี
(เป็นผู้อำนวยการ)
สนับสนุนการปฏิบัติซึ่งกันและกัน
กอ.ปภ.อบต.
(5,765 แห่ง)
นายก อบต.
(เป็นผู้อำนวยการ)
สนับสนุนการปฏิบัติซึ่งกันและกัน
กอ.ปภ.เมืองพัทยา
นายกเมืองพัทยา
(เป็นผู้อำนวยการ)
พื้นที่ประสบภัย
พื้นที่ประสบภัย
พื้นที่ประสบภัย
กอ.ปภ. หมายถึง กองอำนวยการป้องกันและบรรเทาสาธารณ
3
การเผชิญเหตุ/บัญชาการเหตุการณ์ (Single Command) ภายใต้ พ.ร.บ. ป้องกันและบรรเทาสาธารณภัย พ.ศ. 2550


การเผชิญเหตุ/บัญชาการเหตุการณ์ (Single Command) ภายใต้ พ.ร.บ. ป้องกันและบรรเทาสาธารณภัย พ.ศ. 2550
กรณีเกิดอุทกภัยความรุนแรง ระดับ 2 (ขนาดภัยร้ายแรงปานกลาง)
อุทกภัยขนาดกลาง : เกินขีดความสามารถขององค์กรปกครองส่วนท้องถิ่น (เทศบาล/อบต./เมืองพัทยา) อำเภอ (นายอำเภอ) และเขตใน กทม. ไม่สามารถควบคุมสถานการณ์และบริหารจัดการระงับภัยได้โดยลำพัง ผู้อำนวยการจังหวัด (ผู้ว่าราชการจังหวัด) / ผู้อำนวยการ กทม. (ผู้ว่าราชการ กทม.) กรณีในพื้นที่ กทม. เข้าควบคุมสถานการณ์/บัญชาการเหตุการณ์
ศูนย์บัญชาการเหตุการณ์ส่วนหน้าจังหวัด
กอ.ปภ.จังหวัด (76 จว.)
ผู้ว่าราชการจังหวัด (เป็นผู้อำนวยการ)
ศูนย์บัญชาการเหตุการณ์ส่วนหน้า กทม.
กอ.ปภ.กทม.
ผู้ว่าราชการ กทม. (เป็นผู้อำนวยการ)
กอ.ปภ.อำเภอ (878 อ.)
นายอำเภอ (เป็นผู้อำนวยการ)
กอ.ปภ.เขต (50 เขต)
ผู้อำนวยการเขต (เป็น
ผู้อำนวยการ)
กอ.ปภ.เทศบาล
กอ.ปภ.อบต.
กอ.ปภ.เมืองพัทยา


การเผชิญเหตุ/บัญชาการเหตุการณ์ (Single Command) ภายใต้ พ.ร.บ. ป้องกันและบรรเทาสาธารณภัย พ.ศ. 2550
กรณีเกิดอุทกภัยความรุนแรง ระดับ 3 (ขนาดร้ายแรงสูง)
จังหวัด ผู้อำนวยการจังหวัด (ผู้ว่าราชการจังหวัด) ไม่สามารถควบคุมสถานการณ์ได้ ต้องอาศัยผู้เชี่ยวชาญ/อุปกรณ์พิเศษ/กำลังสนับสนุนระดม
สรรพกำลังทุกภาคส่วน เพื่อตอบโต้เหตุฉุกเฉิน/บรรเทาภัย ผู้อำนวยการกลาง (อธิบดีกรมป้องกันและบรรเทาสาธารณภัย) หรือผู้บัญชาการ ปภ.แห่งชาติ (รมว.มท.) เป็นผู้ควบคุมสถานการณ์/บัญชาการเหตุการณ์
กนอช.
กบอ.
สบอช.
สนับสนุน
ข้อมูลน้ำ
การเตือนภัย
กองบัญชาการป้องกันและบรรเทาสาธารณภัยแห่งชาติ
(บก.ปภ.ช.)
รัฐมนตรีว่าการกระทรวงมหาดไทย (ผบ.ปภ.ช.)
สนับสนุน
นโยบาย
แผนฯ
กปภ.ช.
ศูนย์บัญชาการเหตุการณ์ส่วนหน้าจังหวัด
กอ.ปภ.จังหวัด (76 จว.)
ผู้ว่าราชการจังหวัด (เป็นผู้อำนวยการ)
ศูนย์บัญชาการเหตุการณ์ส่วนหน้า กทม.
กอ.ปภ.กทม.
ผู้ว่าราชการ กทม. (เป็นผู้อำนวยการ)
กอ.ปภ.อำเภอ (878 อ.)
นายอำเภอ (เป็นผู้อำนวยการ)
กอ.ปภ.เขต (50 เขต)
ผู้อำนวยการเขต (เป็นผู้อำนวยการ)
กอ.ปภ.เทศบาล
(2,010 แห่ง)
นายกเทศมนตรี
(เป็นผู้อำนวยการ)
กอ.ปภ.อบต.
(5,765 แห่ง)
นายก อบต.
(เป็นผู้อำนวยการ)
กอ.ปภ.เมืองพัทยา
นายกเมืองพัทยา
(เป็นผู้อำนวยการ)
กนอช หมายถึง คณะกรรมการนโยบายน้ำและอุทกภัยแห่งชาติ
กบอ หมายถึง คณะกรรมการบริหารจัดการน้ำและอุทกภัย
สบอช หมายถึง สำนักงานนโยบายและบริหารจัดการน้ำและอุทกภัยแห่งชาติ


การเผชิญเหตุ/บัญชาการเหตุการณ์ (Single Command) ภายใต้ พ.ร.บ. ป้องกันและบรรเทาสาธารณภัย พ.ศ. 2550
กรณีเกิดอุทกภัยความรุนแรง ระดับ 4 (ขนาดร้ายแรงอย่างยิ่ง)
อุทกภัยขนาดใหญ่มาก : เกิดผลกระทบร้ายแรงอย่างยิ่ง ระดับวิกฤตการณ์ มีผลกระทบต่อชีวิตและทรัพย์สิน ความเป็นอยู่และขวัญกำลังใจของประชาชนจำนวนมากอย่างร้ายแรง ผู้อำนวยการกลาง (อธิบดีกรมป้องกันและบรรเทาสาธารณภัย) หรือผู้บัญชาการ ปภ.แห่งชาติ (รมว.มท.) ไม่สามารถควบคุมสถานการณ์/แก้ไขปัญหา/ระงับภัยได้ นายกรัฐมนตรีหรือรองนายกรัฐมนตรีที่ได้รับมอบหมายใช้อำนาจตาม ม.31 แห่ง พ.ร.บ.ปภ. 2550 ควบคุมสถานการณ์/บัญชาการเหตุการณ์ทุกพื้นที่ทั่วราชอาณาจักร
นายกรัฐมนตรี
Single Command (ผู้บัญชาการเหตุการณ์)
กนอช.
กบอ.
สบอช.
สนับสนุน
ข้อมูล
การเตือนภัย
กองบัญชาการป้องกันและบรรเทาสาธารณภัยแห่งชาติ
รัฐมนตรีว่าการกระทรวงมหาดไทย (ผบ.ปภ.ช.)
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แผนฯ
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ผู้อำนวยการ)
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นายกเทศมนตรี
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กบอ หมายถึง คณะกรรมการบริหารจัดการน้ำและอุทกภัย
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ผบ ปภ ช หมายถึง ผู้บัญชาการป้องกันและบรรเทาสาธารณภัยแห่งชาติ


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1
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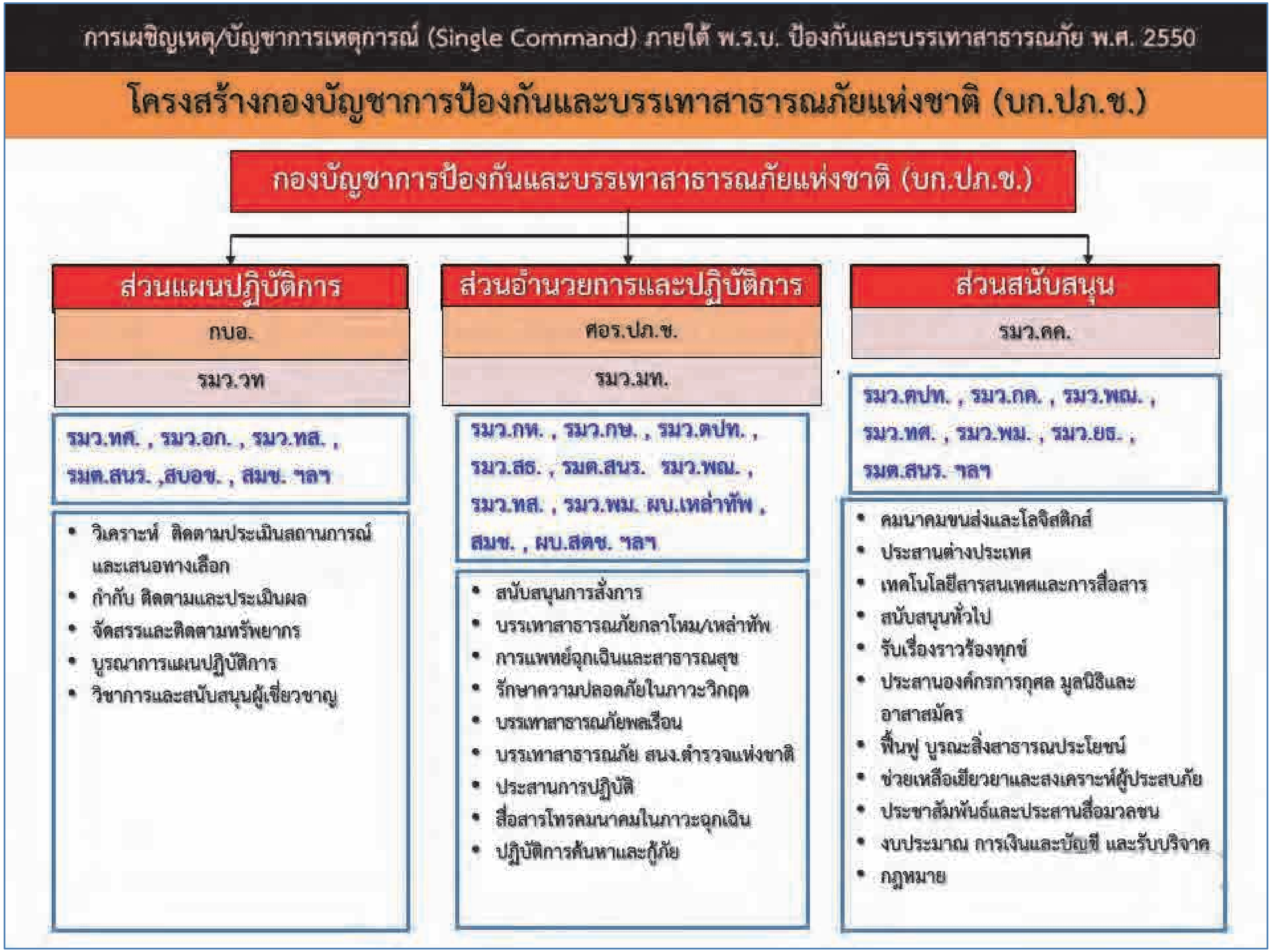
การเผชิญเหตุ/บัญชาการเหตุการณ์ (Single Command) ภายใต้ พ.ร.บ. ป้องกันและบรรเทาสาธารณภัย พ.ศ. 2550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• ดำรงการสื่อสาร
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• ประสานความช่วยเหลือจากต่างประเทศ
• จัดหางบประมาณช่วยเหลือฉุกเฉิน
• การจ่ายเงินช่วยเหลือผู้ประสบภัยพิบัติฉุกเฉิน ตามระเบียบของทางราชการ
• การเงินและบัญชี
• รับบริจาคเงินและสิ่งของ บริหารจัดการเงินและสิ่งของบริจาค รวมทั้งสิ่งของพระราชทาน
• จัดหาค่าตอบแทนผู้ปฏิบัติงานในภาวะฉุกเฉิน
• เผยแพร่ประชาสัมพันธ์สถานการณ์ การแก้ไขปัญหา การให้ความช่วยเหลือ
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• จัดตั้งศูนย์รวมข้อมูลข่าวสาร เพื่อการประชาสัมพันธ์และแถลงข่าว
• รักษาความปลอดภัยในชีวิตและทรัพย์สินของผู้ประสบภัย
• ควบคุมและจัดระเบียบการจราจรในภาวะฉุกเฉิน
• อำนวยความปลอดภัยในการอพยพ

Attachment 11

Benefit Analysis of Non-structural Countermeasures

Table of Contents

1. Damage Mitigation via Non-structural Measures

Implementing flood forecasting and warning systems as well as other non-structural measures are vital to disaster management. In order to utilize flood forecasting and warning systems, etc. on an ongoing basis (i.e. budgeting operational costs), it is necessary to identify how much of an economic impact these measures will have.

This paper estimates the amount of damage that would have been mitigated in the 2011 floods if flood forecasting and warning systems had been leveraged to make the most of the information disseminated.

1.1. Functions of Non-structural Measures

This section provides a list of flood forecasting and warning systems as well as other feasible non-structural measures and summarizes how they should function during a flood.

1.1.1 List of Feasible Non-structural Measures

Shown below is a list of flood forecasting and warning systems as well as other feasible non-structural measures.

Table 1-1: Non-structural Measures That Should Mitigate Flood Damage

Nonstructural Measures	Description
Flood forecasting and information dissemination	Flood forecasting and warning systems are used to estimate river water levels, the time rivers will start to overflow, areas prone to the risk of inundation, as well as inundation depths, and communicate all this information to government organizations and local residents.
Mobile levees and sandbags	Mobile levees and sandbags are installed around various assets, based on information about estimated flood zones and inundation depths, to protect them from inundation.
Waterstops	Waterstops are installed at the entrances of houses, based on information about estimated flood zones and inundation depths, to prevent them from becoming inundated.

1.1.2 Expected Functions during a Flood

Anticipated effects of flood forecasting and warning systems as well as other feasible non-structural measures are as shown below.

Table 1-2: Effects Expected from Feasible Non-structural Measures

Nonstructural Measures	Expected Effects
Flood forecasting and information dissemination	Will give local residents extra time to evacuate and protect their assets from inundation
Mobile levees and sandbags	Will protect assets from inundation when installed around them
Waterstops	Will protect houses from inundation when installed at their entrances

1.2. Correlation between Time Evacuation Began and Damage Rates during the 2011 Floods

We used the resident survey results for the 2011 floods to calculate the difference between the time when inundation started and the time when residents started evacuating, and identified correlations between the time difference and asset damage (Diagram 1-1). Asset damage was based on resident survey results.

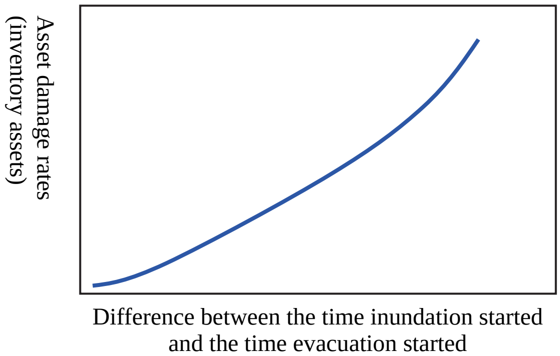


Diagram 1-1: Correlation Analysis

1.2.1 Calculation of Evacuation Time Difference

The evacuation time difference is defined as the number of days residents waited to evacuate from the time inundation started.

A survey conducted among 1,200 residents after the 2011 floods included the following questions concerning the correlation between the time when they started evacuating and the time when inundation started.

Table 1-3: Resident Survey Questions on When to Evacuate

Question No.	Question	Answer
C6-1-1	Did you evacuate before inundation started during the 2011 floods?	1: Yes 2: No
C6-1-2	Did you evacuate after inundation started during the 2011 floods?	1: Yes 2: No
C6-1-3	How many days did you wait until you evacuated after inundation started during the 2011 floods?	X [days]

The evacuation time difference was determined as described below on the basis of the above-mentioned survey questions.

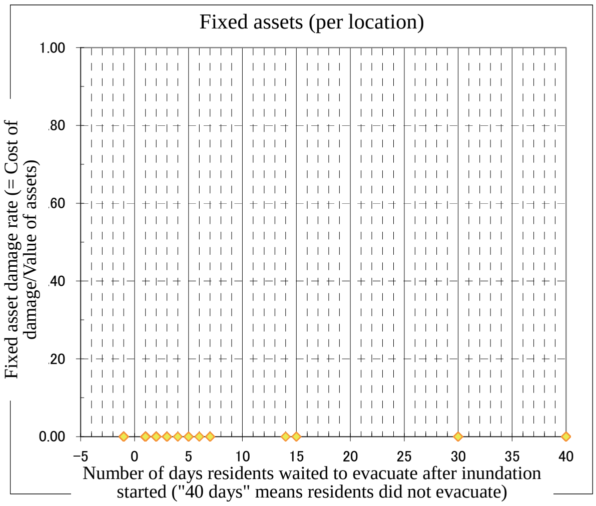
Table 1-4: How to Determine Evacuation Time Difference Based on Resident Survey

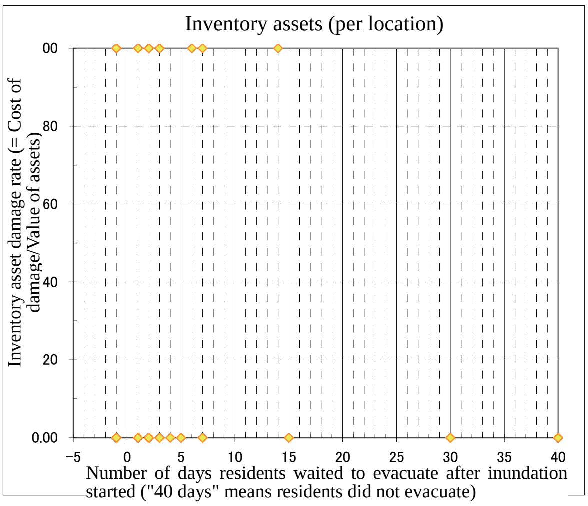
Question C6-1-1	Question C6-1-2	Question C6-1-3	Number of days residents waited to evacuate after inundation started (= Day residents evacuated - Day inundation started)	Remarks
1	2	-	No data => Assumed as - 1 [day]	Evacuated before inundation started
2	1	n	n => n [days]	Evacuated after inundation started
	2	-	No data => Shown as 40 [days]	Did not evacuate after inundation started

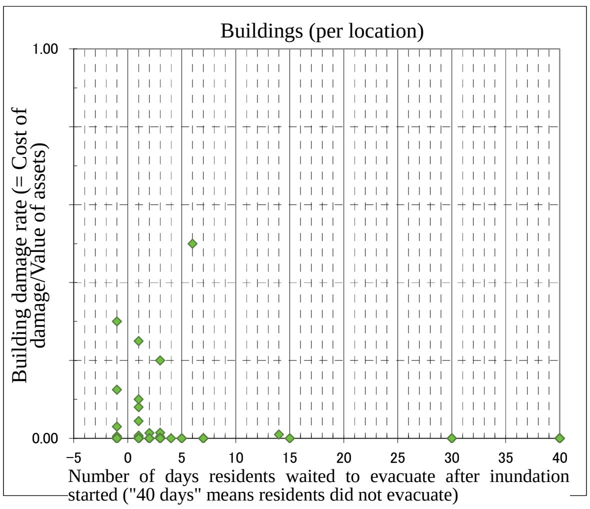
1.2.2 Correlation between Evacuation Time Difference and Damage Rates

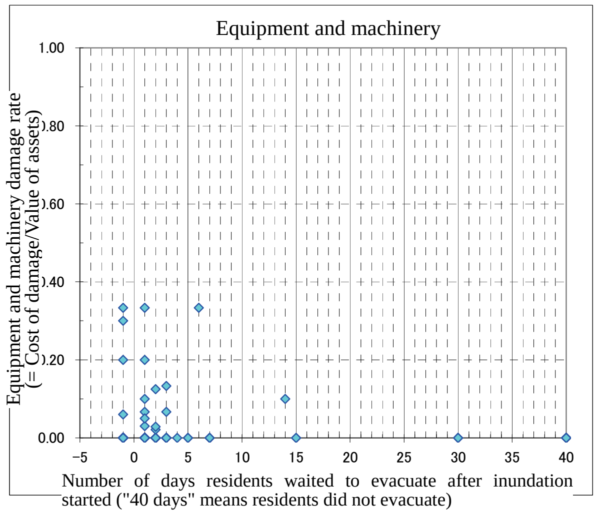
Scatter diagrams were created to examine whether there was any correlation between the evacuation time difference, which was calculated on the basis of the survey results in the previous section, and damage rates. Damage rates were determined by dividing the cost of damage by the total value of assets based on answers to questions related to assets and damage in the resident survey conducted after the 2011 floods.

The scatter diagrams are as shown below.









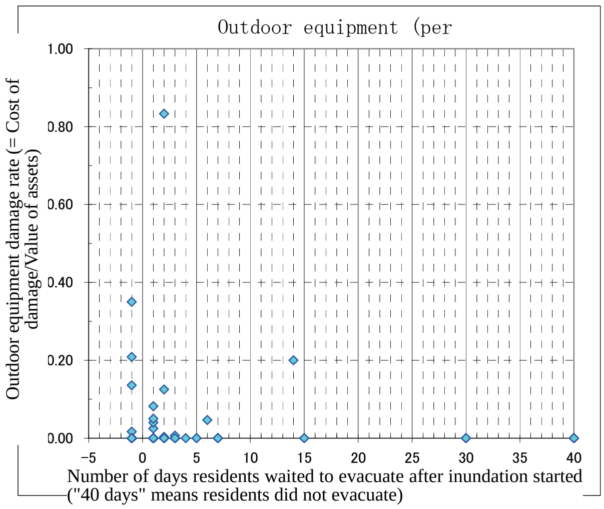


Diagram 1-2: Correlation between Evacuation Time Difference and Damage

When viewed in terms of assets, the diagrams show the following tendencies.

- None of the residents said their fixed assets were damaged. This indicates that they may have regarded only land as a fixed asset when they answered the survey questionnaire.
- In looking at inventory assets (∋ assets on hand), we did not see any clear correlation between asset damage and the number of days from the start of inundation until evacuation. Damage rates were either 0% or 100%. This indicates that most of the merchandise items (or products) were things that could not be sold once they had been immersed in water.
- When it comes to buildings, equipment, machinery and outdoor equipment, there was no clear correlation between asset damage and the number of days from the start of inundation until evacuation.
- Looking at all types of assets, we found that residents who evacuated after 15 days or more from the start of inundation did not suffer any asset damage.

1.3. Correlation between Flood Alerts and Damage Rates during the 2011 Floods

We examined the correlation between types of flood alerts residents thought they needed and asset damage based on the results of the resident survey about the 2011 floods. Asset damage was based on resident survey results.

1.3.1 Types of Flood Alerts

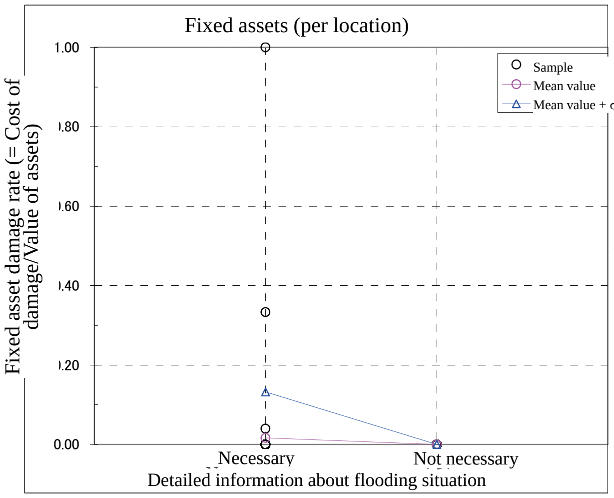
The resident survey revealed that residents thought the following type of flood alert was needed, which was never really provided.

- Detailed information about flooding situation

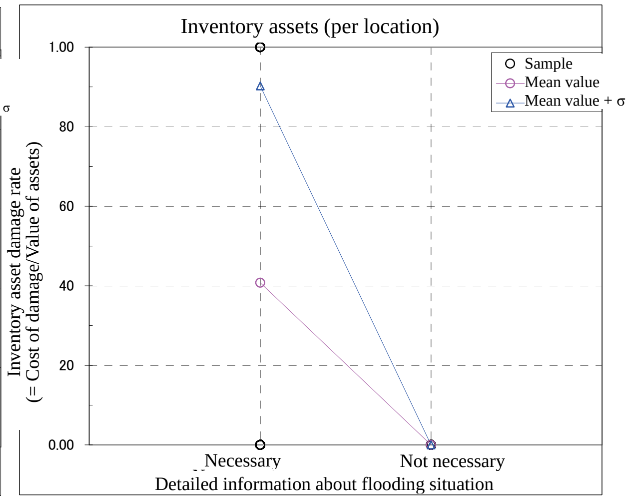
1.3.2 Correlation between Flood Alerts Residents Thought They Needed and Damage Rates

Scatter diagrams were created based on the survey results to identify correlations between damage rates and whether or not residents thought flood alerts were necessary. Damage rates were determined by dividing the cost of damage by the total value of assets based on answers to questions related to assets and damage in the resident survey conducted after the 2011 floods.

The scatter diagrams are as shown below.

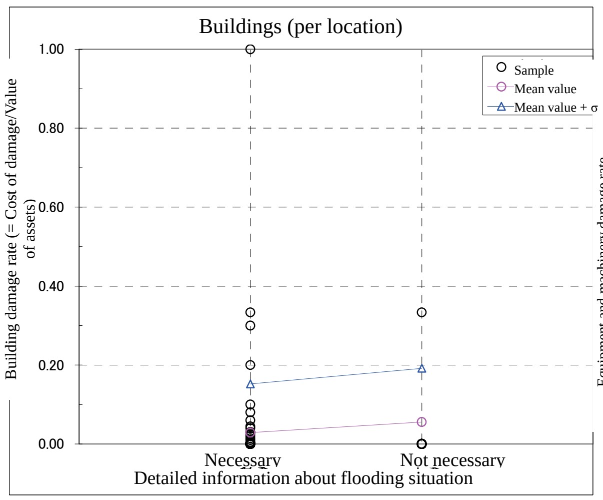


Necessity	Necessary	Not necessary
Mean m	0.02	0.00
Standard deviation σ :	0.12	0.00
m + σ	0.13	0.00
m + -	-0.10	0.00
Sample size	82	6

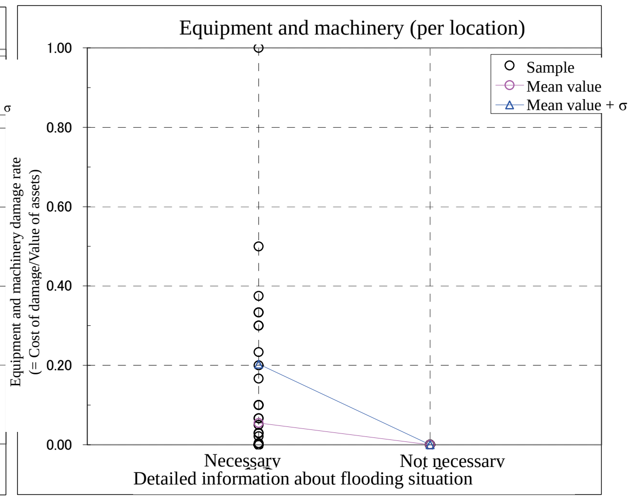


Necessity	Necessary	Not necessary
Mean m	0.41	0.00
Standard deviation σ:	0.49	0.00
m + σ	0.90	0.00
m + -	-0.09	0.00
Sample size	76	4

Diagram 1-3: Correlation between Need for Flood Alerts and Damage Rates (Detailed Information about Flooding Situation 1)

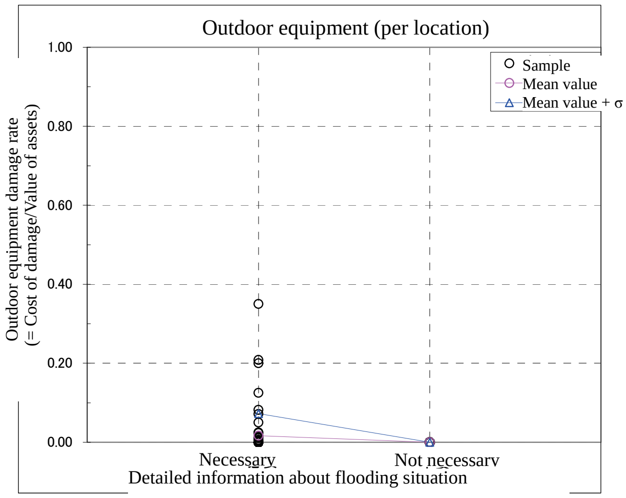


Necessity	Necessary	Not necessary
Mean m	0.03	0.06
Standard deviation σ :	0.12	0.14
m + σ	0.15	0.19
m + -	-0.09	-0.08
Sample size	80	6



Necessity	Necessary	Not necessary
Mean m	0.05	0.00
Standard deviation σ :	0.15	0.00
m + σ	0.20	0.00
m + -	-0.09	0.00
Sample size	79	6

Diagram 1-4: Correlation between Need for Flood Alerts and Damage Rates (Detailed Information about Flooding Situation 2)



Necessity	Necessary	Not necessary
Mean m	0.02	0.00
Standard deviation σ	0.06	0.00
m + σ	0.07	0.00
m + -	-0.04	0.00
Sample size	71	5

Diagram 1-5: Correlation between Need for Flood Alerts and Damage Rates (Detailed Information about Flooding Situation 3)

These diagrams indicate the following tendencies.

- In all asset categories, more than 90% of residents thought detailed information about the flooding situation was necessary.
- No damage to assets, with the exception of buildings, was reported in areas where residents didn't believe detailed information about the flooding situation was necessary. This indicates that those who suffered asset damage required detailed information about the flooding situation.
- Since detailed information about the flooding situation was not actually provided to residents, we were unable to assess how such information would have mitigated damage.

1.4. Estimating How Non-structural Measures Would Mitigate Damage

This section looks at how asset damage and casualties can be minimized by the use of non-structural measures that encourage people to expedite evacuation, install waterstops, and move assets to upper floors or other safe areas.

Originally we were going to use the methodology described below to make an estimate based on the assumption that there would be a clear correlation between the evacuation time difference and damage (see Diagram 1-6).

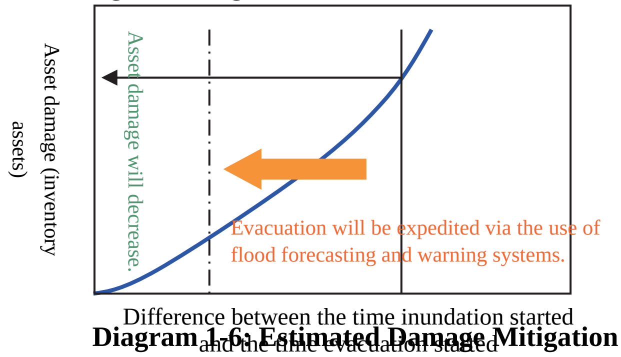


Diagram 1-6: Estimated Damage Mitigation

- Design a regression formula for the time difference between the start of evacuation and inundation as well as asset damage/casualties.
- Estimate how flood forecasting and warning systems would expedite evacuation and/or moving of goods and assets to a safe location (in terms of number of days) since these systems are expected to speed these processes up.
- Use the above regression formula to calculate how asset damage and casualties would be reduced by entering the actual time difference between the start of evacuation and the start of inundation as well as the time difference between the expedited start of evacuation and the start of inundation.

Instead, we decided to use the following method to estimate how non-structural measures would mitigate damage since the resident survey conducted after the 2011 floods showed no clear correlation between the evacuation time difference and damage.

① Sort the cost and amount of damage estimated by the World Bank and Thailand's Ministry of Finance by province and category (based on: Thailand floods 2554 Rapid Assessment for RRR.01-18-2012-.pdf) (see 1.4.1)

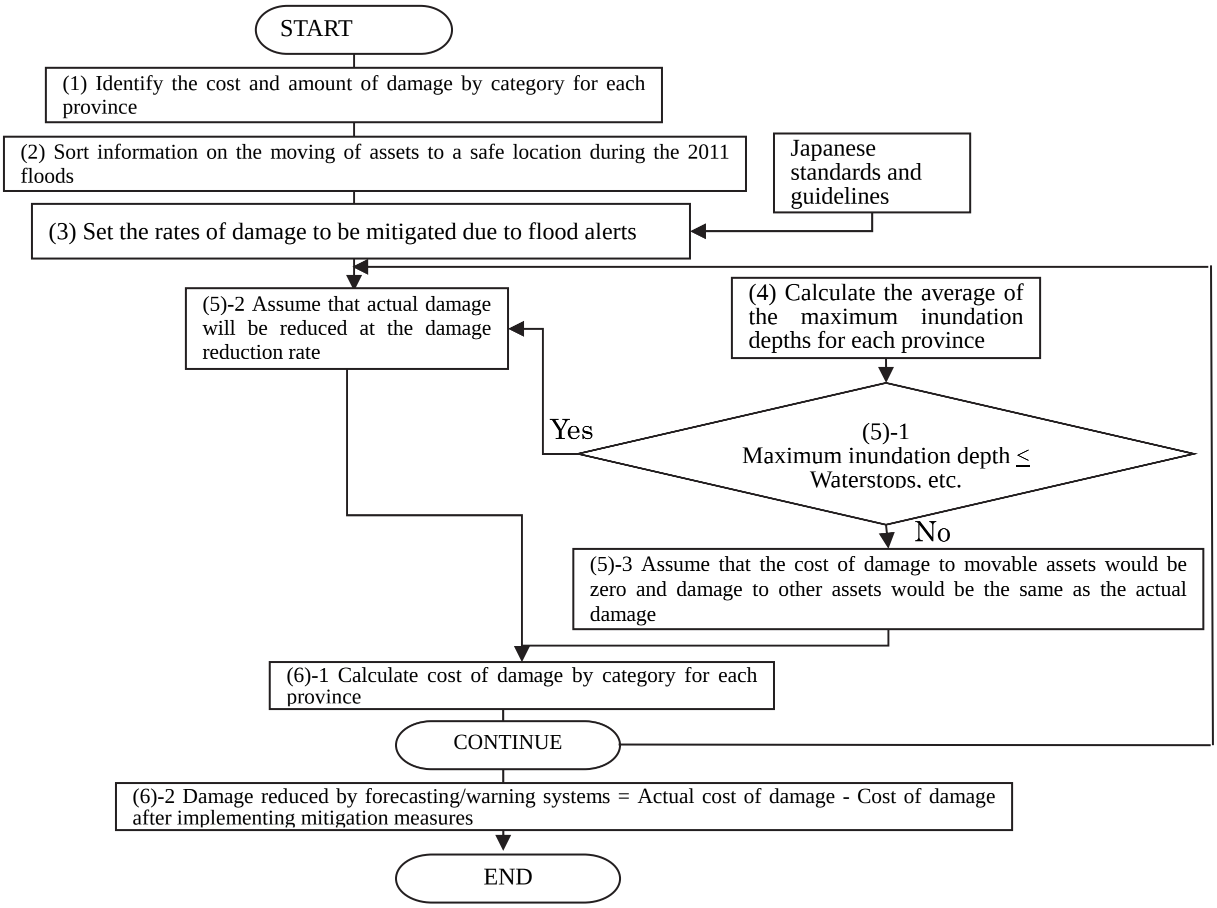
② Sort information on moving of assets to a safe location during the 2011 floods (see 1.4.2).

③ Based on the information sorted out in (2) above as well as Japanese standards and guidelines (Manual for Economic Analysis of Flood Control Measures, Guidelines for Flood Damage Index Analysis, etc.), determine the rate of damage that would be mitigated due to flood alerts that urge people to move assets to upper floors or other safe areas, and use waterstops, mobile levees and/or sandbags to prevent inundation (= estimated damage total divided by actual damage total) (see 1.4.3)

④ Obtain average maximum inundation depth for each province based on the resident survey (see 1.4.4).

⑤ In provinces where the height of waterstops and mobile levees (set at 1.5 m based on case studies) was the same as or higher than the maximum inundation depth, assume that actual damage would be reduced at the damage reduction rate obtained in (3). In provinces where the height of waterstops and mobile levees was lower than the maximum inundation depth, assume that the cost of damage to goods and assets that could be moved to upper floors or other safe areas would be zero. Also assume that damage to other assets would be the same as the actual damage.

⑥ Use the steps described above to calculate the cost of damage by category for each province. Regard the difference between the actual cost of damage and the estimate as the amount of damage mitigation due to forecasting and warning systems (see 1.4.5).



1.4.1 Damage by Province

We sorted the cost and amount of damage estimated by the World Bank and Thailand's Ministry of Finance by province and sector.

Table 1-5: Categories of Damage

Seq. No.	Sector
Productive Sectors	
1	Agriculture, forestry, and fisheries
2	Industry
3	Tourism
4	Financial and insurance
Infrastructure Sectors	
5	Flood control, drainage, and irrigation
6	Water and sanitation
7	Roads and transport
8	Electricity
9	Telecommunications, broadcasting, and postal services
Social Sectors	
10	Health care and public health (hygiene)
11	Housing and household goods
12	Education
13	Cultural and natural heritage
Cross-cutting Sectors	
14	Natural environment and waste management

(1) Agriculture, forestry, and fisheries

Table 1-6 shows the amount of damage to the agriculture, forestry, and fisheries sector by province.

Table 1-7 and Table 1-8 show the amount of damage by sector.

Table 1-6: Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

Seq. No.	Province	Damage	Losses (2011 - 2014)
1	Ang Thong	53	352
2	Ayutthaya	552	4,009
3	Bangkok	81	798
4	Chachoengsao	248	2,109
5	Chainat	21	196
6 Northeast	Kalasin	9	92
7 Northeast	Khon Kaen	759	3,016
8	Lopburi	89	1,014
9 Northeast	Mahasarakham	22	89
10	Nakorn Nayok	19	175
11	Nakorn Patom	71	641
12	Nakorn Sawan	102	807
13	Nontaburi	37	366
14	Patum Thani	189	1,723
15	Phitsanulok	299	1,350
16	Pichit	77	376
17	Prachinburi	54	512
18 Northeast	Roi Et	1,383	6,762
19	Samut Sakorn	31	906
20	Saraburi	108	1,254
21	Singburi	8	132
22 Northeast	Sri Saket	864	4,892
23	Supanburi	111	864
24 Northeast	Surin	249	1,145
25 Northeast	Ubon Ratchathani	189	841
26	Utai Thani	41	292
	Total	5,666	34,715

Table 1-7: Agriculture, Forestry, and Fisheries Sector - Total Damage (by Sub-sector)

[in Thai baht, millions]

Sub-sector	Public	Private	Total
Crops	**0**	**5,184**	**5,184**
Irrigation and drainage systems	0	283	283
Agricultural machinery and equipment	0	4,252	4,252
Storage and buildings	0	511	511
Farms and plantations	0	138	138
Livestock	**0**	**344**	**344**
Aquaculture livestock	0	11	11
Poultry barns and machinery	0	333	333
Fishery machinery	**0**	**137**	**137**
Hatcheries and machinery	0	137	137
Total	**0**	**5,666**	**5,666**

Table 1-8: Agriculture, Forestry, and Fisheries Sector - Losses (by Commodity)

[in Thai baht, millions]

Commodity	2011	2012	2013	2014
Crops	**27,522**	**1,927**	**1,204**	**482**
Rice	26,645	0	0	0
Sugarcane	288	0	0	0
Fruit trees	227	1,927	1,204	482
Flowers	144	0	0	0
Maize	16	0	0	0
Other	202	0	0	0
Livestock	**1,997**	**774**	**0**	**0**
Poultry	1,159	0	0	0
Swine	46	0	0	0
Cattle	722	774	0	0
Other	70	0	0	0
Fisheries	**809**	**0**	**0**	**0**
Tilapia	319	0	0	0
Catfish	256	0	0	0
Shrimp	234	0	0	0
Striped snakehead fish (food fish)	1	0	0	0
Total	**30,328**	**2,701**	**1,204**	**482**

(2) Industry

Table 1-9 shows the amount of damage to the industry sector by province while Table 1-10 shows the amount of damage by category.

Table 1-9: Industry Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	21,449.66	31,516.90
Ayutthaya	92,907.00	17,137.00
Bangkok	39,131.00	20,051.00
Chachoengsao	26,199.81	38,496.50
Chainat	8,518.97	12,517.28
Kalasin	2,099.63	3,085.08
Khon Kaen	3,647.11	5,358.85
Lopburi	14,113.46	20,737.51
Mahasarakham	2,884.61	4,238.48
Nakorn Nayok	8,457.05	12,426.30
Nakorn Patom	37,985.48	55,813.69
Nakorn Sawan	20,064.00	7,238.00
Nontaburi	86,902.96	127,690.22
Patum Thani	69,272.00	17,117.00
Phitsanulok	4,642.01	6,820.70
Pichit	6,287.45	9,238.41
Prachinburi	7,364.61	10,821.14
Roi Et	3,515.64	5,165.68
Samut Sakorn	0.00	1,922.00
Saraburi	9,948.55	14,617.83
Singburi	8,938.81	13,134.17
Sri Saket	858.77	1,261.82
Supanburi	35,979.57	52,866.32
Surin	333.33	489.77
Ubon Ratchathani	496.60	729.68
Utai Thani	1,882.93	2,766.66
Total	**513,881.00**	**493,258.00**

Table 1-10: Industry Sector - Total Damage (by Category) [in Thai baht, millions]

Category	Damage [in Thai baht, millions]
Fixed assets	2,512.00
Inventory assets	439,198.00
Buildings	27,117.03
Equipment and machinery	29,352.71
Outdoor facilities	15,701.25
Total	513,881.00

(3) Tourism

Table 1-11 shows the amount of damage to the tourism sector by province while Table 1-12 shows the amount of damage by category.

Table 1-11: Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	54.50	34.70
Ayutthaya	104.00	2,447.40
Bangkok	328.60	68,884.90
Chachoengsao	111.80	238.00
Chainat	100.50	38.70
Kalasin	65.70	64.60
Khon Kaen	545.60	1,025.00
Lopburi	270.00	411.10
Mahasarakham	58.10	49.70
Nakorn Nayok	347.90	294.20
Nakorn Patom	188.30	251.80
Nakorn Sawan	321.60	343.50
Nontaburi	205.50	345.40
Patum Thani	202.80	151.10
Phitsanulok	50.10	45.20
Pichit	437.60	729.00
Prachinburi	238.20	285.70
Roi Et	121.70	122.90
Samut Sakorn	81.60	57.50
Saraburi	249.30	484.70
Singburi	42.60	43.50
Sri Saket	64.50	205.00
Supanburi	263.80	216.50
Surin	134.90	206.40
Ubon Ratchathani	335.50	593.40
Utai Thani	209.70	69.10
TOTAL	5,134.40	77,639.00
Indirect impact		12,034.40
Grand total	**5,134.40**	**89,673.40**

Table 1-12: Tourism Sector - Total Damage (by Category) [in Thai baht, millions]

Category	Flood impact		
	Damage	Losses	Total
Lodging	978.7	21,476.80	22,455.50
Food and beverage	1,004.20	13,537.10	14,541.30
Shopping	1,338.90	25,270.30	26,609.20
Entertainment	1,004.20	13,798.70	14,802.90
Sightseeing	0	4,586.40	4,586.40
Tour operations	2.1	8,477.00	8,479.10
Other	806.3	2,527.10	3,333.40
Total	5,134.40	89,673.40	94,807.80

(4) Financial and insurance

Table 1-13 shows the amount of damage to the financial and insurance sector by province while Table 1-14 shows the amount of damage by sub-sector.

Table 1-13: Financial and Insurance Sector - Total Damage (by Province) [Thai baht, millions]

Province	Flood impact	
	Damage	Losses
Ang Thong	24.38	2,979.97
Ayutthaya	94.91	11,602.50
Bangkok	367.12	44,878.67
Chachoengsao	29.78	3,639.90
Chainat	9.68	1,183.53
Kalasin	2.39	291.70
Khon Kaen	4.14	506.69
Lopburi	16.04	1,960.76
Mahasarakham	3.28	400.75
Nakorn Nayok	9.61	1,174.93
Nakorn Patom	43.17	5,277.27
Nakorn Sawan	24.78	3,028.99
Nontaburi	98.76	12,073.30
Patum Thani	114.42	13,986.58
Phitsanulok	5.28	644.91
Pichit	7.15	873.51
Prachinburi	8.37	1,023.16
Roi Et	4.00	488.42
Samut Sakorn	9.34	1,141.70
Saraburi	11.31	1,382.14
Singburi	10.16	1,241.86
Sri Saket	0.98	119.31
Supanburi	40.89	4,998.59
Surin	0.38	46.31
Ubon Ratchathani	0.56	68.99
Utai Thani	2.14	261.59
Total	943.00	115,276.00

Table 1-14: Financial and Insurance Sector - Total Damage (by Sub-sector) [Thai baht, millions]

Sub-sector	**Flood impact**		
	Damage	**Losses**	**Total**
Commercial banking	Minimal	20,685	20,685
Specialized financial institutions (SFIs)	Minimal	67,197	67,197
Leasing companies	Minimal	Minimal	Minimal
Credit card companies	Minimal	2,514	2,514
Municipal funds	Minimal	8,153	8,153
Cooperatives	943	7,587	7,587
Insurance sector	Minimal	9,140	9,140
Total	**Minimal**	115,276	115,276

(5) Flood control, drainage, and irrigation

The amount of damage by prefecture for the flood control, drainage, and irrigation sector are as shown in Table 1-15.

Table 1-15: Flood Control, Drainage, and irrigation sector - Total Damage (by Prefecture) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	125.35	0.00
Ayutthaya	659.42	0.00
Bangkok	702.53	0.00
Chachoengsao	738.67	0.00
Chainat	214.57	0.00
Kalasin	301.80	0.00
Khon Kaen	665.90	0.00
Lopburi	199.37	0.00
Mahasarakham	416.44	0.00
Nakorn Nayok	60.06	0.00
Nakorn Patom	307.28	0.00
Nakorn Sawan	532.57	0.00
Nontaburi	372.33	0.00
Patum Thani	256.94	0.00
Phitsanulok	461.05	0.00
Pichit	293.57	0.00
Prachinburi	106.16	0.00
Roi Et	382.29	0.00
Samut Sakorn	50.34	0.00
Saraburi	160.00	0.00
Singburi	165.73	0.00
Sri Saket	331.70	0.00
Supanburi	525.34	0.00
Surin	256.44	0.00
Ubon Ratchathani	420.92	0.00
Utai Thani	8.22	0.00
Total	**8715.00**	**0.00**

(6) Water and sanitation

Table 1-16 shows the amount of damage to the water and sanitation sector by province while Table 1-17 shows the amount of damage by sub-sector.

Table 1-16: Water and Sanitation Sector - Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	50.30	3.90
Ayutthaya	264.60	49.60
Bangkok	281.90	1,822.60
Chachoengsao	296.40	0.40
Chainat	86.10	1.40
Kalasin	121.10	5.70
Khon Kaen	267.20	10.80
Lopburi	80.00	7.50
Mahasarakham	167.10	7.30
Nakorn Nayok	24.10	0.30
Nakorn Patom	123.30	-0.70
Nakorn Sawan	213.70	4.90
Nontaburi	149.40	0.20
Patum Thani	103.10	26.30
Phitsanulok	185.00	2.70
Pichit	117.80	2.60
Prachinburi	42.60	2.30
Roi Et	153.40	8.80
Samut Sakorn	20.20	-0.40
Saraburi	64.20	3.80
Singburi	66.50	-1.00
Sri Saket	133.10	7.90
Supanburi	210.80	1.40
Surin	102.90	5.60
Ubon Ratchathani	168.90	9.50
Utai Thani	3.30	0.10
Total	**3,497.00**	**1,983.50**

Table 1-17: Water and Sanitation Sector - Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Damage
Water supply - urban	
Water intake structures	37.5
Water treatment plants	30.8
Conveyance systems	0.2
Storage systems	0.4
Distribution network	1.3
Water supply - rural	
Surface & groundwater systems	1,783.20
Sanitation - urban	
Sewage treatment works	1,643.60
Total	**3,497.00**

(7) Roads and transport

Table 1-18 shows the amount of damage to the roads and transport sector by province while Table 1-19 shows the amount of damage by sub-sector.

Table 1-18: Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	599.23	167.69
Ayutthya	1448.64	405.28
Bangkok (Note 1)	1749.68	842.30
Chachaengsao	113.45	31.74
Chainat	486.24	136.06
Kalasin	276.64	77.38
Kon Kaen	1207.41	337.84
Lopburi	1582.83	442.79
Mahasarakam	168.12	47.03
Nakhon Nayok	82.97	23.19
Nakhon Pathom	558.21	156.15
Nakhon Sawan	2459.85	688.29
Nonthaburi	962.28	269.23
Pathum Thani	1570.80	439.48
Pichit	2103.56	588.58
Pitsanulok	1086.16	303.96
Prachinburi	550.19	153.90
Roi Et	1016.94	284.51
Samut Sakhon	340.13	95.12
Saraburi	1491.95	417.46
Singburi	892.15	249.67
Sisaket	533.80	149.31
Suphanburi	880.69	246.35
Surin	519.93	145.46
Ubon Ratchatani	524.63	146.74
Uthai Thani	331.65	92.77
Total	23538.11	6938.29

Table 1-19: Roads and Transport Sector - Total Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact		
	Damage	Losses	Total
Roads	**19,638.00**	**6,263.40**	**25,901.40**
Expressways	0	450	450
DOH	11,479.00	3,443.70	14,922.70
DRR	4,456.00	1,336.80	5,792.80
Local	3,443.00	1,032.90	4,475.90
Truck terminal	260	0	260
Railways	**3,000**	**525**	**3,525.00**
Civil aviation	**900**	**150**	**1,050.00**
Inland water	**0**	**0**	**0**
Total	23,538.00	6,938.40	30,476.40

(8) Electricity

Table 1-20 shows the amount of damage to the electricity sector by province while Table 1-21 shows the amount of damage by sub-sector.

Table 1-20: Electricity Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses	Total
Ang Thong	5.51	3.02	8.53
Ayutthaya	2803.64	3359.97	6163.61
Bangkok	2.80	2262.43	2265.23
Chachoengsao	0.00	0.00	0.00
Chainat	1.04	0.65	1.69
Kalasin	0.00	0.00	0.00
Khon Kaen	0.00	0.00	0.00
Lopburi	4.78	2.73	7.51
Maha Sarakham	0.00	0.00	0.00
Nakorn Nayok	1.11	0.54	1.65
Nakorn Patom	1.03	0.56	1.59
Nakorn Sawan	11.27	6.24	17.51
Nontaburi	2.63	72.86	75.48
Patum Thani	310.79	4.06	314.85
Phitsanulok	0.31	0.21	0.51
Pichit	0.28	0.20	0.47
Prachinburi	0.72	0.45	1.17
Roi Et	0.00	0.00	0.00
Samut Sakorn	0.29	0.16	0.45
Saraburi	37.76	0.17	37.94
Singburi	0.30	0.19	0.49
Si Sa Ket	0.00	0.00	0.00
Supanburi	1.31	1.07	2.38
Surin	0.00	0.00	0.00
Ubon Ratchathani	0.00	0.00	0.00
Utai Thani	0.19	0.13	0.32
Total	3185.76	5715.63	8901.39

Table 1-21: Electricity Sector - Total Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact		
	Damage	Losses	Total
Power plants	2,425.07	1,091.76	3,516.83
Transmission facilities (towers and transmission lines)	0.00	2,092.42	2,092.42
Distribution networks	760.69	2,531.42	3,292.10
Total	**3,185.76**	**5,715.59**	**8,901.35**

(9) Telecommunications, broadcasting, and postal services

Table 1-22 shows the amount of damage to the telecommunications, broadcasting, and postal services sector by province while Table 1-23 shows the amount of damage by sub-sector.

Table 1-22: Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	33.34	52.09
Ayutthaya	129.80	202.79
Bangkok	502.07	784.41
Chachoengsao	40.72	63.62
Chainat	13.24	20.69
Kalasin	3.26	5.10
Khon Kaen	5.67	8.86
Lopburi	21.94	34.27
Mahasarakham	4.48	7.00
Nakorn Nayok	13.14	20.54
Nakorn Patom	59.04	92.24
Nakorn Sawan	33.89	52.94
Nontaburi	135.07	211.02
Patum Thani	156.47	244.46
Phitsanulok	7.21	11.27
Pichit	9.77	15.27
Prachinburi	11.45	17.88
Roi Et	5.46	8.54
Samut Sakorn	12.77	19.96
Saraburi	15.46	24.16
Singburi	13.89	21.71
Sri Saket	1.33	2.09
Supanburi	55.92	87.37
Surin	0.52	0.81
Ubon Ratchathani	0.77	1.21
Utai Thani	2.93	4.57
Total	**1289.63**	**2014.84**

Table 1-23: Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact		
	Damage	Losses	Total
Landline communications	742.32	652.02	1,394.34
Cellular communications	280.92	699.09	980.01
Broadcasting	131.39	488.73	620.12
Postal services	135.00	175.00	310.00
Total	**1,289.63**	**2,014.84**	**3,304.47**

(10) Health care and public health (hygiene)

Table 1-24 shows the amount of damage to the health care and public health (hygiene) sector by province while Table 1-25 shows the amount of damage by sub-sector.

Table 1-24: Health Care and Public Health (Hygiene) Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	30.90	122.70
Ayutthaya	283.30	198.90
Bangkok	353.50	550.60
Chachoengsao	11.00	74.70
Chainat	1.80	41.20
Kalasin	0.50	3.50
Khon Kaen	3.30	0.00
Lopburi	15.10	73.80
Mahasarakam	3.70	1.80
Nakorn Nayok	3.70	23.90
Nakorn Patom	9.20	28.20
Nakorn Sawan	109.90	123.40
Nontaburi	320.10	373.40
Patum Thani	425.70	325.90
Phitsanulok	24.70	8.50
Pichit	6.30	10.10
Prachinburi	1.80	7.10
Roi Et	0.00	0.00
Samut Sakorn	3.80	15.30
Saraburi	35.30	17.60
Singburi	20.30	53.30
Sri Saket	0.00	0.00
Supanburi	10.60	30.40
Surin	0.80	1.10
Ubon Ratchathani	1.80	40.00
Utai Thani	6.70	7.40
Total	**1684.00**	**2133.00**

Table 1-25: Health Care and Public Health (Hygiene) Sector - Total Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact		
	Damage	Losses	Total
Hospitals	946.8	884.4	1,831.2
Health centers and private medical/dental clinics	717.5	1,044.3	1,761.7
Provincial/district health offices	19.7	204.4	224.1
Total	**1,684.0**	**2,133.0**	**3,817.1**

(11) Housing and household goods

The amount of damage by prefecture for the housing and household goods sector are as shown in Table 1-26.

Table 1-26: Housing and Household Goods Sector - Total Damage (by Province)

	Housing damage		Household goods damage	Losses	
Province	NUMBER OF DAMAGED HOUSES	ESTIMATE OF COSTS (THB)	(THB)	temporary shelter & utilities including stay in house(THB)	Debris cleaning (also cleaning of goods) (THB)
Ang Thong	50,579	263,596,605	981,101,020	1,014,706,272	50,704,836
Ayutthaya	196,929	1,294,170,947	3,835,439,603	4,552,823,011	198,221,520
Bangkok	761,725	1,954,019,947	14,843,185,266	13,159,573,053	767,119,039
Chachoengsao	61,780	326,727,732	1,198,379,785	1,072,425,632	61,934,142
Chainat	20,088	106,147,303	389,659,610	307,313,926	20,138,218
Kalasin	4,951	7,886,264	96,035,816	60,781,746	4,963,281
Khon Kaen	8,600	4,460,783	166,811,351	101,418,740	8,621,072
Lopburi	33,280	173,079,512	645,544,641	498,277,196	33,362,757
Mahasarakham	6,802	11,229,093	131,949,613	89,384,399	6,819,362
Nakorn Nayok	19,942	199,611,144	386,834,426	313,347,540	19,992,208
Nakorn Patom	89,571	358,681,824	1,737,944,848	1,556,109,343	89,819,709
Nakorn Sawan	51,411	396,007,505	1,005,446,475	757,030,699	51,539,236
Nontaburi	204,920	654,200,726	3,974,928,829	3,928,319,660	205,430,541
Patum Thani	237,394	1,116,013,729	4,616,898,235	5,228,136,293	238,608,525
Phitsanulok	10,946	44,233,906	212,321,607	148,331,015	10,973,113
Pichit	14,826	62,511,270	287,934,620	205,633,421	14,863,045
Prachinburi	17,366	90,338,776	336,854,416	259,578,883	17,409,163
Roi Et	8,290	19,251,251	160,803,432	111,139,682	8,310,573
Samut Sakorn	19,378	30,860,681	378,261,881	288,622,666	19,549,166
Saraburi	23,459	192,143,896	455,055,168	345,421,798	23,517,963
Singburi	21,078	91,156,043	408,865,300	349,356,254	21,130,798
Sri Saket	2,025	7,056,625	39,281,579	18,726,302	2,030,133
Supanburi	84,841	418,463,976	1,645,707,059	1,506,432,468	85,052,716
Surin	786	1,532,403	15,251,955	8,847,503	788,245
Ubon Ratchathani	1,171	2,218,793	22,721,005	995,815	1,174,257
Utai Thani	4,440	22,748,651	86,128,026	43,212,333	4,451,231
Total	1,956,578	7,848,349,383	38,059,345,564	35,925,945,652	1,966,524,852

(12) Education

Table 1-27 shows the amount of damage to the education sector by province while Table 1-28 shows the amount of damage by sub-sector.

Table 1-27: Education Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	16.80	31.50
Ayutthaya	932.20	66.00
Bangkok	4686.10	603.40
Chachoengsao	59.60	23.20
Chainat	34.30	22.10
Kalasin	46.40	14.40
Khon Kaen	38.20	29.20
Lopburi	121.50	45.50
Mahasarakham	39.40	14.20
Nakorn Nayok	48.40	26.10
Nakorn Patom	234.20	40.30
Nakorn Sawan	583.20	73.20
Nontaburi	155.80	257.80
Patum Thani	5480.00	310.80
Phitsanulok	87.20	20.00
Pichit	141.50	26.60
Prachinburi	87.30	23.70
Roi Et	5.60	15.10
Samut Sakorn	69.50	20.00
Saraburi	34.80	33.80
Singburi	25.50	19.70
Sri Saket	5.20	11.90
Supanburi	52.60	21.60
Surin	0.04	3.03
Ubon Ratchathani	34.80	19.70
Utai Thani	30.80	25.10
Total	**13051.00**	**1797.90**

Table 1-28: Education Sector - Total Damage (by Province)

Sub-sector	Flood impact		
	Damage	Losses	Total
Basic education	1,163	922	2,085
Private education	215	74	289
Non formal education	61	84	145
Higher education	9,402	170	9,572
Vocational education	519	364	883
Non-Ministry of Education agencies	1,690	185	1,875
Total	**13,051**	**1,798**	**14,849**

(13) Cultural and natural heritage

Table 1-29 shows the amount of damage to the cultural and natural heritage sector by province while Table 1-30 shows the amount of damage by sub-sector.

Table 1-29: Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
Ang Thong	94.43	65.56
Phra Nakhon Si Ayutthaya	64.28	44.62
Bangkok Metropolis	2824.33	1960.70
Chachoengsao	373.04	258.97
Chai Nat	58.80	40.82
Kalasin	7.11	4.94
Khon Kaen	3.00	2.08
Lop Buri	2.80	1.94
Maha Sarakham	312.43	216.89
Nakhon Nayok	1.10	0.76
Nakhon Pathom	26.20	18.19
Nakhon Sawan	6.72	4.67
Nonthaburi	119.71	83.10
Pathum Thani	117.73	81.73
Phitsanulok	5.47	3.80
Phichit	21.46	14.90
Prachin Buri	56.42	39.17
Roi Et	25.76	17.88
Samut Sakhon	15.75	10.93
Saraburi	5.84	4.05
Sing Buri	0.00	0.00
Si Sa Ket	62.14	43.14
Suphan Buri	123.05	85.42
Surin	21.55	14.96
Ubon Ratchathani	1.40	0.97
Uthai Thani	81.05	56.27
Total	4431.57	3076.48

Table 1-30: Cultural and Natural Heritage Sector - Total Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact	
	Damage	Losses
Heritage structures and sites	4331.60	609.98
Heritage repositories	97.19	4.42
Natural heritage assets	0	16.34
Intangible cultural heritage assets	0	2445.74
Total	**4428.79**	**3076.48**

(14) Natural environment and waste management

Table 1-31 shows the amount of damage to the natural environment and waste management sector by province while Table 1-32 shows the amount of damage by sub-sector.

Table 1-31: Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses
AngThong	3.21	1.20
Ayutthaya	209.00	10.12
Bangkok	19.80	88.30
Chachoengsao	1.00	15.91
Chainat	0.00	0.00
Kalasin	0.00	0.00
KhonKaen	0.00	0.00
Lopburi	29.88	0.96
Mahasarakham	0.00	0.00
NakornNayok	0.00	0.00
NakornPatom	11.07	0.36
NakornSawan	1.81	4.92
Nontaburi	0.00	0.00
PatumThani	30.95	2.86
Phitsanulok	14.66	8.04
Pichit	0.00	0.00
Prachinburi	43.22	1.42
RoiEt	0.00	0.00
SamutSakorn	1.50	41.21
Saraburi	3.13	0.10
Singburi	5.83	0.19
SriSaket	0.00	0.00
Supanburi	0.00	0.00
Surin	0.00	0.00
UbonRatchathani	0.00	0.00
UtaiThani	0.00	0.00
Total	**375.06**	**175.61**

Table 1-32: Natural Environment and Waste Management Sector - Damage (by Sub-sector) [in Thai baht, millions]

Sub-sector	Flood impact		
	Damage	Losses	Total
Municipal solid waste	34	101	135
Biodiversity	13	64	77
Industrial waste	328	11	339
	375	**176**	**551**

1.4.2 Summary of Information on Moving of Assets to a Safe Location

This section summarizes how assets were protected by being moved to a safe location during the 2011 floods. Descriptions are taken from Thailand floods 2554 Rapid Assessment for RRR.01-18-2012-.pdf.

(1) Asset Protection by Sector

How assets were protected or damaged in each sector is as described below.

1) Agriculture, forestry, and fisheries

The following describes situation in the agriculture, forestry and fisheries sector.

- Thanks to the media's broadcasts prior to the floods and slow move of water, many of the large animals, such as cattle, ducks and pigs were moved to higher grounds and roads and were saved from the flood.
- Farmers in flood-prone areas in the Central region (e.g. Ayuthaya) grow rice earlier so that they can harvest before the flood arrives.
- In the past, the farmers generally grew low-yield varieties of floating rice. However, most farmers now grow [rice in] short-duration cycles that can be harvested in late August.
- However, the 2011 flood arrived much earlier than normal, with excessive amounts of water and waves, which severely impacted the livelihoods of several million farm families in the Chao Phraya River Basin.
- Farmers and livestock entrepreneurs [who] visited in Nakhon Sawan and Lopburi provinces explained how they fought the water for [a] few days by putting sand bags and pumping the water continuously with a view to saving their machinery, equipment, and other assets. However, they just had to give up as their pumps stopped working and the water level kept on rising.
- Many tractors and power tillers were moved to higher ground, but many other machines that could not be relocated remained under water for long periods and ... many machines were seen lying [around], in need of repair.
- Owners of large-scale commercial swine farms and cattle small-holders reportedly moved their animals elsewhere before the flood arrived, and therefore experienced less damage.
- Subsistence fisher folk and professional fish farmers ..., when water came into their houses, ... were able to move their fishing gear to upper floors.
- Some medium-sized farmers (about 50 rai) reportedly sold some premature rice ... that had not flowered properly before flooding started in order to generate some operational cash.
- Chickens could not be moved anywhere even after the farmers saw the water coming in ...
- In most cases, a large number of fish, many of them grown for export, were reported lost.

2) Industry

The following describes the situation in the industry sector.

- The enterprises in the upper northern region like Nakornsawan and Ayudhaya experienced more damages than those lying to the south as there was less time for business enterprises to relocate expensive equipment to higher floors.

3) Tourism

No description of the tourism sector moving assets to a safe location was found in the source document (Thailand floods 2554 Rapid Assessment for RRR.01-18-2012-.pdf).

4) Financial and insurance

The following describes the situation in the financial and insurance sector.

- the vast majority of branch banks had sufficient time to get their expensive equipment, or the expensive part of immovable equipment (such as the electronics within ATMs), out of harm's way before the floods struck.

5) Flood control, drainage, and irrigation

No description of the flood control, drainage, and irrigation sector moving assets to a safe location was found in the source document (Thailand Flooding 2554 Rapid Assessment for RRR.01-18-2012-.pdf).

6) Water and sanitation

The following describes the situation in the water and sanitation sector.

- In the rural water supply sector, ... Whereas some of this damage refers to damaged pumps or other control panels, some wells were damaged to such an extent that they needed to be shut down and replaced with new wells.
- Damage to the urban water supply sector was relatively low compared to the rural water supply sector. [The Metropolitan Waterworks Authority] reported that a siphon was damaged at the canal Khlong Bang Luang.

7) Roads and transport

The following describes the situation in the road and transport sector.

a) Roads

- Pavement surface cracking, or otherwise failing, caused typically by traffic continuing to use the road when a long period of inundation had reduced its strength substantially.
- Pavement loss, caused typically by a combination of traffic and rapid shallow flow across the downstream lane of the road surface.
- Embankment erosion, typically on the downstream side of the road, caused by shallow cross flow and, in some areas, wind-induced wave action.
- Damaged cross drainage structures, typically culverts, and adjacent slope protection.
- Incidental damage to traffic control facilities, such as signage, pavement markings, railing, etc.

b) Railways

- [The bulk of damage to the railway infrastructure] is to embankments and trackwork, caused by long periods of inundation, with some damage to signaling, stations, and other facilities.

8) Electricity

The following describes the situation in the electricity sector.

- Eighteen substations were submerged and damaged.
- Some 155 office vehicles were reported as damaged assets in the metropolitan areas of Bangkok and Nonthaburi province.
- It was noted that the damaged power plant, substations and distribution networks are located in very low-lying, flood-prone areas.

9) Telecommunications, broadcasting, and postal services

- The following describes situation in the telecommunications, broadcasting, and postal services sector.
- The main causes of telecommunications disruption due to the extensive flooding in Thailand are physical water damage and electrical power disruptions.
- The landline communications systems operated by the public service providers have been severely affected in urban areas.
- The National Broadcast and Telecommunications Commission (NBTC) reported that a number of 398 base stations and cell sites were damaged /cannot be operated as of 1 November 2011, out of which 97 cell sites were due to electricity disruptions.
- The postal services were also affected by the floods.
- The estimated damages to the postal services sub-sector, which include mainly the damages incurred to buildings, counter service sets and equipment ..., amounted to B135 million.

10) Health care and public health (hygiene)

The following describes the situation in the health care and public health (hygiene) sector.

- Damage was mainly caused by floodwater, water currents, high humidity, and mud.
- Many health centers/health promotion hospitals are located below the roads and streets in front of the facilities, and thus flood water inundated these health facilities even before the flood reached street level.

11) Housing and household goods

The following describes the situation in the housing and household goods sector.

- For two generations the people have developed the ability to evacuate things quickly upstairs and the knowledge of certain locations/areas that would stay dry.
- Much of development has not followed building codes or official plans, which has put many functions in vulnerable areas.
- Local Government agencies stated their desire to rectify these conditions not only by dykes but also by possible resettlement.
- As the flooding was a slow-onset disaster, most of the housing did not suffer severe damage. More damage was observed on household goods.
- Most all families saved their TV set, and other electrical appliances.

12) Education

No description of the education sector moving assets to a safe location was found in the source document (Thailand floods 2554 Rapid Assessment for RRR.01-18-2012-.pdf).

13) Cultural and natural heritage

The following describes the situation in the cultural and natural heritage sector.

- In some cases, major damage was caused by water infiltration and humidity, efflorescence, and resulted in varying degrees of structural damage due to the extended time under water.

14) Natural environment and waste management

The following describes the situation in the natural environment and waste management sector.

- Most of the damages are from buildings, roads, and other structures in the protected areas.

(2) Classification of Asset Protection and Damage

Classification of how assets were protected or damaged in each sector reveals that some assets (shown in blue) were able to be moved to a safe location and others (shown in pink) could not be protected from inundation. The assets shown in the white cells are those that were damaged during the 2011 floods but could have been moved to a safe location or protected from inundation.

Table 1-33: Asset Protection and Damage during 2011 Floods

Blue: Assets that could be moved to a safe location
Pink: Assets that could not be protected from inundation

Sector	Asset	Protection				Damage	Remarks
		Moved to a safe location	Sold	Protected from inundation	Not protected		
Agriculture, forestry, and fisheries	Livestock (cattle, pigs, ducks)	1 Higher ground 1 Roads				Not damaged Not damaged	
	Livestock (chickens)				1 Could not be moved	Damaged	
	Rice		1 Varieties that grow in short-duration cycles (can be harvested in late August)			Caused severe impact (to several million farm families)	Due to earlier-than-usual arrival of the 2011 floods
	Rice		1 Sold rice before it had matured properly			Not damaged	
	Machinery			1 Sandbags 1 Pumping		Damaged Damaged	Pumps eventually stopped working Pumps eventually stopped working
	Equipment			1 Sandbags 1 Pumping		Damaged Damaged	Pumps eventually stopped working Pumps eventually stopped working
	Tractors	1 Higher ground				Not damaged	
	Tillers	1 Higher ground				Not damaged	
	Fishing gear	1 Upper floors				Not damaged	
	Farm raised fish				1 Lost due to flooding	Damaged	
Industry	Machinery	1 Upper floors			1 Insufficient time	Damaged	Companies in upper regions, like Nakhon Sawan and Ayuthaya
	Equipment	1 Upper floors			1 Insufficient time	Damaged	Companies in upper regions, like Nakhon Sawan and Ayuthaya
Financial and insurance	Equipment (electronics)	1 Upper floors				Not damaged?	
Water and sanitation	Pumps				1 Damaged due to inundation	Damaged	
	Control panels				1 Damaged due to inundation	Damaged	
	Wells				1 Damaged due to inundation	Damaged	
	Siphons				1 Damaged due to inundation	Damaged	
Roads	Pavement				1 Traffic during inundation 1 Water current	Damaged Damaged	
	Embankments				1 Water current	Damaged	
	Traffic control facilities (e.g. signage, etc.)				1 Water current	Damaged	
Railways	Embankments				1 Damaged due to inundation	Damaged	
	Trackwork				1 Damaged due to inundation	Damaged	
Electricity	Substations (18 locations)				1 Damaged due to inundation	Damaged	Located in very low-lying, flood-prone areas
	Power plants				1 Damaged due to inundation	Damaged	Located in very low-lying, flood-prone areas
	Distribution networks				1 Damaged due to inundation	Damaged	Located in very low-lying, flood-prone areas
Telecommunications	Landline communications systems				1 Physical water damage 1 Electrical power	Damaged Damaged	
Broadcasting	Base stations and cell sites				1 Damaged due to inundation	Damaged Damaged	
Postal services	Buildings, counter service sets and equipment				1 Damaged due to inundation	Damaged	
Health care and public health (hygiene)	Health centers and health promotion hospitals				1 Floodwater 1 Water current 1 High humidity 1 Mud	Damaged Damaged Damaged Damaged	Located below street level, they were inundated before the roads flooded
Housing and household goods	Housing			1 No severe damage		Damaged	Due to slow onset of flooding
	Household goods				1 Damaged due to inundation	Damaged	
	TV sets and other electrical appliances	1 Moved to upper floors, etc.				Not damaged	
Cultural heritage assets	Temples, museums, etc.				1 Floodwater 1 High humidity 1 Efflorescence	Damaged Damaged Damaged	Damaged to varying degrees due to extended time under water Damaged to varying degrees due to extended time under water Damaged to varying degrees due to extended time under water

1.4.3 Estimated Rates of Damage to Be Mitigated Due to Flood Alerts

Using the findings obtained in 1.4.2 as well as Japanese standards and guidelines (Manual for Economic Analysis of Flood Control Measures, Guidelines for Flood Damage Index Analysis, etc.), we estimated how notification via flood alerts and resulting preventive actions (e.g. moving assets to upper floors and using waterstops and mobile levees to prevent inundation) would change asset damage rates (= Cost of damage / Value of assets $\leq$ 1.0). We defined the rate of damage to be mitigated as a result of notification via flood alerts using the following formula and estimated the rate for each category.

(Damage mitigation rate) =

$$\underbrace{(\text{Cost of damage / Value of assets})_{\text{After implementing mitigation measures}}}_{\text{Damage rate after implementing mitigation measures}} / \underbrace{(\text{Cost of damage / Value of assets})_{\text{Actual}}}_{\text{Actual damage rate}}$$

(1) Agriculture, Forestry, and Fisheries

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-34: Changes in Damage Rates Due to Flood Prevention (Agriculture, Forestry, and Fisheries Sector: Damage)

Sub-sector	Assets unprotected	Assets protected		
	(Flood/inundation depth 1.0 m or more x 7 days or more)	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Crops				
Irrigation and drainage systems	0.50[2]	Impossible[2]	No[2]	None[2]
Agricultural machinery and equipment	1.00[2]	0.5～1.0[2]	No[2]	0.5～1.0[2]
Storage and buildings	0.50[2]	Impossible[2]	No[2]	0.3～0.5[2]
Farms and plantations	1.00[2]	Impossible[2]	No[2]	None[2]
Livestock				
Livestock barns and related equipment	1.00[2]	Impossible[2]	No[2]	0.5～1.0[2]
Poultry barns and related equipment	1.00[2]	Impossible[2]	No[2]	0.5～1.0[2]
Fishery machinery				
Hatcheries and machinery	1.00[2]	Impossible[2]	No[2]	None[2]

Table 1-35: Changes in Damage Rates Due to Flood Prevention (Agriculture, Forestry, and Fisheries Sector: Losses)

Commodity		Assets unprotected (Flood/inundation depth 1.0 m or more x 7 days or more)	Assets protected		
			Move to a safe location	Sell	Flood prevention sandbags, waterstops, mobile levees, etc.)
Crops	Rice	0.74[1)]	Impossible[2)]	0.5～0.74[2)]	None[2)]
	Sugarcane	0.91 (average per field)[1)]	Impossible[2)]	0.5～0.91[2)]	None[2)]
	Fruit trees	0.91 (average per field)[1)]	Impossible[2)]	No[2)]	None[2)]
	Flowers	0.91 (average per field)[1)]	Impossible[2)]	No[2)]	None[2)]
	Maize	0.91 (average per field)[1)]	Impossible[2)]	0.5～0.91[2)]	None[2)]
	Other crops	0.91 (average per field)[1)]	Impossible[2)]	No[2)]	None[2)]
Livestock	Poultry	1.00[2)]	0.00～0.30[2)]	No[2)]	None[2)]
	Swine	1.00[2)]	0.00～0.30[2)]	No[2)]	None[2)]
	Cattle	1.00[2)]	0.00～0.30[2)]	No[2)]	None[2)]
	Other	1.00[2)]	0.00～0.30[2)]	No[2)]	None[2)]
Fisheries	Tilapia	1.00[2)]	Impossible[2)]	No[2)]	None[2)]
	Catfish	1.00[2)]	Impossible[2)]	No[2)]	None[2)]
	Shrimp	1.00[2)]	Impossible[2)]	No[2)]	None[2)]
	Striped snakehead fish (food fish)	1.00[2)]	Impossible[2)]	No[2)]	None[2)]

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(2) Industry

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-36: Changes in Damage Rates Due to Flood Prevention (Industry Sector: Damage)

Sub-sector	Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
		Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Fixed assets	0.79[1)]	Impossible[2)]	No[2)]	None[2)]
Inventory assets	0.59[1)]	0.3～0.59[2)]	No[2)]	None[2)]
Buildings	0.27[1)]	Impossible[2)]	No[2)]	0.14～0.27[2)]
Equipment and machinery	0.79[1)]	0.3～0.59 [2)]	No[2)]	None[2)]
Outdoor facilities	0.79[1)]	Impossible[2)]	No[2)]	0.40～0.79[2)]

Table 1-37: Changes in Damage Rates Due to Flood Prevention (Industry Sector: Losses)

Sub-sector	Assets unprotected	Assets protected		
	Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Total	1.00[2)]	Impossible[2)]	No[2)]	0.5～1.0[2)]

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005
Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(3) Tourism

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-38: Changes in Damage Rates Due to Flood Prevention (Tourism Sector: Damage)

Sub-sector	Assets unprotected	Assets protected		
	Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Lodging	0.79[1)]	Impossible[2)]	No[2)]	0.4～0.79[2)]
Food and beverage services	0.59[1)]	Impossible[2)]	No[2)]	0.3～0.59[2)]
Shopping facilities	0.59[1)]	Impossible[2)]	No[2)]	0.3～0.59[2)]
Entertainment facilities	0.79[1)]	Impossible[2)]	No[2)]	0.4～0.79[2)]
Sightseeing (scenic sites)	0.00[1)]	Impossible[2)]	No[2)]	None [2)]
Tour operations	0.79[1)]	None[2)]	No[2)]	None[2)]
Other (attractions)	0.79[1)]	Impossible[2)]	No[2)]	0.4～0.79[2)]

Table 1-39: Changes in Damage Rates Due to Flood Prevention (Tourism Sector: Losses)

Sub-sector	Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
		Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Lodging	1.00 2)	Impossible 2)	No 2)	1.00 2)
Food and beverage services	1.00 2)	Impossible 2)	No 2)	1.00 2)
Shopping facilities	1.00 2)	Impossible 2)	No 2)	1.00 2)
Entertainment facilities	1.00 2)	Impossible 2)	No 2)	1.00 2)
Sightseeing (scenic sites)	1.00 2)	Impossible 2)	No 2)	None 2)
Tour operations	1.00 2)	None 2)	No 2)	None 2)
Other (attractions)	1.00 2)	Impossible 2)	No 2)	1.00 2)

* The bulk of losses in the tourism sector are from lost sales. We set the damage rate at 1.00 since the tourism sector will lose visitors once tourist sites are flooded regardless of whether or not preventive measures are taken.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(4) Financial and Insurance

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-40: Changes in Damage Rates Due to Flood Prevention (Financial and Insurance Sector: Losses)

Sub-sector	Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
		Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Commercial banks	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
SFIs	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
Leasing companies	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
Credit card companies	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
Municipal funds	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
Cooperatives	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)
Insurance sector	0.59 1)	0.3～0.59 2)	No 2)	0.3～0.59 2)

* The bulk of losses in the financial and insurance sector are made up of lost cash that was stored in vaults. Since we didn't know if the vaults are waterproof or not, we used the inventory asset values to calculate damage rates.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(5) Flood Control, Drainage, and Irrigation

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-41: Changes in Damage Rates Due to Flood Prevention (Flood Control, Drainage, and Irrigation Sector: Damage)

Sub-sector	Assets unprotected	Assets protected		
	Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Flood control facilities	0.30[1)]	Impossible[2)]	No[2)]	None[2)]
Drainage facilities	0.30[1)]	Impossible[2)]	No[2)]	None[2)]
Irrigation facilities	0.30[1)]	Impossible[2)]	No[2)]	None[2)]

* Due to the absence of previous studies, we used the value of depreciable assets owned by farmers and fishermen to obtain damage rates for flood control, drainage, and irrigation facilities.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005
Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(6) Water and Sanitation

Damage and loss rates for each category were estimated using the Guidelines for Flood Damage Index Analysis (draft, March 2013) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-42: Changes in Damage Rates Due to Flood Prevention (Water and Sanitation Sector: Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: ess than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Water supply - urban	Water intake structures	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
	Water treatment plants	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
	Conveyance systems	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
	Storage systems	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
	Distribution network	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
Water supply - rural	Surface & groundwater systems	1.00[1)]	Impossible[2)]	No[2)]	None[2)]
Sanitation - urban	Sewage treatment works	1.00[1)]	Impossible[2)]	No[2)]	None[2)]

* Due to the absence of previous studies, we assumed that water intake structures, pumps, etc. would stop working once the inundation depth reached 1.0 m, causing damage to water and sanitation facilities.

Source 1: Guidelines for Flood Damage Index Analysis (draft), Ministry of Land, Infrastructure, Transport and Tourism, March 2013

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(7) Roads and Transport

Damage and loss rates for each category were estimated using the Guidelines for Flood Damage Index Analysis (draft, March 2013) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-43: Changes in Damage Rates Due to Flood Prevention (Roads and Transport Sector: Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Roads	Expressways	0.00[2]	Impossible[2]	No[2]	None[2]
	DOH	0.50[2]	Impossible[2]	No[2]	None[2]
	DRR	0.50[2]	Impossible[2]	No[2]	None[2]
	Local	0.50[2]	Impossible[2]	No[2]	None[2]
	Truck terminal	0.50[2]	Impossible[2]	No[2]	0.25～0.50[2]
Railways	Railways	0.50[2]	Impossible[2]	No[2]	None[2]
Civil aviation	Runways	0.50[2]	Impossible[2]	No[2]	0.25～0.50[2]
Inland water	Piers and wharfs	0.00[2]	Impossible[2]	No[2]	None[2]

* Due to the absence of previous studies, we assumed that the cost of damage to the roads and transport sector would be 30% of the value of its assets when the inundation depth reached 1.0 m, causing sand and driftwood deposits as well as damage to embankments and asphalt.

Table 1-44: Changes in Damage Rates Due to Flood Prevention (Roads and Transport Sector: Losses)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Roads	Expressways	1.00[1]	Impossible[2]	No[2]	None[2]
	DOH	1.00[1]	Impossible[2]	No[2]	None[2]
	DRR	1.00[1]	Impossible[2]	No[2]	None[2]
	Local	1.00[1]	Impossible[2]	No[2]	None[2]
	Truck terminal	1.00[1]	Impossible[2]	No[2]	0.25～0.50[2]
Railways	Railways	1.00[1]	Impossible[2]	No[2]	None[2]
Civil aviation	Runways	1.00[1]	Impossible[2]	No[2]	0.25～0.50[2]
Inland water	Piers and wharfs	0.00[2]	Impossible[2]	No[2]	None[2]

* The damage rate was set at 100% losses since roadways and traffic will be disrupted and passage totally blocked once the inundation depth reaches 1.0 m.

Source 1: Guidelines for Flood Damage Index Analysis (draft), Ministry of Land, Infrastructure, Transport and Tourism, March 2013

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(8) Electricity

Damage and loss rates for each category were estimated using the Guidelines for Flood Damage Index Analysis (draft, March 2013) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-45: Changes in Damage Rates Due to Flood Prevention (Electricity Sector: Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Electricity	Power plants	1.00[1)]	Impossible[2)]	No[2)]	0.50～1.00[2)]
	Transmission facilities (towers and transmission lines)	0.00[2)]	Impossible[2)]	No[2)]	None[2)]
	Distribution networks	1.00[1)]	Impossible[2)]	No[2)]	0.50～1.00[2)]

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), power distribution facilities like switches installed on streets will break down once the inundation depth reaches 1.0 m. We therefore assumed that the cost of damage to the electricity sector's power generation and distribution facilities would be 100% of their value once the inundation depth exceeded 1.0 m. The damage rate for transmission facilities was set at 0.00 since no damage was reported in the 2011 floods.

Table 1-46: Changes in Damage Rates Due to Flood Prevention (Electricity Sector: Losses)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Electricity	Power plants	1.00[1)]	Impossible[2)]	No[2)]	0.50～1.00[2)]
	Transmission facilities (towers and transmission lines)	0.00[2)]	Impossible[2)]	No[2)]	None[2)]
	Distribution networks	1.00[1)]	Impossible[2)]	No[2)]	0.50～1.00[2)]

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), power distribution facilities like switches installed on the streets will break down once the inundation depth reaches 1.0 m. We therefore assumed that losses related to the electricity sector's power generation and distribution facilities would total 100% of their value once the inundation depth exceeded 1.0 m. Likewise we assumed that losses related to transmission facilities would also be 100% in light of the fact that these facilities were damaged during the 2011 floods.

Source 1: Guidelines for Flood Damage Index Analysis (draft), Ministry of Land, Infrastructure, Transport and Tourism, March 2013

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(9) Telecommunications, Broadcasting, and Postal Services

Damage and loss rates for each category were estimated using the Guidelines for Flood Damage Index Analysis (draft, March 2013) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-47: Changes in Damage Rates Due to Flood Prevention (Telecommunications, Broadcasting, and Postal Services Sector: Damage)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Telecommunications	Landline communications	1.00[1)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
	Cellular communications	1.00[1)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
Broadcasting	Broadcasting	1.00[2)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
Postal services	Postal services	1.00[2)]	Impossible[2)]	No[2)]	0.5～1.0[2)]

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), modular jacks and plugs will be inundated when the water depth reaches 1.0 m. We therefore assumed that the cost of damage to the landline communications sector's assets would be 100% of their value once the inundation depth exceeded 1.0 m. According to the Guidelines, base stations will stop functioning and cellular phone services will be cut off when the inundation depth continues to remain more than 30 cm twenty-four hours after the water depth reached 1.0 m. In light of this, we assumed that the cost of damage to the cellular communications sector's assets would be 100% of their value once the inundation depth exceeded 1.0 m. Based on the fact that the flooding damaged the electrical functions of base stations and relay broadcast stations along with postal counter service facilities and buildings, we assumed that the cost of damage to the broadcasting and postal services sectors' assets would be 100% of their value once the inundation depth exceeded 1.0 m.

Table 1-48: Changes in Damage Rates Due to Flood Prevention (Telecommunications, Broadcasting, and Postal Services Sector: Damage)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Telecommunications	Landline communications	1.00[1)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
	Cellular communications	1.00[1)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
Broadcasting	Broadcasting	1.00[2)]	Impossible[2)]	No[2)]	0.5～1.0[2)]
Postal services	Postal services	1.00[2)]	Impossible[2)]	No[2)]	0.5～1.0[2)]

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), modular jacks and plugs will be inundated and become unusable when the water depth reaches 1.0 m. Therefore we assumed that the landline communications sector would see losses totaling 100% once the inundation depth exceeded 1.0 m. According to the Guidelines, base stations will stop functioning and cellular phone services will be cut off when the inundation depth continues to remain more than 30 cm twenty-four hours after the water depth reached 1.0 m. In light of this, we assumed that the cellular communications sector would see losses totaling 100% once the inundation depth exceeded 1.0 m. We assumed that the broadcasting sector and the postal services sector would see losses totaling 100% once the inundation depth exceeded 1.0 m in the light of the fact that flooding damaged the electrical functions of base stations and relay broadcast stations as well as postal counter service facilities and buildings.

Source 1: Guidelines for Flood Damage Index Analysis (draft), Ministry of Land, Infrastructure, Transport and Tourism, March 2013

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(10) Health Care and Public Health (Hygiene)

Damage and loss rates for each category were estimated using the Guidelines for Flood Damage Index Analysis (draft, March 2013) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-49: Changes in Damage Rates Due to Flood Prevention (Health Care and Public Health (Hygiene): Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Health care	Hospitals	0.50 1)	0.25～0.50 2)	No 2)	0.50～1.0 2)
	Health centers and private medical/dental clinics	0.50 1)	0.25～0.50 2)	No 2)	0.50～1.0 2)
Public health (hygiene)	Provincial/district health offices	0.50 1)	0.25～0.50 2)	No 2)	0.50～1.0 2)

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), floodwaters will reach floor level at a water depth of 0.5 m and power outages will occur at an inundation depth of 0.7 m due to the submersion of electrical outlets. In light of this, we assumed that the cost of damage to the health care and public health sector would total 100% of the value of assets in basements and on first floors once the inundation depth exceeded 1.0 m. The value of assets in basements and on first floors was assumed to be 0.50 of the total asset value. We also assumed that about half of the assets in basements and on first floors could be moved to upper floors.

Table 1-50: Changes in Damage Rates Due to Flood Prevention (Health Care and Public Health (Hygiene): Losses)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Health care	Hospitals	1.00 1)	1.00 2)	No 2)	0.50～1.0 2)
	Health centers and private medical/dental clinics	1.00 1)	1.00 2)	No 2)	0.50～1.0 2)
Public health (hygiene)	Provincial/district health offices	1.00 1)	1.00 2)	No 2)	0.50～1.0 2)

* According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), floodwaters will reach floor level at a water depth of 0.5 m and power outages will occur at an inundation depth of 0.7 m due to submersion of electrical outlets. In light of this, we assumed that the health care sector would experience losses totaling 100% once the inundation depth exceeded 1.0 m. We assumed that all facilities would lose power unless flood prevention measures were taken. Therefore we set the damage rate at 100% even after assets in basements and on first floors had been moved to upper floors. We assumed that the damage rate for health care facilities would be 50% if measures to prevent inundation were taken and power outages were avoided, so hospitalized patients would be protected.

Source 1: Guidelines for Flood Damage Index Analysis (draft), Ministry of Land, Infrastructure, Transport and Tourism, March 2013

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(11) Housing and Household Goods

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-51: Changes in Damage Rates Due to Flood Prevention (Housing and Household Goods Sector: Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Housing	Inundation/destruction damage	0.27[1)]	Impossible[2)]	No[2)]	0.14～0.27[2)]
Household goods	Inundation damage	0.51[1)]	0.26～0.51[2)]	No[2)]	0.26～0.51[2)]

* We used the damage rates provided in the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) for the housing and household goods sector. We also assumed that about half of the assets in basements and on first floors could be moved to upper floors.

Table 1-52: Changes in Damage Rates Due to Flood Prevention (Housing and Household Goods Sector: Losses)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Housing	Evacuation expenses	1.00[1)]	Impossible[2)]	No[2)]	0.50～1.00[2)]
Household goods	Cleanup expenses	1.00[1)]	0.50～1.00[2)]	No[2)]	0.50～1.00[2)]

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(12) Education

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-53: Changes in Damage Rates Due to Flood Prevention (Education Sector: Damage)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Education	Basic education	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$
	Private education	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$
	Non formal education	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$
	Higher education	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$
	Vocational education	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$
	Non-Ministry of Education agencies	1.00$^{2)}$	0.50$^{2)}$	No$^{2)}$	0.50～1.00$^{2)}$

* Damage to the education sector included buildings, equipment, and supplies (textbooks, desks, chairs, blackboards, windows, doors, laboratory instruments, personal computers, etc.). We assumed that all these items, except for the buildings, could be moved to upper floors. Damage to buildings was assumed to be 0.5 of total damage.

Table 1-54: Changes in Damage Rates Due to Flood Prevention (Education Sector: Losses)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Education	Basic education	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$
	Private education	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$
	Non formal education	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$
	Higher education	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$
	Vocational education	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$
	Non-Ministry of Education agencies	1.00$^{2)}$	1.00$^{2)}$	No$^{2)}$	1.00$^{2)}$

* The bulk of losses in the education sector arose from the interruption of operations since many schools were used as shelters for flood victims. Even if educational institutions had preventive measures in place that would successfully protect their assets from inundation, their facilities would be used as evacuation shelters anyway if the surrounding area flooded, forcing residents to evacuate. In light of this, we assumed that the damage rate would not change even if their assets were protected.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005

Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(13) Cultural and Natural Heritage

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-55: Changes in Damage Rates Due to Flood Prevention (Cultural and Natural Heritage Sector: Damage)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Cultural heritage assets	Heritage structures and sites	1.00 2)	Impossible 2)	No 2)	0.50～1.00 2)
	Repository of heritage	1.00 2)	0.50～1.00 2)	No 2)	0.50～1.00 2)
	Intangible cultural heritage assets	1.00 2)	Evacuation of performers 2)	No 2)	No 2)
Natural heritage assets	Natural heritage assets	1.00 2)	Impossible 2)	No 2)	No 2)

* The only way to minimize damage to cultural heritage assets would be to use sandbags, waterstops, mobile levees, etc. that would protect historical heritage structures and sites from inundation or by moving museum exhibits to upper floors. Since not all museum exhibits can be moved to upper floors, we assumed the damage rate to be 0.5.

Table 1-56: Changes in Damage Rates Due to Flood Prevention (Cultural and Natural Heritage Sector: Losses)

Sub-sector		Assets unprotected Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Assets protected		
			Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Cultural heritage assets	Heritage structures and sites	1.00 2)	Impossible 2)	No 2)	0.50～1.00 2)
	Heritage repositories	1.00 2)	1.00 2)	No 2)	0.50～1.00 2)
	Intangible cultural heritage assets	1.00 2)	1.00 2)	No 2)	No 2)
Natural heritage assets	Natural heritage assets	1.00 2)	1.00 2)	No 2)	No 2)

* A large part of the cultural heritage asset losses consisted of expenses incurred for moving culturally valuable articles within the same building, and revenue losses due to temporary suspension of operations and cancellation of events. We assumed that the damage rate would not change for intangible cultural heritage assets because scheduled events would have to be canceled anyway once the surrounding area flooded regardless of whether or not performers could safely evacuate. The damage rate for natural heritage assets is also assumed to remain the same since there is no way to protect them from inundation.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005
Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

(14) Natural Environment and Waste Management

Damage and loss rates for each category were estimated using the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) as shown in the table below. Rates for categories not covered in the standards and guidelines were estimated as a range in light of how difficult it would be to take preventive action.

Table 1-57: Changes in Damage Rates Due to Flood Prevention (Natural Environment and Waste Management Sector: Damage)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Waste	Municipal solid waste	1.00[2)]	Impossible[2)]	No[2)]	0.50～1.0[2)]
	Industrial waste	1.00[2)]	Impossible[2)]	No[2)]	0.50～1.0[2)]
Natural environment	Biodiversity	1.00[2)]	Impossible[2)]	No[2)]	No[2)]

* Damage to the natural environment and waste management sector mainly included damage to waste disposal facilities and equipment as well as destruction of biodiversity conservation-related assets (roads, offices, wildlife and plants).

Table 1-58: Changes in Damage Rates Due to Flood Prevention (Natural Environment and Waste Management Sector: Losses)

Sub-sector		Assets unprotected	Assets protected		
		Inundation depth: less than 1 - 2 m Gradient: less than 1/1000	Move to a safe location	Sell	Flood prevention (sandbags, waterstops, mobile levees, etc.)
Waste	Municipal solid waste	1.00[2)]	Impossible[2)]	No[2)]	0.50～1.0[2)]
	Industrial waste	1.00[2)]	Impossible[2)]	No[2)]	0.50～1.0[2)]
Natural environment	Biodiversity	1.00[2)]	Impossible[2)]	No[2)]	No[2)]

* Flooding impaired the operational capacity of waste management facilities and damaged the waste management infrastructure. This resulted in increased expenses for transporting waste to other waste disposal facilities.

Source 1: Manual for Economic Analysis of Flood Control Measures (draft), River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, April 2005
Source 2: Estimated using "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning" (Ministry of Finance, Royal Thai Government and the World Bank, January 18, 2012) and in light of how difficult it would be to take preventive action.

1.4.4 Calculating Average Maximum Inundation Depths by Province

Using the arithmetic mean based on the resident survey, we obtained the average maximum inundation depth for each province. The mean value for all provinces where the survey was conducted (= 0.67 m) was used for Thailand's northeastern area where the survey was not conducted.

Table 1-59: Average Maximum Inundation Depth by Province (Based on Resident Survey)

SEQ.No	Province	(Average maximum inundation depth by province [m]	Remarks
1	Ang Thong	0.44	
2	Ayudhya	1.39	
3	Bangkok	0.27	
4	Chachoengsao	0.20	
5	Chainat	0.81	
6	*Kalasin*	*0.67*	Northeastern Thailand
7	*Khon Kaen*	*0.67*	Northeastern Thailand
8	Lopburi	1.33	
9	*Mahasarakham*	*0.67*	Northeastern Thailand
10	Nakhon Nayok	0.48	
11	Nakhon Prathom	0.48	
12	Nakhon Sawan	1.34	
13	Nonthaburi	0.68	
14	Pathum Thani	0.81	
15	Phitsanu Lok	0.99	
16	Phichit	1.02	
17	Ratchaburi	0.00	
18	*Roi Et*	*0.67*	Northeastern Thailand
19	Samut Sakhon	0.17	
20	Saraburi	0.36	
21	Singburi	0.66	
22	*Sri Saket*	*0.67*	Northeastern Thailand
23	Suphan Buri	0.46	
24	*Surin*	*0.67*	Northeastern Thailand
25	*Ubon Ratchathani*	*0.67*	Northeastern Thailand
26	Uthai Thani	1.46	

1.4.5 Calculating Damage to Be Mitigated by Flood Alerts (by Province)

We used the following method to calculate the cost of damage by category based on the average maximum inundation depth by province.

- Provinces where the maximum inundation depth was equal to or lower than the height of waterstops and mobile levees: Assume that the damage rate would be the lowest among the rates for when waterstops, mobile levees, and sandbags are used to protect assets; when assets are moved to upper floors or higher ground; or when assets are sold before the flood arrives.
- Provinces where the maximum inundation depth was higher than the height of waterstops and mobile levees: Assume that damage would be incurred at the same rate as when assets were moved to upper floors or higher ground or sold before the flood arrived, whichever is lower.
- We used intermediate values for damage rates that were estimated as a range.

(1) Calculating Damage for Protected Assets (by Category)

The calculation process for determining the cost of damage when preventive measures have been implemented is as provided in the following pages.

Table 1-60: Calculating Damage for Protected Assets (Agriculture, Forestry, and Fisheries)

Calculation table

Actual damage

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses (2011 - 2014)														
		Total	Crops				Livestock		Fishery machinery	Total	Crops						Livestock				Fisheries			
			Irrigation and drainage systems	Agricultural machinery and equipment	Storage and buildings	Farms and plantations	Livestock barns and related equipment	Poultry barns and related equipment	Hatcheries and machinery		Rice	Sugarcane	Fruit trees	Flowers	Maize	Other	Poultry	Swine	Cattle	Other	Tilapia	Catfish	Shrimp	Striped snakehead fish (food fish)
1	Ang Thong	53	3	40	5	1	0	3	1	352	270	3	39	1	0	2	12	0	15	1	3	3	2	0.010
2	Ayutthaya	552	28	414	50	13	1	32	13	4,009	3,077	33	443	17	2	23	134	5	173	8	37	30	27	0.115
3	Bangkok	81	4	61	7	2	0	5	2	798	612	7	88	3	0	5	27	1	34	2	7	6	5	0.023
4	Chachoengsao	248	12	186	22	6	0	15	6	2,109	1,619	17	233	9	1	12	70	3	91	4	19	16	14	0.061
5	Chainat	21	1	16	2	1	0	1	1	196	150	2	22	1	0	1	7	0	8	0	2	1	1	0.006
6	Kalasin	9	0	7	1	0	0	1	0	92	71	1	10	0	0	1	3	0	4	0	1	1	1	0.003
7	Khon Kaen	759	38	570	68	18	1	45	18	3,016	2,315	25	334	13	1	18	101	4	130	6	28	22	20	0.087
8	Lopburi	89	4	67	8	2	0	5	2	1,014	778	8	112	4	0	6	34	1	44	2	9	7	7	0.029
9	Mahasarakham	22	1	17	2	1	0	1	1	89	68	1	10	0	0	1	3	0	4	0	1	1	1	0.003
10	Nakorn Nayok	19	1	14	2	0	0	1	0	175	134	1	19	1	0	1	6	0	8	0	2	1	1	0.005
11	Nakorn Patom	71	4	53	6	2	0	4	2	641	492	5	71	3	0	4	21	1	28	1	6	5	4	0.018
12	Nakorn Sawan	102	5	77	9	2	0	6	2	807	619	7	89	3	0	5	27	1	35	2	7	6	5	0.023
13	Nontaburi	37	2	28	3	1	0	2	1	366	281	3	40	2	0	2	12	0	16	1	3	3	2	0.011
14	Patum Thani	189	9	142	17	5	0	11	5	1,723	1,322	14	191	7	1	10	58	2	74	3	16	13	12	0.050
15	Phitsanulok	299	15	224	27	7	1	18	7	1,350	1,036	11	149	6	1	8	45	2	58	3	12	10	9	0.039
16	Pichit	77	4	58	7	2	0	5	2	376	289	3	42	2	0	2	13	0	16	1	3	3	3	0.011
17	Prachinburi	54	3	41	5	1	0	3	1	512	393	4	57	2	0	3	17	1	22	1	5	4	3	0.015
18	Roi Et	1,383	69	1,038	125	34	3	81	33	6,762	5,190	56	748	28	3	39	226	9	291	14	62	50	46	0.195
19	Samut Sakorn	31	2	23	3	1	0	2	1	906	695	8	100	4	0	5	30	1	39	2	8	7	6	0.026
20	Saraburi	108	5	81	10	3	0	6	3	1,254	962	10	139	5	1	7	42	2	54	3	12	9	8	0.036
21	Singburi	8	0	6	1	0	0	0	0	132	101	1	15	1	0	1	4	0	6	0	1	1	1	0.004
22	Sri Saket	864	43	648	78	21	2	51	21	4,892	3,755	41	541	20	2	28	163	6	211	10	45	36	33	0.141
23	Supanburi	111	6	83	10	3	0	7	3	864	663	7	96	4	0	5	29	1	37	2	8	6	6	0.025
24	Surin	249	12	187	22	6	0	15	6	1,145	879	9	127	5	1	7	38	2	49	2	11	8	8	0.033
25	Ubon Ratchathani	189	9	142	17	5	0	11	5	841	645	7	93	3	0	5	28	1	36	2	8	6	6	0.024
26	Utai Thani	41	2	31	4	1	0	2	1	292	224	2	32	1	0	2	10	0	13	1	3	2	2	0.008
	Total	5,666	283	4,252	511	138	11	333	137	34,715	26,645	288	3,840	144	16	202	1,159	46	1,496	70	319	256	234	1

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.50	1.00	0.50	1.00	1.00	1.00	1.00	0.74	0.91	0.91	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	0.75	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	0.15	0.15	0.15	0.15	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No	No	0.62	0.71	No	No	0.71	No	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	0.75	0.40	None	0.75	0.75	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.50**	**0.75**	**0.40**	**1.00**	**0.75**	**0.75**	**1.00**	**0.62**	**0.71**	**0.91**	**0.91**	**0.71**	**0.91**	**0.15**	**0.15**	**0.15**	**0.15**	**1.00**	**1.00**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.50**	**0.75**	**0.50**	**1.00**	**1.00**	**1.00**	**1.00**	**0.62**	**0.71**	**0.91**	**0.91**	**0.71**	**0.91**	**0.15**	**0.15**	**0.15**	**0.15**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses (2011 - 2014)														
		Total	Crops				Livestock		Fishery machinery	Total	Crops						Livestock				Fisheries			
			Irrigation and drainage systems	Agricultural machinery and equipment	Storage and buildings	Farms and plantations	Aquaculture livestock	Poultry barns and machinery	Hatcheries and machinery		Rice	Sugarcane	Fruit trees	Flowers	Maize	Other	Poultry	Swine	Cattle	Other	Tilapia	Catfish	Shrimp	Striped snakehead fish (food fish)
1	Ang Thong	41	3	30	4	1	0	2	1	284	226	2	39	1	0	2	2	0	2	0	3	3	2	0.010
2	Ayutthaya	430	28	311	40	13	1	24	13	3,230	2,578	26	443	17	1	23	20	1	26	1	37	30	27	0.115
3	Bangkok	63	4	46	6	2	0	4	2	643	513	5	88	3	0	5	4	0	5	0	7	6	5	0.023
4	Chachoengsao	193	12	140	18	6	0	11	6	1,699	1,356	14	233	9	1	12	11	0	14	1	19	16	14	0.061
5	Chainat	16	1	12	2	1	0	1	1	158	126	1	22	1	0	1	1	0	1	0	2	1	1	0.006
6	Kalasin	7	0	5	1	0	0	0	0	74	59	1	10	0	0	1	0	0	1	0	1	1	1	0.003
7	Khon Kaen	591	38	427	55	18	1	33	18	2,430	1,940	20	334	13	1	18	15	1	19	1	28	22	20	0.087
8	Lopburi	69	4	50	6	2	0	4	2	817	652	7	112	4	0	6	5	0	7	0	9	7	7	0.029
9	Mahasarakham	17	1	12	2	1	0	1	1	72	57	1	10	0	0	1	0	0	1	0	1	1	1	0.003
10	Nakorn Nayok	15	1	11	1	0	0	1	0	141	113	1	19	1	0	1	1	0	1	0	2	1	1	0.005
11	Nakorn Patom	55	4	40	5	2	0	3	2	517	412	4	71	3	0	4	3	0	4	0	6	5	4	0.018
12	Nakorn Sawan	79	5	57	7	2	0	4	2	650	519	5	89	3	0	5	4	0	5	0	7	6	5	0.023
13	Nontaburi	29	2	21	3	1	0	2	1	295	235	2	40	2	0	2	2	0	2	0	3	3	2	0.011
14	Patum Thani	147	9	106	14	5	0	8	5	1,388	1,108	11	191	7	1	10	9	0	11	1	16	13	12	0.050
15	Phitsanulok	233	15	168	22	7	0	13	7	1,088	868	9	149	6	0	8	7	0	9	0	12	10	9	0.039
16	Pichit	60	4	43	6	2	0	3	2	303	242	2	42	2	0	2	2	0	2	0	3	3	3	0.011
17	Prachinburi	42	3	30	4	1	0	2	1	413	329	3	57	2	0	3	3	0	3	0	5	4	3	0.015
18	Roi Et	1,077	69	778	100	34	2	61	33	5,449	4,348	44	748	28	2	39	34	1	44	2	62	50	46	0.195
19	Samut Sakorn	24	2	17	2	1	0	1	1	730	583	6	100	4	0	5	5	0	6	0	8	7	6	0.026
20	Saraburi	84	5	61	8	3	0	5	3	1,010	806	8	139	5	0	7	6	0	8	0	12	9	8	0.036
21	Singburi	6	0	5	1	0	0	0	0	106	85	1	15	1	0	1	1	0	1	0	1	1	1	0.004
22	Sri Saket	673	43	486	62	21	1	38	21	3,942	3,146	32	541	20	2	28	24	1	32	1	45	36	33	0.141
23	Supanburi	86	6	62	8	3	0	5	3	696	556	6	96	4	0	5	4	0	6	0	8	6	6	0.025
24	Surin	194	12	140	18	6	0	11	6	923	736	7	127	5	0	7	6	0	7	0	11	8	8	0.033
25	Ubon Ratchathani	147	9	106	14	5	0	8	5	678	541	5	93	3	0	5	4	0	5	0	8	6	6	0.024
26	Utai Thani	32	2	23	3	1	0	2	1	235	188	2	32	1	0	2	1	0	2	0	3	2	2	0.008
	Total	4,414	283	3,189	409	138	8	250	137	27,971	22,323	225	3,840	144	12	202	174	7	224	10	319	256	234	1

Table 1-61: Calculating Damage for Protected Assets (Industry)

Calculation table
Actual damage
Industry Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage						Losses
		Total	Asset damage					Total (losses due to
			Fixed assets	nventory assets	Buildings	ment and mac	utdoor facilitie	suspended
1	Ang Thong	21,450	105	18,332	1,132	1,225	655	31,517
2	Ayutthaya	92,907	454	79,405	4,903	5,307	2,839	17,137
3	Bangkok	39,131	191	33,444	2,065	2,235	1,196	20,051
4	Chachoengsao	26,200	128	22,392	1,383	1,497	801	38,496
5	Chainat	8,519	42	7,281	450	487	260	12,517
6	Kalasin	2,100	10	1,794	111	120	64	3,085
7	Khon Kaen	3,647	18	3,117	192	208	111	5,359
8	Lopburi	14,113	69	12,062	745	806	431	20,738
9	Mahasarakham	2,885	14	2,465	152	165	88	4,238
10	Nakorn Nayok	8,457	41	7,228	446	483	258	12,426
11	Nakorn Patom	37,985	186	32,465	2,004	2,170	1,161	55,814
12	Nakorn Sawan	20,064	98	17,148	1,059	1,146	613	7,238
13	Nontaburi	86,903	425	74,273	4,586	4,964	2,655	127,690
14	Patum Thani	69,272	339	59,205	3,655	3,957	2,117	17,117
15	Phitsanulok	4,642	23	3,967	245	265	142	6,821
16	Pichit	6,287	31	5,374	332	359	192	9,238
17	Prachinburi	7,365	36	6,294	389	421	225	10,821
18	Roi Et	3,516	17	3,005	186	201	107	5,166
19	Samut Sakorn	0	0	0	0	0	0	1,922
20	Saraburi	9,949	49	8,503	525	568	304	14,618
21	Singburi	8,939	44	7,640	472	511	273	13,134
22	Sri Saket	859	4	734	45	49	26	1,262
23	Supanburi	35,980	176	30,751	1,899	2,055	1,099	52,866
24	Surin	333	2	285	18	19	10	490
25	Ubon Ratchathani	497	2	424	26	28	15	730
26	Utai Thani	1,883	9	1,609	99	108	58	2,767
	Total	513,881	2,512	439,198	27,117	29,353	15,701	493,258

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.79	0.59	0.27	0.79	0.79	1.00
Assets protected	Move to a safe location	Impossible	0.45	Impossible	0.45	Impossible	Impossible
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	0.21	None	0.60	0.75
Words in blue: No measures taken	Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)	0.79	0.45	0.21	0.45	0.60	0.75
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	0.79	0.45	0.27	0.45	0.79	1.00

Damage after Implementing Measures
Industry Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage						Losses
		Total	Asset damage					Total (losses due to
			Fixed assets	nventory assets	Buildings	ment and mac	utdoor facilitie	suspended
1	Ang Thong	16,163	105	13,982	880	698	498	23,638
2	Ayutthaya	70,009	454	60,563	3,813	3,023	2,156	12,853
3	Bangkok	29,487	191	25,508	1,606	1,273	908	15,038
4	Chachoengsao	19,743	128	17,079	1,075	852	608	28,872
5	Chainat	6,419	42	5,553	350	277	198	9,388
6	Kalasin	1,582	10	1,369	86	68	49	2,314
7	Khon Kaen	2,748	18	2,377	150	119	85	4,019
8	Lopburi	10,635	69	9,200	579	459	328	15,553
9	Mahasarakham	2,174	14	1,880	118	94	67	3,179
10	Nakorn Nayok	6,373	41	5,513	347	275	196	9,320
11	Nakorn Patom	28,624	186	24,761	1,559	1,236	881	41,860
12	Nakorn Sawan	15,119	98	13,079	823	653	466	5,429
13	Nontaburi	65,485	425	56,649	3,567	2,828	2,017	95,768
14	Patum Thani	52,199	339	45,156	2,843	2,254	1,608	12,838
15	Phitsanulok	3,498	23	3,026	191	151	108	5,116
16	Pichit	4,738	31	4,099	258	205	146	6,929
17	Prachinburi	5,550	36	4,801	302	240	171	8,116
18	Roi Et	2,649	17	2,292	144	114	82	3,874
19	Samut Sakorn	0	0	0	0	0	0	1,442
20	Saraburi	7,497	49	6,485	408	324	231	10,963
21	Singburi	6,736	44	5,827	367	291	207	9,851
22	Sri Saket	647	4	560	35	28	20	946
23	Supanburi	27,112	176	23,454	1,477	1,171	835	39,650
24	Surin	251	2	217	14	11	8	367
25	Ubon Ratchathani	374	2	324	20	16	12	547
26	Utai Thani	1,419	9	1,227	77	61	44	2,075
	Total	387,229	2,512	334,982	21,091	16,720	11,925	369,944

Table 1-62: Calculating Damage for Protected Assets (Tourism)

Calculation table
Actual damage
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses							
		Total	Asset damage							Total	Sales losses						
			Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other		Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
1	Ang Thong	54.50	10.39	10.66	14.21	10.66	0.00	0.02	8.56	34.70	9.60	6.05	11.29	6.17	2.05	3.79	1.13
2	Ayutthaya	104.00	19.82	20.34	27.12	20.34	0.00	0.04	16.33	2,447.40	677.01	426.73	796.59	434.97	144.58	267.22	79.66
3	Bangkok	328.60	62.64	64.27	85.69	64.27	0.00	0.13	51.60	68,884.90	19,055.21	12,010.74	22,420.98	12,242.84	4,069.27	7,521.19	2,242.16
4	Chachoengsao	111.80	21.31	21.87	29.15	21.87	0.00	0.05	17.56	238.00	65.84	41.50	77.47	42.30	14.06	25.99	7.75
5	Chainat	100.50	19.16	19.66	26.21	19.66	0.00	0.04	15.78	38.70	10.71	6.75	12.60	6.88	2.29	4.23	1.26
6	Kalasin	65.70	12.52	12.85	17.13	12.85	0.00	0.03	10.32	64.60	17.87	11.26	21.03	11.48	3.82	7.05	2.10
7	Khon Kaen	545.60	104.00	106.71	142.28	106.71	0.00	0.22	85.68	1,025.00	283.54	178.72	333.62	182.17	60.55	111.91	33.36
8	Lopburi	270.00	51.47	52.81	70.41	52.81	0.00	0.11	42.40	411.10	113.72	71.68	133.81	73.06	24.29	44.89	13.38
9	Mahasarakham	58.10	11.07	11.36	15.15	11.36	0.00	0.02	9.12	49.70	13.75	8.67	16.18	8.83	2.94	5.43	1.62
10	Nakorn Nayok	347.90	66.32	68.04	90.72	68.04	0.00	0.14	54.63	294.20	81.38	51.30	95.76	52.29	17.38	32.12	9.58
11	Nakorn Patom	188.30	35.89	36.83	49.10	36.83	0.00	0.08	29.57	251.80	69.65	43.90	81.96	44.75	14.87	27.49	8.20
12	Nakorn Sawan	321.60	61.30	62.90	83.86	62.90	0.00	0.13	50.50	343.50	95.02	59.89	111.80	61.05	20.29	37.50	11.18
13	Nontaburi	205.50	39.17	40.19	53.59	40.19	0.00	0.08	32.27	345.40	95.55	60.22	112.42	61.39	20.40	37.71	11.24
14	Patum Thani	202.80	38.66	39.66	52.88	39.66	0.00	0.08	31.85	151.10	41.80	26.35	49.18	26.85	8.93	16.50	4.92
15	Phitsanulok	50.10	9.55	9.80	13.06	9.80	0.00	0.02	7.87	45.20	12.50	7.88	14.71	8.03	2.67	4.94	1.47
16	Pichit	437.60	83.41	85.59	114.11	85.59	0.00	0.18	68.72	729.00	201.66	127.11	237.28	129.56	43.06	79.60	23.73
17	Prachinburi	238.20	45.40	46.59	62.12	46.59	0.00	0.10	37.41	285.70	79.03	49.81	92.99	50.78	16.88	31.19	9.30
18	Roi Et	121.70	23.20	23.80	31.74	23.80	0.00	0.05	19.11	122.90	34.00	21.43	40.00	21.84	7.26	13.42	4.00
19	Samut Sakorn	81.60	15.55	15.96	21.28	15.96	0.00	0.03	12.81	57.50	15.91	10.03	18.72	10.22	3.40	6.28	1.87
20	Saraburi	249.30	47.52	48.76	65.01	48.76	0.00	0.10	39.15	484.70	134.08	84.51	157.76	86.15	28.63	52.92	15.78
21	Singburi	42.60	8.12	8.33	11.11	8.33	0.00	0.02	6.69	43.50	12.03	7.58	14.16	7.73	2.57	4.75	1.42
22	Sri Saket	64.50	12.29	12.62	16.82	12.62	0.00	0.03	10.13	205.00	56.71	35.74	66.72	36.43	12.11	22.38	6.67
23	Supanburi	263.80	50.28	51.59	68.79	51.59	0.00	0.11	41.43	216.50	59.89	37.75	70.47	38.48	12.79	23.64	7.05
24	Surin	134.90	25.71	26.38	35.18	26.38	0.00	0.06	21.18	206.40	57.10	35.99	67.18	36.68	12.19	22.54	6.72
25	Ubon Ratchathani	335.50	63.95	65.62	87.49	65.62	0.00	0.14	52.69	593.40	164.15	103.46	193.14	105.46	35.05	64.79	19.31
26	Utai Thani	209.70	39.97	41.01	54.68	41.01	0.00	0.09	32.93	69.10	19.11	12.05	22.49	12.28	4.08	7.54	2.25
	Total	5,134.40	978.70	1,004.20	1,338.90	1,004.20	0.00	2.10	806.30	77,639.00	21,476.80	13,537.10	25,270.30	13,798.70	4,586.40	8,477.00	2,527.10
	Indirect impact									12,034.40							
	Total	5,134.40								89,673.40	21,476.80	13,537.10	25,270.30	13,798.70	4,586.40	8,477.00	2,527.10

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.79	0.59	0.59	0.79	0.00	0.79	0.79		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	None	Impossible		Impossible	Impossible	Impossible	Impossible	Impossible	None	Impossible
	Sell	No	No	No	No	No	No	No		No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.60	0.45	0.45	0.60	None	None	0.60		1.00	1.00	1.00	1.00	None	None	1.00
Words in blue: No measures taken	Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)	0.60	0.45	0.45	0.60	0.00	0.79	0.60		1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	0.79	0.59	0.59	0.79	0.00	0.79	0.79		1.00	1.00	1.00	1.00	1.00	1.00	1.00

Damage after Implementing Measures
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses							
		Total	Asset damage							Total	Sales losses						
			Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other		Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
1	Ang Thong	41.48	7.89	8.13	10.84	8.10	0.00	0.02	6.50	40.08	9.60	6.05	11.29	6.17	2.05	3.79	1.13
2	Ayutthaya	79.15	15.06	15.51	20.68	15.45	0.00	0.04	12.40	2,826.76	677.01	426.73	796.59	434.97	144.58	267.22	79.66
3	Bangkok	250.08	47.57	49.02	65.36	48.81	0.00	0.13	39.19	79,562.37	19,055.21	12,010.74	22,420.98	12,242.84	4,069.27	7,521.19	2,242.16
4	Chachoengsao	85.09	16.19	16.68	22.24	16.61	0.00	0.05	13.33	274.89	65.84	41.50	77.47	42.30	14.06	25.99	7.75
5	Chainat	76.49	14.55	14.99	19.99	14.93	0.00	0.04	11.99	44.70	10.71	6.75	12.60	6.88	2.29	4.23	1.26
6	Kalasin	50.00	9.51	9.80	13.07	9.76	0.00	0.03	7.84	74.61	17.87	11.26	21.03	11.48	3.82	7.05	2.10
7	Khon Kaen	415.23	78.99	81.39	108.52	81.05	0.00	0.22	65.07	1,183.88	283.54	178.72	333.62	182.17	60.55	111.91	33.36
8	Lopburi	205.49	39.09	40.28	53.70	40.11	0.00	0.11	32.20	474.82	113.72	71.68	133.81	73.06	24.29	44.89	13.38
9	Mahasarakham	44.22	8.41	8.67	11.56	8.63	0.00	0.02	6.93	57.40	13.75	8.67	16.18	8.83	2.94	5.43	1.62
10	Nakorn Nayok	264.77	50.37	51.90	69.19	51.68	0.00	0.14	41.49	339.80	81.38	51.30	95.76	52.29	17.38	32.12	9.58
11	Nakorn Patom	143.31	27.26	28.09	37.45	27.97	0.00	0.08	22.46	290.83	69.65	43.90	81.96	44.75	14.87	27.49	8.20
12	Nakorn Sawan	244.76	46.56	47.97	63.96	47.77	0.00	0.13	38.36	396.74	95.02	59.89	111.80	61.05	20.29	37.50	11.18
13	Nontaburi	156.40	29.75	30.66	40.87	30.53	0.00	0.08	24.51	398.94	95.55	60.22	112.42	61.39	20.40	37.71	11.24
14	Patum Thani	154.34	29.36	30.25	40.34	30.12	0.00	0.08	24.19	174.52	41.80	26.35	49.18	26.85	8.93	16.50	4.92
15	Phitsanulok	38.13	7.25	7.47	9.96	7.44	0.00	0.02	5.98	52.21	12.50	7.88	14.71	8.03	2.67	4.94	1.47
16	Pichit	333.04	63.35	65.28	87.04	65.00	0.00	0.18	52.19	842.00	201.66	127.11	237.28	129.56	43.06	79.60	23.73
17	Prachinburi	181.28	34.48	35.53	47.38	35.38	0.00	0.10	28.41	329.98	79.03	49.81	92.99	50.78	16.88	31.19	9.30
18	Roi Et	92.62	17.62	18.15	24.21	18.08	0.00	0.05	14.52	141.95	34.00	21.43	40.00	21.84	7.26	13.42	4.00
19	Samut Sakorn	62.10	11.81	12.17	16.23	12.12	0.00	0.03	9.73	66.41	15.91	10.03	18.72	10.22	3.40	6.28	1.87
20	Saraburi	189.73	36.09	37.19	49.58	37.03	0.00	0.10	29.73	559.83	134.08	84.51	157.76	86.15	28.63	52.92	15.78
21	Singburi	32.42	6.17	6.35	8.47	6.33	0.00	0.02	5.08	50.24	12.03	7.58	14.16	7.73	2.57	4.75	1.42
22	Sri Saket	49.09	9.34	9.62	12.83	9.58	0.00	0.03	7.69	236.78	56.71	35.74	66.72	36.43	12.11	22.38	6.67
23	Supanburi	200.77	38.19	39.35	52.47	39.19	0.00	0.11	31.46	250.06	59.89	37.75	70.47	38.48	12.79	23.64	7.05
24	Surin	102.67	19.53	20.12	26.83	20.04	0.00	0.06	16.09	238.39	57.10	35.99	67.18	36.68	12.19	22.54	6.72
25	Ubon Ratchathani	255.34	48.57	50.05	66.73	49.84	0.00	0.14	40.02	685.38	164.15	103.46	193.14	105.46	35.05	64.79	19.31
26	Utai Thani	159.59	30.36	31.28	41.71	31.15	0.00	0.09	25.01	79.81	19.11	12.05	22.49	12.28	4.08	7.54	2.25
	Total	3,907.59	743.32	765.92	1,021.19	762.68	0.00	2.10	612.38	89,673.40	21,476.80	13,537.10	25,270.30	13,798.70	4,586.40	8,477.00	2,527.10

Table 1-63: Calculating Damage for Protected Assets (Financial and Insurance)

Calculation table
Actual damage
Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

	Province	Damage								Losses							
		Total	Asset damage							Total	Sales losses						
			Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector		Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
1	Ang Thong	24.38	0.00	0.00	0.00	0.00	0.00	24.38	0.00	2,979.97	534.72	1,737.09	0.00	64.99	210.76	196.13	236.28
2	Ayutthaya	94.91	0.00	0.00	0.00	0.00	0.00	94.91	0.00	11,602.50	2,081.94	6,763.36	0.00	253.03	820.60	763.63	919.94
3	Bangkok	367.12	0.00	0.00	0.00	0.00	0.00	367.12	0.00	44,878.67	8,052.98	26,160.79	0.00	978.74	3,174.08	2,953.73	3,558.34
4	Chachoengsao	29.78	0.00	0.00	0.00	0.00	0.00	29.78	0.00	3,639.90	653.14	2,121.78	0.00	79.38	257.44	239.56	288.60
5	Chainat	9.68	0.00	0.00	0.00	0.00	0.00	9.68	0.00	1,183.53	212.37	689.91	0.00	25.81	83.71	77.90	93.84
6	Kalasin	2.39	0.00	0.00	0.00	0.00	0.00	2.39	0.00	291.70	52.34	170.04	0.00	6.36	20.63	19.20	23.13
7	Khon Kaen	4.14	0.00	0.00	0.00	0.00	0.00	4.14	0.00	506.69	90.92	295.36	0.00	11.05	35.84	33.35	40.17
8	Lopburi	16.04	0.00	0.00	0.00	0.00	0.00	16.04	0.00	1,960.76	351.84	1,142.97	0.00	42.76	138.68	129.05	155.46
9	Mahasarakham	3.28	0.00	0.00	0.00	0.00	0.00	3.28	0.00	400.75	71.91	233.61	0.00	8.74	28.34	26.38	31.78
10	Nakorn Nayok	9.61	0.00	0.00	0.00	0.00	0.00	9.61	0.00	1,174.93	210.83	684.89	0.00	25.62	83.10	77.33	93.16
11	Nakorn Patom	43.17	0.00	0.00	0.00	0.00	0.00	43.17	0.00	5,277.27	946.95	3,076.24	0.00	115.09	373.24	347.33	418.42
12	Nakorn Sawan	24.78	0.00	0.00	0.00	0.00	0.00	24.78	0.00	3,028.99	543.52	1,765.67	0.00	66.06	214.23	199.36	240.16
13	Nontaburi	98.76	0.00	0.00	0.00	0.00	0.00	98.76	0.00	12,073.30	2,166.42	7,037.80	0.00	263.30	853.90	794.62	957.27
14	Patum Thani	114.42	0.00	0.00	0.00	0.00	0.00	114.42	0.00	13,986.58	2,509.74	8,153.09	0.00	305.03	989.21	920.54	1,108.97
15	Phitsanulok	5.28	0.00	0.00	0.00	0.00	0.00	5.28	0.00	644.91	115.72	375.93	0.00	14.06	45.61	42.45	51.13
16	Pichit	7.15	0.00	0.00	0.00	0.00	0.00	7.15	0.00	873.51	156.74	509.19	0.00	19.05	61.78	57.49	69.26
17	Prachinburi	8.37	0.00	0.00	0.00	0.00	0.00	8.37	0.00	1,023.16	183.59	596.42	0.00	22.31	72.36	67.34	81.12
18	Roi Et	4.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	488.42	87.64	284.71	0.00	10.65	34.54	32.15	38.73
19	Samut Sakorn	9.34	0.00	0.00	0.00	0.00	0.00	9.34	0.00	1,141.70	204.86	665.52	0.00	24.90	80.75	75.14	90.52
20	Saraburi	11.31	0.00	0.00	0.00	0.00	0.00	11.31	0.00	1,382.14	248.01	805.68	0.00	30.14	97.75	90.97	109.59
21	Singburi	10.16	0.00	0.00	0.00	0.00	0.00	10.16	0.00	1,241.86	222.84	723.91	0.00	27.08	87.83	81.73	98.46
22	Sri Saket	0.98	0.00	0.00	0.00	0.00	0.00	0.98	0.00	119.31	21.41	69.55	0.00	2.60	8.44	7.85	9.46
23	Supanburi	40.89	0.00	0.00	0.00	0.00	0.00	40.89	0.00	4,998.59	896.94	2,913.79	0.00	109.01	353.53	328.99	396.33
24	Surin	0.38	0.00	0.00	0.00	0.00	0.00	0.38	0.00	46.31	8.31	26.99	0.00	1.01	3.28	3.05	3.67
25	Ubon Ratchathani	0.56	0.00	0.00	0.00	0.00	0.00	0.56	0.00	68.99	12.38	40.22	0.00	1.50	4.88	4.54	5.47
26	Utai Thani	2.14	0.00	0.00	0.00	0.00	0.00	2.14	0.00	261.59	46.94	152.49	0.00	5.70	18.50	17.22	20.74
	TOTAL	943.00	0.00	0.00	0.00	0.00	0.00	943.00	0.00	115,276.00	20,685.00	67,197.00	0.00	2,514.00	8,153.00	7,587.00	9,140.00

Changes in Damage Rates due to Flood Prevention

115276.00

Assets unprotected		0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Assets protected	Move to a safe locati	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	Sell	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**

Damage after Implementing Measures
Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

	Province	Damage								Losses							
		Total	Asset damage							Total	Sales losses						
			Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector		Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
1	Ang Thong	18.59	0.00	0.00	0.00	0.00	0.00	18.59	0.00	2,272.86	407.84	1,324.90	0.00	49.57	160.75	149.59	180.21
2	Ayutthaya	72.39	0.00	0.00	0.00	0.00	0.00	72.39	0.00	8,849.36	1,587.92	5,158.49	0.00	192.99	625.88	582.43	701.65
3	Bangkok	280.01	0.00	0.00	0.00	0.00	0.00	280.01	0.00	34,229.49	6,142.10	19,953.15	0.00	746.49	2,420.91	2,252.85	2,713.99
4	Chachoengsao	22.71	0.00	0.00	0.00	0.00	0.00	22.71	0.00	2,776.20	498.16	1,618.31	0.00	60.54	196.35	182.72	220.12
5	Chainat	7.38	0.00	0.00	0.00	0.00	0.00	7.38	0.00	902.69	161.98	526.20	0.00	19.69	63.84	59.41	71.57
6	Kalasin	1.82	0.00	0.00	0.00	0.00	0.00	1.82	0.00	222.48	39.92	129.69	0.00	4.85	15.74	14.64	17.64
7	Khon Kaen	3.16	0.00	0.00	0.00	0.00	0.00	3.16	0.00	386.46	69.35	225.27	0.00	8.43	27.33	25.44	30.64
8	Lopburi	12.23	0.00	0.00	0.00	0.00	0.00	12.23	0.00	1,495.50	268.35	871.76	0.00	32.61	105.77	98.43	118.57
9	Mahasarakham	2.50	0.00	0.00	0.00	0.00	0.00	2.50	0.00	305.66	54.85	178.18	0.00	6.67	21.62	20.12	24.24
10	Nakorn Nayok	7.33	0.00	0.00	0.00	0.00	0.00	7.33	0.00	896.13	160.80	522.37	0.00	19.54	63.38	58.98	71.05
11	Nakorn Patom	32.93	0.00	0.00	0.00	0.00	0.00	32.93	0.00	4,025.03	722.25	2,346.28	0.00	87.78	284.67	264.91	319.14
12	Nakorn Sawan	18.90	0.00	0.00	0.00	0.00	0.00	18.90	0.00	2,310.25	414.55	1,346.70	0.00	50.38	163.39	152.05	183.17
13	Nontaburi	75.33	0.00	0.00	0.00	0.00	0.00	75.33	0.00	9,208.45	1,652.35	5,367.82	0.00	200.82	651.28	606.06	730.12
14	Patum Thani	87.27	0.00	0.00	0.00	0.00	0.00	87.27	0.00	10,667.73	1,914.21	6,218.46	0.00	232.65	754.48	702.11	845.82
15	Phitsanulok	4.02	0.00	0.00	0.00	0.00	0.00	4.02	0.00	491.88	88.26	286.73	0.00	10.73	34.79	32.37	39.00
16	Pichit	5.45	0.00	0.00	0.00	0.00	0.00	5.45	0.00	666.23	119.55	388.36	0.00	14.53	47.12	43.85	52.82
17	Prachinburi	6.38	0.00	0.00	0.00	0.00	0.00	6.38	0.00	780.37	140.03	454.90	0.00	17.02	55.19	51.36	61.87
18	Roi Et	3.05	0.00	0.00	0.00	0.00	0.00	3.05	0.00	372.53	66.85	217.15	0.00	8.12	26.35	24.52	29.54
19	Samut Sakorn	7.12	0.00	0.00	0.00	0.00	0.00	7.12	0.00	870.79	156.25	507.60	0.00	18.99	61.59	57.31	69.04
20	Saraburi	8.62	0.00	0.00	0.00	0.00	0.00	8.62	0.00	1,054.17	189.16	614.50	0.00	22.99	74.56	69.38	83.58
21	Singburi	7.75	0.00	0.00	0.00	0.00	0.00	7.75	0.00	947.18	169.96	552.13	0.00	20.66	66.99	62.34	75.10
22	Sri Saket	0.74	0.00	0.00	0.00	0.00	0.00	0.74	0.00	91.00	16.33	53.04	0.00	1.98	6.44	5.99	7.21
23	Supanburi	31.19	0.00	0.00	0.00	0.00	0.00	31.19	0.00	3,812.48	684.11	2,222.38	0.00	83.14	269.64	250.92	302.28
24	Surin	0.29	0.00	0.00	0.00	0.00	0.00	0.29	0.00	35.32	6.34	20.59	0.00	0.77	2.50	2.32	2.80
25	Ubon Ratchathani	0.43	0.00	0.00	0.00	0.00	0.00	0.43	0.00	52.62	9.44	30.67	0.00	1.15	3.72	3.46	4.17
26	Utai Thani	1.63	0.00	0.00	0.00	0.00	0.00	1.63	0.00	199.52	35.80	116.30	0.00	4.35	14.11	13.13	15.82
	TOTAL	719.24	0.00	0.00	0.00	0.00	0.00	719.24	0.00	87,922.37	15,776.69	51,251.95	0.00	1,917.46	6,218.39	5,786.69	6,971.19

Table 1-64: Calculating Damage for Protected Assets (Flood Control, Drainage, and Irrigation)

Actual damage
Flood Control, Drainage, and Irrigation Sector - Total Damage (by Prefecture) [in Thai baht, millions]

	Province	Damage	Losses
		Total	Total
1	Ang Thong	125.35	0.00
2	Ayutthaya	659.42	0.00
3	Bangkok	702.53	0.00
4	Chachoengsao	738.67	0.00
5	Chainat	214.57	0.00
6	Kalasin	301.80	0.00
7	Khon Kaen	665.90	0.00
8	Lopburi	199.37	0.00
9	Mahasarakham	416.44	0.00
10	Nakorn Nayok	60.06	0.00
11	Nakorn Patom	307.28	0.00
12	Nakorn Sawan	532.57	0.00
13	Nontaburi	372.33	0.00
14	Patum Thani	256.94	0.00
15	Phitsanulok	461.05	0.00
16	Pichit	293.57	0.00
17	Prachinburi	106.16	0.00
18	Roi Et	382.29	0.00
19	Samut Sakorn	50.34	0.00
20	Saraburi	160.00	0.00
21	Singburi	165.73	0.00
22	Sri Saket	331.70	0.00
23	Supanburi	525.34	0.00
24	Surin	256.44	0.00
25	Ubon Ratchathani	420.92	0.00
26	Utai Thani	8.22	0.00
	TOTAL	**8715.00**	**0.00**
	for check	8715.00	0.00

Changes in Damage Rates due to Flood Prevention

		Flood control facilities	Drainage facilities	Irrigation facilities
Assets unprotected		0.30	0.30	0.30
Assets protected	Move to a safe location	Impossible	Impossible	Impossible
	Sell	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.30**	**0.30**	**0.30**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.30**	**0.30**	**0.30**

Damage after Implementing Measures
Flood Control, Drainage, and Irrigation Sector - Total Damage (by Prefecture) [in Thai baht, millions]

	Province	Damage	Losses
		Total	Total
1	Ang Thong	125.35	0.00
2	Ayutthaya	659.42	0.00
3	Bangkok	702.53	0.00
4	Chachoengsao	738.67	0.00
5	Chainat	214.57	0.00
6	Kalasin	301.80	0.00
7	Khon Kaen	665.90	0.00
8	Lopburi	199.37	0.00
9	Mahasarakham	416.44	0.00
10	Nakorn Nayok	60.06	0.00
11	Nakorn Patom	307.28	0.00
12	Nakorn Sawan	532.57	0.00
13	Nontaburi	372.33	0.00
14	Patum Thani	256.94	0.00
15	Phitsanulok	461.05	0.00
16	Pichit	293.57	0.00
17	Prachinburi	106.16	0.00
18	Roi Et	382.29	0.00
19	Samut Sakorn	50.34	0.00
20	Saraburi	160.00	0.00
21	Singburi	165.73	0.00
22	Sri Saket	331.70	0.00
23	Supanburi	525.34	0.00
24	Surin	256.44	0.00
25	Ubon Ratchathani	420.92	0.00
26	Utai Thani	8.22	0.00
	TOTAL	**8715.00**	**0.00**

Table 1-65: Calculating Damage for Protected Assets (Water and Sanitation)

Calculation table
Actual damage
Water and Sanitation Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses		
		Total	Asset damage							Total	Sales losses	
			Water intake structures	Water treatment plants	Conveyance systems	Storage systems	Distribution network	Surface & groundwater systems	Sewage treatment works		Waterworks	Sewer system
1	Ang Thong	50.30	0.54	0.44	0.00	0.01	0.02	25.65	23.64	3.90	3.90	0.00
2	Ayutthaya	264.60	2.84	2.33	0.02	0.03	0.10	134.93	124.36	49.60	49.57	0.04
3	Bangkok	281.90	3.02	2.48	0.02	0.03	0.10	143.75	132.49	1,822.60	1,821.41	1.29
4	Chachoengsao	296.40	3.18	2.61	0.02	0.03	0.11	151.14	139.31	0.40	0.40	0.00
5	Chainat	86.10	0.92	0.76	0.00	0.01	0.03	43.90	40.47	1.40	1.40	0.00
6	Kalasin	121.10	1.30	1.07	0.01	0.01	0.05	61.75	56.92	5.70	5.70	0.00
7	Khon Kaen	267.20	2.87	2.35	0.02	0.03	0.10	136.25	125.58	10.80	10.79	0.01
8	Lopburi	80.00	0.86	0.70	0.00	0.01	0.03	40.79	37.60	7.50	7.50	0.01
9	Mahasarakham	167.10	1.79	1.47	0.01	0.02	0.06	85.21	78.54	7.30	7.30	0.01
10	Nakorn Nayok	24.10	0.26	0.21	0.00	0.00	0.01	12.29	11.33	0.30	0.30	0.00
11	Nakorn Patom	123.30	1.32	1.09	0.01	0.01	0.05	62.87	57.95	-0.70	-0.70	0.00
12	Nakorn Sawan	213.70	2.29	1.88	0.01	0.02	0.08	108.97	100.44	4.90	4.90	0.00
13	Nontaburi	149.40	1.60	1.32	0.01	0.02	0.06	76.18	70.22	0.20	0.20	0.00
14	Patum Thani	103.10	1.11	0.91	0.01	0.01	0.04	52.57	48.46	26.30	26.28	0.02
15	Phitsanulok	185.00	1.98	1.63	0.01	0.02	0.07	94.34	86.95	2.70	2.70	0.00
16	Pichit	117.80	1.26	1.04	0.01	0.01	0.04	60.07	55.37	2.60	2.60	0.00
17	Prachinburi	42.60	0.46	0.38	0.00	0.00	0.02	21.72	20.02	2.30	2.30	0.00
18	Roi Et	153.40	1.64	1.35	0.01	0.02	0.06	78.22	72.10	8.80	8.79	0.01
19	Samut Sakorn	20.20	0.22	0.18	0.00	0.00	0.01	10.30	9.49	-0.40	-0.40	0.00
20	Saraburi	64.20	0.69	0.57	0.00	0.01	0.02	32.74	30.17	3.80	3.80	0.00
21	Singburi	66.50	0.71	0.59	0.00	0.01	0.02	33.91	31.26	-1.00	-1.00	0.00
22	Sri Saket	133.10	1.43	1.17	0.01	0.02	0.05	67.87	62.56	7.90	7.89	0.01
23	Supanburi	210.80	2.26	1.86	0.01	0.02	0.08	107.49	99.08	1.40	1.40	0.00
24	Surin	102.90	1.10	0.91	0.01	0.01	0.04	52.47	48.36	5.60	5.60	0.00
25	Ubon Ratchathani	168.90	1.81	1.49	0.01	0.02	0.06	86.13	79.38	9.50	9.49	0.01
26	Utai Thani	3.30	0.04	0.03	0.00	0.00	0.00	1.68	1.55	0.10	0.10	0.00
	TOTAL	**3,497.00**	**37.50**	**30.80**	**0.20**	**0.40**	**1.30**	**1,783.20**	**1,643.60**	**1,983.50**	**1,982.20**	**1.40**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible		Impossible		Impossible	Impossible
	Sell	No	No	No	No	No	No	No		No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None			None		None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		**1.00**	**1.00**

Damage after Implementing Measures
Water and Sanitation Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								Losses		
		Total	Asset damage							Total	Sales losses	
			Water intake structures	Water treatment plants	Conveyance systems	Storage systems	Distribution network	Surface & groundwater systems	Sewage treatment works		Waterworks	Sewer system
1	Ang Thong	50.30	0.54	0.44	0.00	0.01	0.02	25.65	23.64	3.90	3.90	0.00
2	Ayutthaya	264.60	2.84	2.33	0.02	0.03	0.10	134.93	124.36	49.60	49.57	0.04
3	Bangkok	281.90	3.02	2.48	0.02	0.03	0.10	143.75	132.49	1,822.69	1,821.41	1.29
4	Chachoengsao	296.40	3.18	2.61	0.02	0.03	0.11	151.14	139.31	0.40	0.40	0.00
5	Chainat	86.10	0.92	0.76	0.00	0.01	0.03	43.90	40.47	1.40	1.40	0.00
6	Kalasin	121.10	1.30	1.07	0.01	0.01	0.05	61.75	56.92	5.70	5.70	0.00
7	Khon Kaen	267.20	2.87	2.35	0.02	0.03	0.10	136.25	125.58	10.80	10.79	0.01
8	Lopburi	80.00	0.86	0.70	0.00	0.01	0.03	40.79	37.60	7.50	7.50	0.01
9	Mahasarakham	167.10	1.79	1.47	0.01	0.02	0.06	85.21	78.54	7.30	7.30	0.01
10	Nakorn Nayok	24.10	0.26	0.21	0.00	0.00	0.01	12.29	11.33	0.30	0.30	0.00
11	Nakorn Patom	123.30	1.32	1.09	0.01	0.01	0.05	62.87	57.95	-0.70	-0.70	0.00
12	Nakorn Sawan	213.70	2.29	1.88	0.01	0.02	0.08	108.97	100.44	4.90	4.90	0.00
13	Nontaburi	149.40	1.60	1.32	0.01	0.02	0.06	76.18	70.22	0.20	0.20	0.00
14	Patum Thani	103.10	1.11	0.91	0.01	0.01	0.04	52.57	48.46	26.30	26.28	0.02
15	Phitsanulok	185.00	1.98	1.63	0.01	0.02	0.07	94.34	86.95	2.70	2.70	0.00
16	Pichit	117.80	1.26	1.04	0.01	0.01	0.04	60.07	55.37	2.60	2.60	0.00
17	Prachinburi	42.60	0.46	0.38	0.00	0.00	0.02	21.72	20.02	2.30	2.30	0.00
18	Roi Et	153.40	1.64	1.35	0.01	0.02	0.06	78.22	72.10	8.80	8.79	0.01
19	Samut Sakorn	20.20	0.22	0.18	0.00	0.00	0.01	10.30	9.49	-0.40	-0.40	0.00
20	Saraburi	64.20	0.69	0.57	0.00	0.01	0.02	32.74	30.17	3.80	3.80	0.00
21	Singburi	66.50	0.71	0.59	0.00	0.01	0.02	33.91	31.26	-1.00	-1.00	0.00
22	Sri Saket	133.10	1.43	1.17	0.01	0.02	0.05	67.87	62.56	7.90	7.89	0.01
23	Supanburi	210.80	2.26	1.86	0.01	0.02	0.08	107.49	99.08	1.40	1.40	0.00
24	Surin	102.90	1.10	0.91	0.01	0.01	0.04	52.47	48.36	5.60	5.60	0.00
25	Ubon Ratchathani	168.90	1.81	1.49	0.01	0.02	0.06	86.13	79.38	9.50	9.49	0.01
26	Utai Thani	3.30	0.04	0.03	0.00	0.00	0.00	1.68	1.55	0.10	0.10	0.00
	TOTAL	**3,497.00**	**37.50**	**30.80**	**0.20**	**0.40**	**1.30**	**1,783.20**	**1,643.60**	**1,983.60**	**1,982.20**	**1.40**

Table 1-66: Calculating Damage for Protected Assets (Roads and Transport)

Calculation table

Actual damage

Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								
		Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
1	Ang Thong	599.23	0.00	292.23	113.44	87.65	6.62	76.37	22.91	0.00
2	Ayutthya	1448.64	0.00	706.47	274.24	211.90	16.00	184.63	55.39	0.00
3	Bangkok (Note 1)	1749.68	0.00	853.28	331.23	255.93	19.33	223.00	66.90	0.00
4	Chachaengsao	113.45	0.00	55.33	21.48	16.60	1.25	14.46	4.34	0.00
5	Chainat	486.24	0.00	237.13	92.05	71.12	5.37	61.97	18.59	0.00
6	Kalasin	276.64	0.00	134.91	52.37	40.47	3.06	35.26	10.58	0.00
7	Kon Kaen	1207.41	0.00	588.82	228.57	176.61	13.34	153.89	46.17	0.00
8	Lopburi	1582.83	0.00	771.91	299.65	231.53	17.48	201.74	60.52	0.00
9	Mahasarakam	168.12	0.00	81.99	31.83	24.59	1.86	21.43	6.43	0.00
10	Nakhon Nayok	82.97	0.00	40.46	15.71	12.14	0.92	10.57	3.17	0.00
11	Nakhon Pathom	558.21	0.00	272.23	105.67	81.65	6.17	71.15	21.34	0.00
12	Nakhon Sawan	2459.85	0.00	1199.61	465.67	359.81	27.17	313.51	94.05	0.00
13	Nonthaburi	962.28	0.00	469.28	182.17	140.76	10.63	122.65	36.79	0.00
14	Pathum Thani	1570.80	0.00	766.04	297.37	229.77	17.35	200.20	60.06	0.00
15	Pichit	2103.56	0.00	1025.86	398.23	307.70	23.24	268.11	80.43	0.00
16	Pitsanulok	1086.16	0.00	529.70	205.62	158.88	12.00	138.43	41.53	0.00
17	Prachinburi	550.19	0.00	268.31	104.16	80.48	6.08	70.12	21.04	0.00
18	Roi Et	1016.94	0.00	495.94	192.52	148.75	11.23	129.61	38.88	0.00
19	Samut Sakhon	340.13	0.00	165.87	64.39	49.75	3.76	43.35	13.01	0.00
20	Saraburi	1491.95	0.00	727.59	282.44	218.23	16.48	190.15	57.05	0.00
21	Singburi	892.15	0.00	435.08	168.89	130.50	9.85	113.71	34.11	0.00
22	Sisaket	533.80	0.00	260.32	101.05	78.08	5.90	68.03	20.41	0.00
23	Suphanburi	880.69	0.00	429.49	166.72	128.82	9.73	112.25	33.67	0.00
24	Surin	519.93	0.00	253.56	98.43	76.05	5.74	66.27	19.88	0.00
25	Ubon Ratchatani	524.63	0.00	255.85	99.32	76.74	5.80	66.87	20.06	0.00
26	Uthai Thani	331.65	0.00	161.74	62.78	48.51	3.66	42.27	12.68	0.00
	Total	23538.11	0.00	11479.00	4456.00	3443.00	260.00	3000.00	900.00	0.00

	Province	Losses								
		Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
1	Ang Thong	167.69	10.88	83.23	32.31	24.96	0.00	12.69	3.63	0.00
2	Ayutthya	405.28	26.29	201.15	78.09	60.33	0.00	30.67	8.76	0.00
3	Bangkok (Note 1)	842.30	54.63	418.06	162.29	125.39	0.00	63.73	18.21	0.00
4	Chachaengsao	31.74	2.06	15.75	6.12	4.73	0.00	2.40	0.69	0.00
5	Chainat	136.06	8.82	67.53	26.21	20.25	0.00	10.29	2.94	0.00
6	Kalasin	77.38	5.02	38.41	14.91	11.52	0.00	5.86	1.67	0.00
7	Kon Kaen	337.84	21.91	167.68	65.09	50.29	0.00	25.56	7.30	0.00
8	Lopburi	442.79	28.72	219.77	85.31	65.92	0.00	33.50	9.57	0.00
9	Mahasarakam	47.03	3.05	23.34	9.06	7.00	0.00	3.56	1.02	0.00
10	Nakhon Nayok	23.19	1.50	11.51	4.47	3.45	0.00	1.75	0.50	0.00
11	Nakhon Pathom	156.15	10.13	77.50	30.09	23.25	0.00	11.82	3.38	0.00
12	Nakhon Sawan	688.29	44.64	341.62	132.61	102.47	0.00	52.08	14.88	0.00
13	Nonthaburi	269.23	17.46	133.63	51.87	40.08	0.00	20.37	5.82	0.00
14	Pathum Thani	439.48	28.50	218.13	84.67	65.43	0.00	33.25	9.50	0.00
15	Pichit	588.58	38.17	292.13	113.40	87.62	0.00	44.54	12.72	0.00
16	Pitsanulok	303.96	19.71	150.87	58.56	45.25	0.00	23.00	6.57	0.00
17	Prachinburi	153.90	9.98	76.39	29.65	22.91	0.00	11.65	3.33	0.00
18	Roi Et	284.51	18.45	141.21	54.82	42.35	0.00	21.53	6.15	0.00
19	Samut Sakhon	95.12	6.17	47.21	18.33	14.16	0.00	7.20	2.06	0.00
20	Saraburi	417.46	27.08	207.20	80.43	62.15	0.00	31.59	9.03	0.00
21	Singburi	249.67	16.19	123.92	48.10	37.17	0.00	18.89	5.40	0.00
22	Sisaket	149.31	9.68	74.11	28.77	22.23	0.00	11.30	3.23	0.00
23	Suphanburi	246.35	15.98	122.27	47.46	36.67	0.00	18.64	5.33	0.00
24	Surin	145.46	9.43	72.20	28.03	21.65	0.00	11.01	3.14	0.00
25	Ubon Ratchatani	146.74	9.52	72.83	28.27	21.85	0.00	11.10	3.17	0.00
26	Uthai Thani	92.77	6.02	46.04	17.87	13.81	0.00	7.02	2.01	0.00
	Total	6938.29	450.00	3443.70	1336.80	1032.90	0.00	525.00	150.00	0.00

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Assets protected	Move to a safe location						None		Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell								No	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None	0.38	None	0.38	None	None	None	None	None	0.38	None	0.38	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.00**	**0.50**	**0.50**	**0.50**	**0.38**	**0.50**	**0.38**	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**	**0.38**	**1.00**	**0.38**	**0.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.00**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**0.00**

Damage after Implementing Measures

Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage								
		Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
1	Ang Thong	592.14	0.00	292.23	113.44	87.65	5.03	76.37	17.41	0.00
2	Ayutthya	1431.49	0.00	706.47	274.24	211.90	12.16	184.63	42.10	0.00
3	Bangkok (Note 1)	1728.98	0.00	853.28	331.23	255.93	14.69	223.00	50.84	0.00
4	Chachaengsao	112.11	0.00	55.33	21.48	16.60	0.95	14.46	3.30	0.00
5	Chainat	480.49	0.00	237.13	92.05	71.12	4.08	61.97	14.13	0.00
6	Kalasin	273.37	0.00	134.91	52.37	40.47	2.32	35.26	8.04	0.00
7	Kon Kaen	1193.12	0.00	588.82	228.57	176.61	10.14	153.89	35.09	0.00
8	Lopburi	1564.10	0.00	771.91	299.65	231.53	13.29	201.74	46.00	0.00
9	Mahasarakam	166.13	0.00	81.99	31.83	24.59	1.41	21.43	4.89	0.00
10	Nakhon Nayok	81.99	0.00	40.46	15.71	12.14	0.70	10.57	2.41	0.00
11	Nakhon Pathom	551.60	0.00	272.23	105.67	81.65	4.69	71.15	16.22	0.00
12	Nakhon Sawan	2430.74	0.00	1199.61	465.67	359.81	20.65	313.51	71.48	0.00
13	Nonthaburi	950.89	0.00	469.28	182.17	140.76	8.08	122.65	27.96	0.00
14	Pathum Thani	1552.21	0.00	766.04	297.37	229.77	13.19	200.20	45.65	0.00
15	Pichit	2078.67	0.00	1025.86	398.23	307.70	17.66	268.11	61.13	0.00
16	Pitsanulok	1073.31	0.00	529.70	205.62	158.88	9.12	138.43	31.56	0.00
17	Prachinburi	543.68	0.00	268.31	104.16	80.48	4.62	70.12	15.99	0.00
18	Roi Et	1004.91	0.00	495.94	192.52	148.75	8.54	129.61	29.55	0.00
19	Samut Sakhon	336.10	0.00	165.87	64.39	49.75	2.86	43.35	9.88	0.00
20	Saraburi	1474.30	0.00	727.59	282.44	218.23	12.52	190.15	43.36	0.00
21	Singburi	881.59	0.00	435.08	168.89	130.50	7.49	113.71	25.93	0.00
22	Sisaket	527.48	0.00	260.32	101.05	78.08	4.48	68.03	15.51	0.00
23	Suphanburi	870.27	0.00	429.49	166.72	128.82	7.39	112.25	25.59	0.00
24	Surin	513.78	0.00	253.56	98.43	76.05	4.36	66.27	15.11	0.00
25	Ubon Ratchatani	518.42	0.00	255.85	99.32	76.74	4.40	66.87	15.25	0.00
26	Uthai Thani	327.72	0.00	161.74	62.78	48.51	2.78	42.27	9.64	0.00
	Total	23259.60	0.00	11479.00	4456.00	3443.00	197.60	3000.00	684.00	0.00

	Province	Losses								
		Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
1	Ang Thong	165.45	10.88	83.23	32.31	24.96	0.00	12.69	1.38	0.00
2	Ayutthya	399.85	26.29	201.15	78.09	60.33	0.00	30.67	3.33	0.00
3	Bangkok (Note 1)	831.03	54.63	418.06	162.29	125.39	0.00	63.73	6.92	0.00
4	Chachaengsao	31.32	2.06	15.75	6.12	4.73	0.00	2.40	0.26	0.00
5	Chainat	134.23	8.82	67.53	26.21	20.25	0.00	10.29	1.12	0.00
6	Kalasin	76.34	5.02	38.41	14.91	11.52	0.00	5.86	0.64	0.00
7	Kon Kaen	333.32	21.91	167.68	65.09	50.29	0.00	25.56	2.78	0.00
8	Lopburi	436.87	28.72	219.77	85.31	65.92	0.00	33.50	3.64	0.00
9	Mahasarakam	46.40	3.05	23.34	9.06	7.00	0.00	3.56	0.39	0.00
10	Nakhon Nayok	22.88	1.50	11.51	4.47	3.45	0.00	1.75	0.19	0.00
11	Nakhon Pathom	154.06	10.13	77.50	30.09	23.25	0.00	11.82	1.28	0.00
12	Nakhon Sawan	679.08	44.64	341.62	132.61	102.47	0.00	52.08	5.65	0.00
13	Nonthaburi	265.62	17.46	133.63	51.87	40.08	0.00	20.37	2.21	0.00
14	Pathum Thani	433.60	28.50	218.13	84.67	65.43	0.00	33.25	3.61	0.00
15	Pichit	580.70	38.17	292.13	113.40	87.62	0.00	44.54	4.84	0.00
16	Pitsanulok	299.89	19.71	150.87	58.56	45.25	0.00	23.00	2.50	0.00
17	Prachinburi	151.84	9.98	76.39	29.65	22.91	0.00	11.65	1.26	0.00
18	Roi Et	280.70	18.45	141.21	54.82	42.35	0.00	21.53	2.34	0.00
19	Samut Sakhon	93.85	6.17	47.21	18.33	14.16	0.00	7.20	0.78	0.00
20	Saraburi	411.88	27.08	207.20	80.43	62.15	0.00	31.59	3.43	0.00
21	Singburi	246.32	16.19	123.92	48.10	37.17	0.00	18.89	2.05	0.00
22	Sisaket	147.31	9.68	74.11	28.77	22.23	0.00	11.30	1.23	0.00
23	Suphanburi	243.06	15.98	122.27	47.46	36.67	0.00	18.64	2.02	0.00
24	Surin	143.51	9.43	72.20	28.03	21.65	0.00	11.01	1.19	0.00
25	Ubon Ratchatani	144.78	9.52	72.83	28.27	21.85	0.00	11.10	1.21	0.00
26	Uthai Thani	91.53	6.02	46.04	17.87	13.81	0.00	7.02	0.76	0.00
	Total	6845.40	450.00	3443.70	1336.80	1032.90	0.00	525.00	57.00	0.00

Table 1-67: Calculating Damage for Protected Assets (Electricity)

Calculation table
Actual damage
Electricity Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Asset damage			Total	Sales losses		
			Power generation	Transmission facilities	Distribution networks		Power generation	Transmission facilities	Distribution networks
1	Ang Thong	5.51	4.19	0.00	1.32	3.02	0.58	1.11	1.34
2	Ayutthaya	2803.64	2134.19	0.00	669.45	3359.97	641.80	1230.04	1488.11
3	Bangkok	2.80	2.13	0.00	0.67	2262.43	432.15	828.25	1002.02
4	Chachoengsao	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chainat	1.04	0.79	0.00	0.25	0.65	0.12	0.24	0.29
6	Kalasin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Khon Kaen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Lopburi	4.78	3.64	0.00	1.14	2.73	0.52	1.00	1.21
9	Maha Sarakham	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Nakorn Nayok	1.11	0.84	0.00	0.27	0.54	0.10	0.20	0.24
11	Nakorn Patom	1.03	0.78	0.00	0.25	0.56	0.11	0.21	0.25
12	Nakorn Sawan	11.27	8.58	0.00	2.69	6.24	1.19	2.28	2.76
13	Nontaburi	2.63	2.00	0.00	0.63	72.86	13.92	26.67	32.27
14	Patum Thani	310.79	236.58	0.00	74.21	4.06	0.78	1.49	1.80
15	Phitsanulok	0.31	0.24	0.00	0.07	0.21	0.04	0.08	0.09
16	Pichit	0.28	0.21	0.00	0.07	0.20	0.04	0.07	0.09
17	Prachinburi	0.72	0.55	0.00	0.17	0.45	0.09	0.16	0.20
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	0.29	0.22	0.00	0.07	0.16	0.03	0.06	0.07
20	Saraburi	37.76	28.74	0.00	9.02	0.17	0.03	0.06	0.08
21	Singburi	0.30	0.23	0.00	0.07	0.19	0.04	0.07	0.08
22	Si Sa Ket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	1.31	1.00	0.00	0.31	1.07	0.20	0.39	0.47
24	Surin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Ubon Ratchathani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Utai Thani	0.19	0.14	0.00	0.05	0.13	0.02	0.05	0.06
	TOTAL	3185.76	2425.07	0.00	760.69	5715.63	1091.76	2092.42	2531.42

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	0.00	1.00	1.00	0.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	None	0.75	0.75	None	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.00**	**0.75**	**0.75**	**0.00**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**0.00**	**1.00**	**1.00**	**0.00**	**1.00**

Damage after Implementing Measures
Electricity Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Asset damage			Total	Sales losses		
			Power generation	Transmission facilities	Distribution networks		Power generation	Transmission facilities	Distribution networks
1	Ang Thong	4.13	3.15	0.00	0.99	2.54	0.43	1.11	1.00
2	Ayutthaya	2102.73	1600.64	0.00	502.09	2827.47	481.35	1230.04	1116.08
3	Bangkok	2.10	1.60	0.00	0.50	1903.88	324.12	828.25	751.51
4	Chachoengsao	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chainat	0.78	0.59	0.00	0.19	0.55	0.09	0.24	0.22
6	Kalasin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Khon Kaen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Lopburi	3.59	2.73	0.00	0.86	2.30	0.39	1.00	0.91
9	Maha Sarakham	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Nakorn Nayok	0.83	0.63	0.00	0.20	0.45	0.08	0.20	0.18
11	Nakorn Patom	0.77	0.59	0.00	0.18	0.47	0.08	0.21	0.19
12	Nakorn Sawan	8.45	6.43	0.00	2.02	5.25	0.89	2.28	2.07
13	Nontaburi	1.97	1.50	0.00	0.47	61.31	10.44	26.67	24.20
14	Patum Thani	233.09	177.44	0.00	55.66	3.42	0.58	1.49	1.35
15	Phitsanulok	0.23	0.18	0.00	0.06	0.18	0.03	0.08	0.07
16	Pichit	0.21	0.16	0.00	0.05	0.17	0.03	0.07	0.07
17	Prachinburi	0.54	0.41	0.00	0.13	0.38	0.06	0.16	0.15
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	0.22	0.17	0.00	0.05	0.13	0.02	0.06	0.05
20	Saraburi	28.32	21.56	0.00	6.76	0.14	0.02	0.06	0.06
21	Singburi	0.23	0.17	0.00	0.05	0.16	0.03	0.07	0.06
22	Si Sa Ket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	0.98	0.75	0.00	0.23	0.90	0.15	0.39	0.36
24	Surin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Ubon Ratchathani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Utai Thani	0.14	0.11	0.00	0.03	0.11	0.02	0.05	0.04
	TOTAL	2389.32	1818.80	0.00	570.52	4809.81	818.82	2092.42	1898.57

Table 1-68: Calculating Damage for Protected Assets (Telecommunications, Broadcasting, and Postal Services)

Calculation table
Actual damage
Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage					Losses				
		Total	Asset damage				Total	Sales losses			
			Landline communication	Cellular communication	Broadcasting	Postal services		Landline communication	Cellular communication	Broadcasting	Postal services
1	Ang Thong	33.34	19.19	7.26	3.40	3.49	52.09	16.86	18.07	12.63	4.52
2	Ayutthaya	129.80	74.71	28.27	13.22	13.59	202.79	65.63	70.36	49.19	17.61
3	Bangkok	502.07	289.00	109.37	51.15	52.56	784.41	253.84	272.17	190.27	68.13
4	Chachoengsao	40.72	23.44	8.87	4.15	4.26	63.62	20.59	22.07	15.43	5.53
5	Chainat	13.24	7.62	2.88	1.35	1.39	20.69	6.69	7.18	5.02	1.80
6	Kalasin	3.26	1.88	0.71	0.33	0.34	5.10	1.65	1.77	1.24	0.44
7	Khon Kaen	5.67	3.26	1.23	0.58	0.59	8.86	2.87	3.07	2.15	0.77
8	Lopburi	21.94	12.63	4.78	2.23	2.30	34.27	11.09	11.89	8.31	2.98
9	Mahasarakham	4.48	2.58	0.98	0.46	0.47	7.00	2.27	2.43	1.70	0.61
10	Nakorn Nayok	13.14	7.57	2.86	1.34	1.38	20.54	6.65	7.13	4.98	1.78
11	Nakorn Patom	59.04	33.98	12.86	6.01	6.18	92.24	29.85	32.00	22.37	8.01
12	Nakorn Sawan	33.89	19.51	7.38	3.45	3.55	52.94	17.13	18.37	12.84	4.60
13	Nontaburi	135.07	77.75	29.42	13.76	14.14	211.02	68.29	73.22	51.19	18.33
14	Patum Thani	156.47	90.07	34.08	15.94	16.38	244.46	79.11	84.82	59.30	21.23
15	Phitsanulok	7.21	4.15	1.57	0.74	0.76	11.27	3.65	3.91	2.73	0.98
16	Pichit	9.77	5.62	2.13	1.00	1.02	15.27	4.94	5.30	3.70	1.33
17	Prachinburi	11.45	6.59	2.49	1.17	1.20	17.88	5.79	6.20	4.34	1.55
18	Roi Et	5.46	3.15	1.19	0.56	0.57	8.54	2.76	2.96	2.07	0.74
19	Samut Sakorn	12.77	7.35	2.78	1.30	1.34	19.96	6.46	6.92	4.84	1.73
20	Saraburi	15.46	8.90	3.37	1.58	1.62	24.16	7.82	8.38	5.86	2.10
21	Singburi	13.89	8.00	3.03	1.42	1.45	21.71	7.02	7.53	5.27	1.89
22	Sri Saket	1.33	0.77	0.29	0.14	0.14	2.09	0.67	0.72	0.51	0.18
23	Supanburi	55.92	32.19	12.18	5.70	5.85	87.37	28.27	30.31	21.19	7.59
24	Surin	0.52	0.30	0.11	0.05	0.05	0.81	0.26	0.28	0.20	0.07
25	Ubon Ratchathani	0.77	0.44	0.17	0.08	0.08	1.21	0.39	0.42	0.29	0.10
26	Utai Thani	2.93	1.68	0.64	0.30	0.31	4.57	1.48	1.59	1.11	0.40
	TOTAL	1289.63	742.32	280.92	131.39	135.00	2014.84	652.02	699.09	**488.73**	**175.00**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth >	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures
Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage					Losses				
		Total	Asset damage				Total	Sales losses			
			Landline communication	Cellular communication	Broadcasting	Postal services		Landline communication	Cellular communication	Broadcasting	Postal services
1	Ang Thong	25.00	14.39	5.45	2.55	2.62	39.06	12.64	13.55	9.48	3.39
2	Ayutthaya	97.35	56.04	21.21	9.92	10.19	152.09	49.22	52.77	36.89	13.21
3	Bangkok	376.55	216.75	82.02	38.36	39.42	588.31	190.38	204.12	142.70	51.10
4	Chachoengsao	30.54	17.58	6.65	3.11	3.20	47.71	15.44	16.56	11.57	4.14
5	Chainat	9.93	5.72	2.16	1.01	1.04	15.51	5.02	5.38	3.76	1.35
6	Kalasin	2.45	1.41	0.53	0.25	0.26	3.82	1.24	1.33	0.93	0.33
7	Khon Kaen	4.25	2.45	0.93	0.43	0.45	6.64	2.15	2.30	1.61	0.58
8	Lopburi	16.45	9.47	3.58	1.68	1.72	25.70	8.32	8.92	6.23	2.23
9	Mahasarakham	3.36	1.94	0.73	0.34	0.35	5.25	1.70	1.82	1.27	0.46
10	Nakorn Nayok	9.86	5.67	2.15	1.00	1.03	15.40	4.98	5.34	3.74	1.34
11	Nakorn Patom	44.28	25.49	9.65	4.51	4.64	69.18	22.39	24.00	16.78	6.01
12	Nakorn Sawan	25.41	14.63	5.54	2.59	2.66	39.71	12.85	13.78	9.63	3.45
13	Nontaburi	101.30	58.31	22.07	10.32	10.60	158.27	51.22	54.91	38.39	13.75
14	Patum Thani	117.35	67.55	25.56	11.96	12.28	183.35	59.33	63.62	44.47	15.92
15	Phitsanulok	5.41	3.11	1.18	0.55	0.57	8.45	2.74	2.93	2.05	0.73
16	Pichit	7.33	4.22	1.60	0.75	0.77	11.45	3.71	3.97	2.78	0.99
17	Prachinburi	8.58	4.94	1.87	0.87	0.90	13.41	4.34	4.65	3.25	1.16
18	Roi Et	4.10	2.36	0.89	0.42	0.43	6.40	2.07	2.22	1.55	0.56
19	Samut Sakorn	9.58	5.51	2.09	0.98	1.00	14.97	4.84	5.19	3.63	1.30
20	Saraburi	11.60	6.68	2.53	1.18	1.21	18.12	5.86	6.29	4.39	1.57
21	Singburi	10.42	6.00	2.27	1.06	1.09	16.28	5.27	5.65	3.95	1.41
22	Sri Saket	1.00	0.58	0.22	0.10	0.10	1.56	0.51	0.54	0.38	0.14
23	Supanburi	41.94	24.14	9.14	4.27	4.39	65.53	21.20	22.74	15.89	5.69
24	Surin	0.39	0.22	0.08	0.04	0.04	0.61	0.20	0.21	0.15	0.05
25	Ubon Ratchathani	0.58	0.33	0.13	0.06	0.06	0.90	0.29	0.31	0.22	0.08
26	Utai Thani	2.19	1.26	0.48	0.22	0.23	3.43	1.11	1.19	0.83	0.30
	TOTAL	967.22	556.74	210.69	98.54	101.25	1511.13	489.02	524.32	**366.55**	**131.25**

Table 1-69: Calculating Damage for Protected Assets (Health Care and Public Health (Hygiene))

Calculation table
Actual damage
Health Care and Public Health (Hygiene) Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Asset damage			Total	Sales losses		
			Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices
1	Ang Thong	30.90	17.37	13.17	0.36	122.70	50.87	60.07	11.76
2	Ayutthaya	283.30	159.28	120.71	3.31	198.90	82.47	97.38	19.06
3	Bangkok	353.50	198.75	150.62	4.14	550.60	228.29	269.57	52.76
4	Chachoengsao	11.00	6.18	4.69	0.13	74.70	30.97	36.57	7.16
5	Chainat	1.80	1.01	0.77	0.02	41.20	17.08	20.17	3.95
6	Kalasin	0.50	0.28	0.21	0.01	3.50	1.45	1.71	0.34
7	Khon Kaen	3.30	1.86	1.41	0.04	0.00	0.00	0.00	0.00
8	Lopburi	15.10	8.49	6.43	0.18	73.80	30.60	36.13	7.07
9	Mahasarakam	3.70	2.08	1.58	0.04	1.80	0.75	0.88	0.17
10	Nakorn Nayok	3.70	2.08	1.58	0.04	23.90	9.91	11.70	2.29
11	Nakorn Patom	9.20	5.17	3.92	0.11	28.20	11.69	13.81	2.70
12	Nakorn Sawan	109.90	61.79	46.82	1.29	123.40	51.17	60.42	11.83
13	Nontaburi	320.10	179.97	136.38	3.74	373.40	154.82	182.81	35.78
14	Patum Thani	425.70	239.34	181.38	4.98	325.90	135.13	159.56	31.23
15	Phitsanulok	24.70	13.89	10.52	0.29	8.50	3.52	4.16	0.81
16	Pichit	6.30	3.54	2.68	0.07	10.10	4.19	4.94	0.97
17	Prachinburi	1.80	1.01	0.77	0.02	7.10	2.94	3.48	0.68
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	3.80	2.14	1.62	0.04	15.30	6.34	7.49	1.47
20	Saraburi	35.30	19.85	15.04	0.41	17.60	7.30	8.62	1.69
21	Singburi	20.30	11.41	8.65	0.24	53.30	22.10	26.10	5.11
22	Sri Saket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	10.60	5.96	4.52	0.12	30.40	12.60	14.88	2.91
24	Surin	0.80	0.45	0.34	0.01	1.10	0.46	0.54	0.11
25	Ubon Ratchathani	1.80	1.01	0.77	0.02	40.00	16.59	19.58	3.83
26	Utai Thani	6.70	3.77	2.85	0.08	7.40	3.07	3.62	0.71
	TOTAL	**1684.00**	**946.80**	**717.50**	**19.70**	**2133.00**	**884.40**	**1044.30**	**204.40**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.50	0.50	0.50	1.00	1.00	1.00
Assets protected	Move to a safe location	0.38	0.38	0.38	1.00	1.00	1.00
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.38**	**0.38**	**0.38**	**0.75**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.38**	**0.38**	**0.38**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures
Health Care and Public Health (Hygiene) Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Asset damage			Total	Sales losses		
			Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices
1	Ang Thong	23.48	13.20	10.01	0.27	92.03	38.16	45.05	8.82
2	Ayutthaya	215.31	121.05	91.74	2.52	149.18	61.85	73.03	14.30
3	Bangkok	268.66	151.05	114.47	3.14	412.97	171.22	202.18	39.57
4	Chachoengsao	8.36	4.70	3.56	0.10	56.03	23.23	27.43	5.37
5	Chainat	1.37	0.77	0.58	0.02	30.90	12.81	15.13	2.96
6	Kalasin	0.38	0.21	0.16	0.00	2.63	1.09	1.29	0.25
7	Khon Kaen	2.51	1.41	1.07	0.03	0.00	0.00	0.00	0.00
8	Lopburi	11.48	6.45	4.89	0.13	55.35	22.95	27.10	5.30
9	Mahasarakam	2.81	1.58	1.20	0.03	1.35	0.56	0.66	0.13
10	Nakorn Nayok	2.81	1.58	1.20	0.03	17.93	7.43	8.78	1.72
11	Nakorn Patom	6.99	3.93	2.98	0.08	21.15	8.77	10.35	2.03
12	Nakorn Sawan	83.52	46.96	35.59	0.98	92.55	38.37	45.31	8.87
13	Nontaburi	243.28	136.78	103.65	2.85	280.06	116.12	137.11	26.84
14	Patum Thani	323.53	181.90	137.85	3.78	244.44	101.35	119.67	23.42
15	Phitsanulok	18.77	10.55	8.00	0.22	6.38	2.64	3.12	0.61
16	Pichit	4.79	2.69	2.04	0.06	7.58	3.14	3.71	0.73
17	Prachinburi	1.37	0.77	0.58	0.02	5.33	2.21	2.61	0.51
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	2.89	1.62	1.23	0.03	11.48	4.76	5.62	1.10
20	Saraburi	26.83	15.08	11.43	0.31	13.20	5.47	6.46	1.26
21	Singburi	15.43	8.67	6.57	0.18	39.98	16.57	19.57	3.83
22	Sri Saket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	8.06	4.53	3.43	0.09	22.80	9.45	11.16	2.18
24	Surin	0.61	0.34	0.26	0.01	0.83	0.34	0.40	0.08
25	Ubon Ratchathani	1.37	0.77	0.58	0.02	30.00	12.44	14.69	2.87
26	Utai Thani	5.09	2.86	2.17	0.06	5.55	2.30	2.72	0.53
	TOTAL	**1279.69**	**719.48**	**545.24**	**14.97**	**1599.67**	**663.24**	**783.15**	**153.29**

Table 1-70: Calculating Damage for Protected Assets (Housing and Household Goods)

Calculation table
Actual damage
Housing and Household Goods Sector - Total Damage (by Province) [in Thai baht]

	Province	Damage		Losses	
		Inundation/destruction of houses	Inundation damage to household goods	Evacuation expenses	Cleanup expenses
1	Ang Thong	**263,596,605**	**981,101,020**	**1,014,706,272**	**50,704,836**
2	Ayutthaya	**1,294,170,947**	**3,835,439,603**	**4,552,823,011**	**198,221,520**
3	Bangkok	**1,954,019,947**	**14,843,185,266**	**13,159,573,053**	**767,119,039**
4	Chachoengsao	**326,727,732**	**1,198,379,785**	**1,072,425,632**	**61,934,142**
5	Chainat	**106,147,303**	**389,659,610**	**307,313,926**	**20,138,218**
6	Kalasin	**7,886,264**	**96,035,816**	**60,781,746**	**4,963,281**
7	Khon Kaen	**4,460,783**	**166,811,351**	**101,418,740**	**8,621,072**
8	Lopburi	**173,079,512**	**645,544,641**	**498,277,196**	**33,362,757**
9	Mahasarakham	**11,229,093**	**131,949,613**	**89,384,399**	**6,819,362**
10	Nakorn Nayok	**199,611,144**	**386,834,426**	**313,347,540**	**19,992,208**
11	Nakorn Patom	**358,681,824**	**1,737,944,848**	**1,556,109,343**	**89,819,709**
12	Nakorn Sawan	**396,007,505**	**1,005,446,475**	**757,030,699**	**51,539,236**
13	Nontaburi	**654,200,726**	**3,974,928,829**	**3,928,319,660**	**205,430,541**
14	Patum Thani	**1,116,013,729**	**4,616,898,235**	**5,228,136,293**	**238,608,525**
15	Phitsanulok	**44,233,906**	**212,321,607**	**148,331,015**	**10,973,113**
16	Pichit	**62,511,270**	**287,934,620**	**205,633,421**	**14,863,045**
17	Prachinburi	**90,338,776**	**336,854,416**	**259,578,883**	**17,409,163**
18	Roi Et	**19,251,251**	**160,803,432**	**111,139,682**	**8,310,573**
19	Samut Sakorn	**30,860,681**	**378,261,881**	**288,622,666**	**19,549,166**
20	Saraburi	**192,143,896**	**455,055,168**	**345,421,798**	**23,517,963**
21	Singburi	**91,156,043**	**408,865,300**	**349,356,254**	**21,130,798**
22	Sri Saket	**7,056,625**	**39,281,579**	**18,726,302**	**2,030,133**
23	Supanburi	**418,463,976**	**1,645,707,059**	**1,506,432,468**	**85,052,716**
24	Surin	**1,532,403**	**15,251,955**	**8,847,503**	**788,245**
25	Ubon Ratchathani	**2,218,793**	**22,721,005**	**995,815**	**1,174,257**
26	Utai Thani	**22,748,651**	**86,128,026**	**43,212,333**	**4,451,231**
	TOTAL	**7,848,349,383**	**38,059,345,564**	**35,925,945,652**	**1,966,524,852**
			45,907,694,947		37,892,470,504

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.27	0.51	1.00	1.00
Assets protected	Move to a safe location	Impossible	0.39	Impossible	0.75
	Sell	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.21	0.39	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.21**	**0.39**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.27**	**0.39**	**1.00**	**0.75**

Damage after Implementing Measures
Housing and Household Goods Sector - Total Damage (by Province) [in Thai baht]

	Province	Damage		Losses	
		Inundation/destruction of houses	Inundation damage to household goods	Evacuation expenses	Cleanup expenses
1	Ang Thong	**205,019,582**	**750,253,721**	**761,029,704**	**38,028,627**
2	Ayutthaya	**1,006,577,403**	**2,932,983,226**	**3,414,617,258**	**148,666,140**
3	Bangkok	**1,519,793,292**	**11,350,671,086**	**9,869,679,790**	**575,339,279**
4	Chachoengsao	**254,121,569**	**916,408,071**	**804,319,224**	**46,450,607**
5	Chainat	**82,559,013**	**297,974,996**	**230,485,445**	**15,103,664**
6	Kalasin	**6,133,761**	**73,439,153**	**45,586,310**	**3,722,461**
7	Khon Kaen	**3,469,498**	**127,561,621**	**76,064,055**	**6,465,804**
8	Lopburi	**134,617,398**	**493,651,784**	**373,707,897**	**25,022,068**
9	Mahasarakham	**8,733,739**	**100,902,645**	**67,038,299**	**5,114,522**
10	Nakorn Nayok	**155,253,112**	**295,814,561**	**235,010,655**	**14,994,156**
11	Nakorn Patom	**278,974,752**	**1,329,016,648**	**1,167,082,007**	**67,364,782**
12	Nakorn Sawan	**308,005,837**	**768,870,834**	**567,773,024**	**38,654,427**
13	Nontaburi	**508,822,787**	**3,039,651,457**	**2,946,239,745**	**154,072,906**
14	Patum Thani	**868,010,678**	**3,530,569,239**	**3,921,102,220**	**178,956,394**
15	Phitsanulok	**34,404,149**	**162,363,582**	**111,248,261**	**8,229,835**
16	Pichit	**48,619,877**	**220,185,298**	**154,225,066**	**11,147,284**
17	Prachinburi	**70,263,492**	**257,594,553**	**194,684,162**	**13,056,872**
18	Roi Et	**14,973,195**	**122,967,330**	**83,354,762**	**6,232,930**
19	Samut Sakorn	**24,002,752**	**289,259,085**	**216,467,000**	**14,661,875**
20	Saraburi	**149,445,252**	**347,983,364**	**259,066,349**	**17,638,472**
21	Singburi	**70,899,145**	**312,661,700**	**262,017,191**	**15,848,099**
22	Sri Saket	**5,488,486**	**30,038,855**	**14,044,727**	**1,522,600**
23	Supanburi	**325,471,981**	**1,258,481,869**	**1,129,824,351**	**63,789,537**
24	Surin	**1,191,869**	**11,663,260**	**6,635,627**	**591,184**
25	Ubon Ratchathani	**1,725,728**	**17,374,886**	**746,861**	**880,693**
26	Utai Thani	**17,693,395**	**65,862,608**	**32,409,250**	**3,338,423**
	TOTAL	**6,104,271,744**	**29,104,205,433**	**26,944,459,238**	**1,474,893,637**
			35,208,477,177		28,419,352,874

Table 1-71: Calculating Damage for Protected Assets (Education)

Calculation table

Actual damage

Education Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage: Total	Damage: Basic education	Damage: Private education	Damage: Non formal education	Damage: Higher education	Damage: Vocational education	Damage: Non-Ministry of Education agencies	Losses: Total	Losses: Basic education	Losses: Private education	Losses: Non formal education	Losses: Higher education	Losses: Vocational education	Losses: Non-Ministry of Education agencies
1	Ang Thong	16.80	1.50	0.28	0.08	12.10	0.67	2.18	31.50	16.15	1.30	1.47	2.98	6.38	3.24
2	Ayutthaya	932.20	83.07	15.36	4.36	671.56	37.07	120.71	66.00	33.85	2.72	3.08	6.24	13.36	6.79
3	Bangkok	4686.10	417.59	77.20	21.90	3375.89	186.35	606.81	603.40	309.44	24.84	28.19	57.05	122.16	62.09
4	Chachoengsao	59.60	5.31	0.98	0.28	42.94	2.37	7.72	23.20	11.90	0.95	1.08	2.19	4.70	2.39
5	Chainat	34.30	3.06	0.57	0.16	24.71	1.36	4.44	22.10	11.33	0.91	1.03	2.09	4.47	2.27
6	Kalasin	46.40	4.13	0.76	0.22	33.43	1.85	6.01	14.40	7.38	0.59	0.67	1.36	2.92	1.48
7	Khon Kaen	38.20	3.40	0.63	0.18	27.52	1.52	4.95	29.20	14.97	1.20	1.36	2.76	5.91	3.00
8	Lopburi	121.50	10.83	2.00	0.57	87.53	4.83	15.73	45.50	23.33	1.87	2.13	4.30	9.21	4.68
9	Mahasarakham	39.40	3.51	0.65	0.18	28.38	1.57	5.10	14.20	7.28	0.58	0.66	1.34	2.87	1.46
10	Nakorn Nayok	48.40	4.31	0.80	0.23	34.87	1.92	6.27	26.10	13.38	1.07	1.22	2.47	5.28	2.69
11	Nakorn Patom	234.20	20.87	3.86	1.09	168.72	9.31	30.33	40.30	20.67	1.66	1.88	3.81	8.16	4.15
12	Nakorn Sawan	583.20	51.97	9.61	2.73	420.14	23.19	75.52	73.20	37.54	3.01	3.42	6.92	14.82	7.53
13	Nontaburi	155.80	13.88	2.57	0.73	112.24	6.20	20.17	257.80	132.21	10.61	12.04	24.38	52.19	26.53
14	Patum Thani	5480.00	488.33	90.28	25.61	3947.82	217.92	709.62	310.80	159.38	12.79	14.52	29.39	62.92	31.98
15	Phitsanulok	87.20	7.77	1.44	0.41	62.82	3.47	11.29	20.00	10.26	0.82	0.93	1.89	4.05	2.06
16	Pichit	141.50	12.61	2.33	0.66	101.94	5.63	18.32	26.60	13.64	1.09	1.24	2.52	5.39	2.74
17	Prachinburi	87.30	7.78	1.44	0.41	62.89	3.47	11.30	23.70	12.15	0.98	1.11	2.24	4.80	2.44
18	Roi Et	5.60	0.50	0.09	0.03	4.03	0.22	0.73	15.10	7.74	0.62	0.71	1.43	3.06	1.55
19	Samut Sakorn	69.50	6.19	1.14	0.32	50.07	2.76	9.00	20.00	10.26	0.82	0.93	1.89	4.05	2.06
20	Saraburi	34.80	3.10	0.57	0.16	25.07	1.38	4.51	33.80	17.33	1.39	1.58	3.20	6.84	3.48
21	Singburi	25.50	2.27	0.42	0.12	18.37	1.01	3.30	19.70	10.10	0.81	0.92	1.86	3.99	2.03
22	Sri Saket	5.20	0.46	0.09	0.02	3.75	0.21	0.67	11.90	6.10	0.49	0.56	1.13	2.41	1.22
23	Supanburi	52.60	4.69	0.87	0.25	37.89	2.09	6.81	21.60	11.08	0.89	1.01	2.04	4.37	2.22
24	Surin	0.04	0.00	0.00	0.00	0.03	0.00	0.01	3.03	1.55	0.12	0.14	0.29	0.61	0.31
25	Ubon Ratchathani	34.80	3.10	0.57	0.16	25.07	1.38	4.51	19.70	10.10	0.81	0.92	1.86	3.99	2.03
26	Utai Thani	30.80	2.74	0.51	0.14	22.19	1.22	3.99	25.10	12.87	1.03	1.17	2.37	5.08	2.58
	Total	**13051.00**	**1163.00**	**215.00**	**61.00**	**9402.00**	**519.00**	**1690.00**	**1797.90**	**922.00**	**74.00**	**84.00**	**170.00**	**364.00**	**185.00**

Changes in Damage Rates due to Flood Prevention

		Damage						Losses					
Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe locati	0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00
	Sell	No	No	No	No	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Education Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage: Total	Damage: Basic education	Damage: Private education	Damage: Non formal education	Damage: Higher education	Damage: Vocational education	Damage: Non-Ministry of Education agencies	Losses: Total	Losses: Basic education	Losses: Private education	Losses: Non formal education	Losses: Higher education	Losses: Vocational education	Losses: Non-Ministry of Education agencies
1	Ang Thong	8.40	0.75	0.14	0.04	6.05	0.33	1.09	31.52	16.15	1.30	1.47	2.98	6.38	3.24
2	Ayutthaya	466.06	41.54	7.68	2.18	335.78	18.54	60.36	66.04	33.85	2.72	3.08	6.24	13.36	6.79
3	Bangkok	2342.87	208.79	38.60	10.95	1687.94	93.18	303.41	603.77	309.44	24.84	28.19	57.05	122.16	62.09
4	Chachoengsao	29.80	2.66	0.49	0.14	21.47	1.19	3.86	23.21	11.90	0.95	1.08	2.19	4.70	2.39
5	Chainat	17.15	1.53	0.28	0.08	12.35	0.68	2.22	22.11	11.33	0.91	1.03	2.09	4.47	2.27
6	Kalasin	23.20	2.07	0.38	0.11	16.71	0.92	3.00	14.41	7.38	0.59	0.67	1.36	2.92	1.48
7	Khon Kaen	19.10	1.70	0.31	0.09	13.76	0.76	2.47	29.22	14.97	1.20	1.36	2.76	5.91	3.00
8	Lopburi	60.75	5.41	1.00	0.28	43.76	2.42	7.87	45.53	23.33	1.87	2.13	4.30	9.21	4.68
9	Mahasarakham	19.70	1.76	0.32	0.09	14.19	0.78	2.55	14.21	7.28	0.58	0.66	1.34	2.87	1.46
10	Nakorn Nayok	24.20	2.16	0.40	0.11	17.43	0.96	3.13	26.12	13.38	1.07	1.22	2.47	5.28	2.69
11	Nakorn Patom	117.09	10.44	1.93	0.55	84.36	4.66	15.16	40.32	20.67	1.66	1.88	3.81	8.16	4.15
12	Nakorn Sawan	291.58	25.99	4.80	1.36	210.07	11.60	37.76	73.24	37.54	3.01	3.42	6.92	14.82	7.53
13	Nontaburi	77.89	6.94	1.28	0.36	56.12	3.10	10.09	257.96	132.21	10.61	12.04	24.38	52.19	26.53
14	Patum Thani	2739.79	244.17	45.14	12.81	1973.91	108.96	354.81	310.99	159.38	12.79	14.52	29.39	62.92	31.98
15	Phitsanulok	43.60	3.89	0.72	0.20	31.41	1.73	5.65	20.01	10.26	0.82	0.93	1.89	4.05	2.06
16	Pichit	70.74	6.30	1.17	0.33	50.97	2.81	9.16	26.62	13.64	1.09	1.24	2.52	5.39	2.74
17	Prachinburi	43.65	3.89	0.72	0.20	31.45	1.74	5.65	23.71	12.15	0.98	1.11	2.24	4.80	2.44
18	Roi Et	2.80	0.25	0.05	0.01	2.02	0.11	0.36	15.11	7.74	0.62	0.71	1.43	3.06	1.55
19	Samut Sakorn	34.75	3.10	0.57	0.16	25.03	1.38	4.50	20.01	10.26	0.82	0.93	1.89	4.05	2.06
20	Saraburi	17.40	1.55	0.29	0.08	12.54	0.69	2.25	33.82	17.33	1.39	1.58	3.20	6.84	3.48
21	Singburi	12.75	1.14	0.21	0.06	9.19	0.51	1.65	19.71	10.10	0.81	0.92	1.86	3.99	2.03
22	Sri Saket	2.60	0.23	0.04	0.01	1.87	0.10	0.34	11.91	6.10	0.49	0.56	1.13	2.41	1.22
23	Supanburi	26.30	2.34	0.43	0.12	18.95	1.05	3.41	21.61	11.08	0.89	1.01	2.04	4.37	2.22
24	Surin	0.02	0.00	0.00	0.00	0.01	0.00	0.00	3.03	1.55	0.12	0.14	0.29	0.61	0.31
25	Ubon Ratchathani	17.40	1.55	0.29	0.08	12.54	0.69	2.25	19.71	10.10	0.81	0.92	1.86	3.99	2.03
26	Utai Thani	15.40	1.37	0.25	0.07	11.09	0.61	1.99	25.12	12.87	1.03	1.17	2.37	5.08	2.58
	Total	**6524.97**	**581.50**	**107.50**	**30.50**	**4700.98**	**259.50**	**845.00**	**1799.03**	**922.02**	**74.00**	**84.00**	**170.00**	**364.01**	**185.00**

Table 1-72: Calculating Damage for Protected Assets (Cultural and Natural Heritage)

Calculation table

Actual damage

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage: Total	Damage: Heritage structures and sites	Damage: Heritage repositories	Damage: Natural heritage assets	Damage: Intangible cultural heritage assets	Losses: Total	Losses: Heritage structures and sites	Losses: Heritage repositories	Losses: Natural heritage assets	Losses: Intangible cultural heritage assets
1	Ang Thong	94.43	92.30	2.07	0.00	0.00	65.56	13.00	0.09	0.35	52.11
2	Phra Nakhon Si Ayutthaya	64.28	62.83	1.41	0.00	0.00	44.62	8.85	0.06	0.24	35.48
3	Bangkok Metropolis	2824.33	2760.62	61.94	0.00	0.00	1960.70	388.75	2.82	10.41	1558.72
4	Chachoengsao	373.04	364.62	8.18	0.00	0.00	258.97	51.35	0.37	1.38	205.88
5	Chai Nat	58.80	57.47	1.29	0.00	0.00	40.82	8.09	0.06	0.22	32.45
6	Kalasin	7.11	6.95	0.16	0.00	0.00	4.94	0.98	0.01	0.03	3.92
7	Khon Kaen	3.00	2.93	0.07	0.00	0.00	2.08	0.41	0.00	0.01	1.66
8	Lop Buri	2.80	2.74	0.06	0.00	0.00	1.94	0.39	0.00	0.01	1.55
9	Maha Sarakham	312.43	305.38	6.85	0.00	0.00	216.89	43.00	0.31	1.15	172.43
10	Nakhon Nayok	1.10	1.08	0.02	0.00	0.00	0.76	0.15	0.00	0.00	0.61
11	Nakhon Pathom	26.20	25.61	0.57	0.00	0.00	18.19	3.61	0.03	0.10	14.46
12	Nakhon Sawan	6.72	6.57	0.15	0.00	0.00	4.67	0.92	0.01	0.02	3.71
13	Nonthaburi	119.71	117.01	2.63	0.00	0.00	83.10	16.48	0.12	0.44	66.07
14	Pathum Thani	117.73	115.07	2.58	0.00	0.00	81.73	16.20	0.12	0.43	64.97
15	Phitsanulok	5.47	5.35	0.12	0.00	0.00	3.80	0.75	0.01	0.02	3.02
16	Phichit	21.46	20.98	0.47	0.00	0.00	14.90	2.95	0.02	0.08	11.84
17	Prachin Buri	56.42	55.15	1.24	0.00	0.00	39.17	7.77	0.06	0.21	31.14
18	Roi Et	25.76	25.18	0.56	0.00	0.00	17.88	3.55	0.03	0.09	14.22
19	Samut Sakhon	15.75	15.39	0.35	0.00	0.00	10.93	2.17	0.02	0.06	8.69
20	Saraburi	5.84	5.71	0.13	0.00	0.00	4.05	0.80	0.01	0.02	3.22
21	Sing Buri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Si Sa Ket	62.14	60.74	1.36	0.00	0.00	43.14	8.55	0.06	0.23	34.29
23	Suphan Buri	123.05	120.27	2.70	0.00	0.00	85.42	16.94	0.12	0.45	67.91
24	Surin	21.55	21.06	0.47	0.00	0.00	14.96	2.97	0.02	0.08	11.89
25	Ubon Ratchathani	1.40	1.37	0.03	0.00	0.00	0.97	0.19	0.00	0.01	0.77
26	Uthai Thani	81.05	79.22	1.78	0.00	0.00	56.27	11.16	0.08	0.30	44.73
	Total	4431.57	4331.60	97.19	0.00	0.00	3076.48	609.98	4.42	16.34	2445.74

Changes in Damage Rates due to Flood Prevention

		Damage				Losses			
Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe locati	Impossible	0.75	Impossible	Evacuation of performers	Impossible	1.00	1.00	1.00
	Sell	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	No	No	0.75	0.75	No	No
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.75**	**1.00**	**1.00**	**0.75**	**0.75**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**0.75**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage: Total	Damage: Heritage structures and sites	Damage: Heritage repositories	Damage: Natural heritage assets	Damage: Intangible cultural heritage assets	Losses: Total	Losses: Heritage structures and sites	Losses: Heritage repositories	Losses: Natural heritage assets	Losses: Intangible cultural heritage assets
1	Ang Thong	70.78	69.22	1.55	0.00	0.00	62.28	9.75	0.07	0.35	52.11
2	Phra Nakhon Si Ayutthaya	48.18	47.12	1.06	0.00	0.00	42.40	6.64	0.05	0.24	35.48
3	Bangkok Metropolis	2116.92	2070.46	46.46	0.00	0.00	1862.81	291.56	2.11	10.41	1558.72
4	Chachoengsao	279.60	273.47	6.14	0.00	0.00	246.04	38.51	0.28	1.38	205.88
5	Chai Nat	44.07	43.11	0.97	0.00	0.00	38.78	6.07	0.04	0.22	32.45
6	Kalasin	5.33	5.21	0.12	0.00	0.00	4.69	0.73	0.01	0.03	3.92
7	Khon Kaen	2.25	2.20	0.05	0.00	0.00	1.98	0.31	0.00	0.01	1.66
8	Lop Buri	2.10	2.05	0.05	0.00	0.00	1.85	0.29	0.00	0.01	1.55
9	Maha Sarakham	234.18	229.04	5.14	0.00	0.00	206.07	32.25	0.23	1.15	172.43
10	Nakhon Nayok	0.82	0.81	0.02	0.00	0.00	0.73	0.11	0.00	0.00	0.61
11	Nakhon Pathom	19.64	19.21	0.43	0.00	0.00	17.28	2.70	0.02	0.10	14.46
12	Nakhon Sawan	5.04	4.93	0.11	0.00	0.00	4.43	0.69	0.01	0.02	3.71
13	Nonthaburi	89.73	87.76	1.97	0.00	0.00	78.96	12.36	0.09	0.44	66.07
14	Pathum Thani	88.24	86.31	1.94	0.00	0.00	77.65	12.15	0.09	0.43	64.97
15	Phitsanulok	4.10	4.01	0.09	0.00	0.00	3.61	0.56	0.00	0.02	3.02
16	Phichit	16.08	15.73	0.35	0.00	0.00	14.15	2.22	0.02	0.08	11.84
17	Prachin Buri	42.29	41.36	0.93	0.00	0.00	37.21	5.82	0.04	0.21	31.14
18	Roi Et	19.31	18.88	0.42	0.00	0.00	16.99	2.66	0.02	0.09	14.22
19	Samut Sakhon	11.81	11.55	0.26	0.00	0.00	10.39	1.63	0.01	0.06	8.69
20	Saraburi	4.38	4.28	0.10	0.00	0.00	3.85	0.60	0.00	0.02	3.22
21	Sing Buri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Si Sa Ket	46.58	45.55	1.02	0.00	0.00	40.98	6.41	0.05	0.23	34.29
23	Suphan Buri	92.23	90.21	2.02	0.00	0.00	81.16	12.70	0.09	0.45	67.91
24	Surin	16.15	15.80	0.35	0.00	0.00	14.21	2.22	0.02	0.08	11.89
25	Ubon Ratchathani	1.05	1.03	0.02	0.00	0.00	0.92	0.14	0.00	0.01	0.77
26	Uthai Thani	60.75	59.42	1.33	0.00	0.00	53.46	8.37	0.06	0.30	44.73
	Total	3321.59	3248.70	72.89	0.00	0.00	2922.88	457.49	3.32	16.34	2445.74

Table 1-73: Calculating Damage for Protected Assets (Natural Environment and Waste Management)

Calculation table

Actual damage

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Municipal solid waste	Biodiversity	Industrial waste	Total	Municipal solid waste	Biodiversity	Industrial waste
1	Ang Thong	3.21	0.29	0.11	2.81	1.20	0.69	0.44	0.08
2	Ayutthaya	209.00	18.95	7.24	182.78	10.12	5.82	3.69	0.63
3	Bangkok	19.80	1.79	0.69	17.32	88.30	50.78	32.18	5.53
4	Chachoengsao	1.00	0.09	0.03	0.87	15.91	9.15	5.80	1.00
5	Chainat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Kalasin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Khon Kaen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Lopburi	29.88	2.71	1.04	26.13	0.96	0.55	0.35	0.06
9	Mahasarakham	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Nakorn Nayok	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Nakorn Patom	11.07	1.00	0.38	9.68	0.36	0.21	0.13	0.02
12	Nakorn Sawan	1.81	0.16	0.06	1.58	4.92	2.83	1.79	0.31
13	Nontaburi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Patum Thani	30.95	2.81	1.07	27.07	2.86	1.64	1.04	0.18
15	Phitsanulok	14.66	1.33	0.51	12.82	8.04	4.62	2.93	0.50
16	Pichit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Prachinburi	43.22	3.92	1.50	37.80	1.42	0.82	0.52	0.09
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	1.50	0.14	0.05	1.31	41.21	23.70	15.02	2.58
20	Saraburi	3.13	0.28	0.11	2.74	0.10	0.06	0.04	0.01
21	Singburi	5.83	0.53	0.20	5.10	0.19	0.11	0.07	0.01
22	Sri Saket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Surin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Ubon Ratchathani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Utai Thani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**375.06**	**34.00**	**13.00**	**328.00**	**175.61**	**101.00**	**64.00**	**11.00**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe locati	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	No	0.75	0.75	No	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**1.00**	**0.75**	**0.75**	**1.00**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai baht, millions]

	Province	Damage				Losses			
		Total	Municipal solid waste	Biodiversity	Industrial waste	Total	Municipal solid waste	Biodiversity	Industrial waste
1	Ang Thong	2.43	0.22	0.11	2.11	1.01	0.52	0.44	0.06
2	Ayutthaya	158.54	14.21	7.24	137.08	8.53	4.37	3.69	0.48
3	Bangkok	15.02	1.35	0.69	12.99	74.42	38.09	32.18	4.15
4	Chachoengsao	0.76	0.07	0.03	0.66	13.41	6.86	5.80	0.75
5	Chainat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Kalasin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Khon Kaen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Lopburi	22.67	2.03	1.04	19.60	0.81	0.41	0.35	0.05
9	Mahasarakham	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Nakorn Nayok	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Nakorn Patom	8.40	0.75	0.38	7.26	0.30	0.16	0.13	0.02
12	Nakorn Sawan	1.37	0.12	0.06	1.19	4.15	2.12	1.79	0.23
13	Nontaburi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Patum Thani	23.48	2.10	1.07	20.30	2.41	1.23	1.04	0.13
15	Phitsanulok	11.12	1.00	0.51	9.62	6.78	3.47	2.93	0.38
16	Pichit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Prachinburi	32.78	2.94	1.50	28.35	1.20	0.61	0.52	0.07
18	Roi Et	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Samut Sakorn	1.14	0.10	0.05	0.98	34.73	17.78	15.02	1.94
20	Saraburi	2.37	0.21	0.11	2.05	0.08	0.04	0.04	0.00
21	Singburi	4.42	0.40	0.20	3.82	0.16	0.08	0.07	0.01
22	Sri Saket	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Supanburi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Surin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Ubon Ratchathani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Utai Thani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**284.50**	**25.50**	**13.00**	**246.00**	**147.98**	**75.74**	**63.99**	**8.25**

(2) Comparison of Damage before and after Implementing Preventive Measures

Learning the estimated date and time of a flood's arrival via flood forecasting and warning systems will enable residents to protect their assets. They can prevent inundation by installing waterstops, mobile levees, and sandbags around their houses and other assets. Residents can also move their assets to upper floors or higher ground, or sell them before the flood arrives so they can prevent them from depreciating in value.

We regarded the difference between the estimated cost of damage after implementing preventive measures and the actual cost of damage (calculated in the previous section) as the amount of damage mitigated due to forecasting and warning systems.

We estimated the amount of damage mitigated due to forecasting and warning systems for each sector as described below.

1) Agriculture, Forestry, and Fisheries

In estimating damage to facilities and equipment (depreciable assets), we assumed that damage to equipment and buildings could be reduced by installing waterstops, mobile levees, and sandbags once people learned the estimated date and time of a flood's arrival via forecasting and warning systems. We assumed that it would be impossible to install mobile levees and sandbags around irrigation and drainage systems as well as plantations due to the expansive nature of these assets, so implementing such measures would not mitigate damage.

As a result, damage to facilities and equipment (depreciable assets) is estimated to decline from 5,666 [million baht] to 4,414 [million baht] (see Table 1-74).

Table 1-74: Reduction of Damage to Facilities and Equipment (Depreciable Assets)

Actual damage

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage							
	Total	Crops				Livestock		Fishery machinery
		Irrigation and drainage systems	Agricultural machinery and equipment	Storage and buildings	Farms and plantations	Livestock barns and related equipment	Poultry barns and related equipment	Hatcheries and machinery
Total	5,666	283	4,252	511	138	11	333	137

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.50	1.00	0.50	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	0.75	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	0.75	0.40	None	0.75	0.75	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.50**	**0.75**	**0.40**	**1.00**	**0.75**	**0.75**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.50**	**0.75**	**0.50**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage							
	Total	Crops				Livestock		Fishery machinery
		Irrigation and drainage systems	Agricultural machinery and equipment	Storage and buildings	Farms and plantations	Aquaculture livestock	Poultry barns and machinery	Hatcheries and machinery
Total	4,414	283	3,189	409	138	8	250	137

When calculating losses related to products (inventory assets), we assumed that damage to products (crops, livestock, fishery products) can be reduced by moving them to upper floors or higher ground or by selling them after learning the estimated date and time of a flood's arrival via forecasting and warning systems. Whether or not products could be moved to upper floors or higher ground or sold was determined on the basis of the 2011 flood data we looked at in 1.4.2 .

As a result, damage to products (inventory assets) would decline from 34,715 [million baht] to 27,971 [million baht] (see Table 1-75).

Table 1-75: Reduction of Losses in Products (Inventory Assets)

Actual damage

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses (2011 - 2014)														
	Total	Total	Crops						Livestock				Fisheries			
			Rice	Sugarcane	Fruit trees	Flowers	Maize	Other	Poultry	Swine	Cattle	Other	Tilapia	Catfish	Shrimp	Striped snakehead fish (food fish)
Total	5,666	34,715	26,645	288	3,840	144	16	202	1,159	46	1,496	70	319	256	234	1

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.74	0.91	0.91	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	0.15	0.15	0.15	0.15	Impossible	Impossible	Impossible	Impossible
	Sell	0.62	0.71	No	No	0.71	No	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.62**	**0.71**	**0.91**	**0.91**	**0.71**	**0.91**	**0.15**	**0.15**	**0.15**	**0.15**	**1.00**	**1.00**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.62**	**0.71**	**0.91**	**0.91**	**0.71**	**0.91**	**0.15**	**0.15**	**0.15**	**0.15**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Agriculture, Forestry, and Fisheries Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses (2011 - 2014)														
	Total	Total	Crops						Livestock				Fisheries			
			Rice	Sugarcane	Fruit trees	Flowers	Maize	Other	Poultry	Swine	Cattle	Other	Tilapia	Catfish	Shrimp	Striped snakehead fish (food fish)
Total	4,414	27,971	22,323	225	3,840	144	12	202	174	7	224	10	319	256	234	1

2) Industry

In estimating damage to facilities and equipment (depreciable assets) and products (inventory assets), we assumed that damage to equipment and buildings could be reduced by installing waterstops, mobile levees, and sandbags after learning the estimated date and time of a flood's arrival via forecasting and warning systems. We assumed that damage to inventory assets as well as equipment and machinery could be reduced since they could be moved to upper floors or higher ground before a flood arrives.

As a result, damage to facilities and equipment (depreciable assets) and products (inventory assets) is estimated to decline from 513,881 [million baht] to 387,229 [million baht] (see Table 1-76).

Table 1-76: Reduction of Damage to Facilities/Equipment (Depreciable Assets) and Products (Inventory Assets)

Actual damage

Industry Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage						Losses
	Total	Asset damage					Total (losses due to suspended
		Fixed assets	nventory asset	Buildings	ment and mac	utdoor facilitie	
Total	**513,881**	**2,512**	**439,198**	**27,117**	**29,353**	**15,701**	**493,258**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.79	0.59	0.27	0.79	0.79	1.00
Assets protected	Move to a safe location	Impossible	0.45	Impossible	0.45	Impossible	Impossible
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	0.21	None	0.60	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.79**	**0.45**	**0.21**	**0.45**	**0.60**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.79**	**0.45**	**0.27**	**0.45**	**0.79**	**1.00**

Damage after Implementing Measures

Industry Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage						Losses
	Total	Asset damage					Total (losses due to suspended
		Fixed assets	nventory asset	Buildings	ment and mac	utdoor facilitie	
Total	**387,229**	**2,512**	**334,982**	**21,091**	**16,720**	**11,925**	**369,944**

In estimating losses due to suspended operations, we assumed that losses could be reduced by installing waterstops, mobile levees, and sandbags since supplying products could be resumed once the floodwaters receded although expanding inundation would inevitably disrupt supply chains. As a result, losses due to suspended operations can be reduced from 493,258 to 369,944 [million baht] (see Table 1-76).

3) Tourism

In estimating damage to depreciable assets including lodging, food services, and entertainment facilities, we assumed that damage to facilities and buildings could be reduced by installing waterstops, mobile levees, and sandbags after learning the estimated date and time of a flood's arrival via forecasting and warning systems.

As a result, damage to depreciable assets including lodging, food services, and entertainment facilities is estimated to decline from 5,134 [million baht] to 3,908 [million baht] (see Table 1-77).

Table 1-77: Reduction of Damage to the Tourism Sector

Actual damage
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage							
	Total	Asset damage						
		Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
Total	5,134.40	978.70	1,004.20	1,338.90	1,004.20	0.00	2.10	806.30

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.79	0.59	0.59	0.79	0.00	0.79	0.79
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	None	Impossible
	Sell	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.60	0.45	0.45	0.60	None	None	0.60
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.60**	**0.45**	**0.45**	**0.60**	**0.00**	**0.79**	**0.60**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.79**	**0.59**	**0.59**	**0.79**	**0.00**	**0.79**	**0.79**

Damage after Implementing Measures
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage							
	Total	Asset damage						
		Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
Total	3,907.59	743.32	765.92	1,021.19	762.68	0.00	2.10	612.38

We assumed that there would be no difference in losses incurred due to suspended operations since expanding inundation would inevitably cut off supply chains and adversely affect customer traffic.

As a result, losses due to suspended operations would remain the same at 89,673 [million baht] (see

Table 1-78).

Table 1-78: Reduction of Losses in the Tourism Sector

Actual damage
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses								
	Total	Total	Sales losses							
				Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
Total	5,134.40	77,639.00	21,476.80	13,537.10	25,270.30	13,798.70	4,586.40	8,477.00	2,527.10

Changes in Damage Rates due to Flood Prevention

		Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	None	Impossible
	Sell	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	1.00	1.00	1.00	1.00	None	None	1.00
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures
Tourism Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses								
	Total	Total	Sales losses							
				Lodging	Food and beverage	Shopping	Entertainment	Sightseeing	Tour operations	Other
Total	3,907.59	89,673.40	21,476.80	13,537.10	25,270.30	13,798.70	4,586.40	8,477.00	2,527.10

4) Financial and Insurance

We assumed that damage to assets owned by banks, leasing companies, credit card companies, cooperatives, and insurance companies could be reduced by moving them to upper floors or installing waterstops, mobile levees, and sandbags after learning the estimated date and time of a flood's arrival via forecasting and warning systems.

As a result, damage to depreciable assets is estimated to decline from 943 [million baht] to 719 [million baht] (see Table 1-79).

Table 1-79: Reduction of Damage to the Financial and Insurance Sector

Actual damage
Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

Province	Damage							
	Total	Asset damage						
		Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
TOTAL	943.00	0.00	0.00	0.00	0.00	0.00	943.00	0.00

Changes in Damage Rates due to Flood Prevention

		Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
Assets unprotected		0.59	0.59	0.59	0.59	0.59	0.59	0.59
Assets protected	Move to a safe locati	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	Sell	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**

Damage after Implementing Measures
Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

Province	Damage							
	Total	Asset damage						
		Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
TOTAL	719.24	0.00	0.00	0.00	0.00	0.00	719.24	0.00

In estimating sales losses due to suspended operations, we assumed that operations could be continued by moving depreciable assets to upper floors and installing waterstops, mobile levees, and sandbags to prevent inundation.

As a result, sales losses are estimated to decline from 115,276 [million baht] to 87,922 [million baht] (see Table 1-80).

Table 1-80: Reduction of Losses in the Financial and Insurance Sector

Actual damage

Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

Province	Damage	Losses							
	Total	Total	Sales losses						
			Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
TOTAL	943.00	115,276.00	20,685.00	67,197.00	0.00	2,514.00	8,153.00	7,587.00	9,140.00

Changes in Damage Rates due to Flood Preventio 115276.00

Assets unprotected		0.59	0.59	0.59	0.59	0.59	0.59	0.59
Assets protected	Move to a safe location	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	Sell	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**

Damage after Implementing Measures

Financial and Insurance Sector - Total Damage in the (by Province) [Thai baht, millions]

Province	Damage	Losses							
	Total	Total	Sales losses						
			Commercial banks	Specialized financial	Leasing companies	Credit card companies	Municipal funds	Cooperatives	Insurance sector
TOTAL	719.24	87,922.37	15,776.69	51,251.95	0.00	1,917.46	6,218.39	5,786.69	6,971.19

5) Flood Control, Drainage, and Irrigation

When it comes to damage to flood control, drainage, and irrigation facilities, operators would not take preventive measures like moving assets to upper floors or installing waterstops, mobile levees, and sandbags in an attempt to maintain effective operations even after learning the estimated date and time of a flood's arrival via forecasting and warning systems. In light of this, we assumed that damage to these assets would be the same as the damage actually incurred (see

Table 1-81).

Table 1-81: Reduction of Damage to the Flood Control, Drainage, and Irrigation Sector

Actual damage

Flood Control, Drainage, and Irrigation Sector - Total Damage (by Prefecture) [in Thai baht, millions]

Province	Damage	Losses
	Total	Total
TOTAL	8715.00	0.00

Changes in Damage Rates due to Flood Prevention

		Flood control facilities	Drainage facilities	Irrigation facilities
Assets unprotected		0.30	0.30	0.30
Assets protected	Move to a safe location	Impossible	Impossible	Impossible
	Sell	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.30**	**0.30**	**0.30**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.30**	**0.30**	**0.30**

Damage after Implementing Measures

Flood Control, Drainage, and Irrigation Sector - Total Damage (by Prefecture) [in Thai baht, millions]

Province	Damage	Losses
	Total	Total
TOTAL	8715.00	0.00

6) Water and Sanitation

Water and sanitation facilities cannot be protected by moving them to upper floors or by waterstops, mobile levees, and sandbags installed after their operators have learned the date and time of a flood's arrival via forecasting and warning systems. In light of this, we assumed that the water and sanitation sector would suffer the same damage and sales losses actually incurred. (see Table 1-82).

Table 1-82: Reduction of Damage to the Water and Sanitation Sector

Actual damage

Water and Sanitation Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage								Losses		
	Total	Asset damage							Total	Sales losses	
		Water intake structures	Water treatment plants	Conveyance systems	Storage systems	Distribution network	Surface & groundwater systems	Sewage treatment works		Waterworks	Sewer system
TOTAL	3,497.00	37.50	30.80	0.20	0.40	1.30	1,783.20	1,643.60	1,983.50	1,982.20	1.40

Changes in Damage Rates due to Flood Prevention

		Water intake structures	Water treatment plants	Conveyance systems	Storage systems	Distribution network	Surface & groundwater systems	Sewage treatment works	Losses Total	Waterworks	Sewer system
Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible		Impossible		Impossible	Impossible
	Sell	No	No	No	No	No	No	No		No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None			None		None	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		**1.00**	**1.00**

Damage after Implementing Measures

Water and Sanitation Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage								Losses		
	Total	Asset damage							Total	Sales losses	
		Water intake structures	Water treatment plants	Conveyance systems	Storage systems	Distribution network	Surface & groundwater systems	Sewage treatment works		Waterworks	Sewer system
TOTAL	3,497.00	37.50	30.80	0.20	0.40	1.30	1,783.20	1,643.60	1,983.60	1,982.20	1.40

7) Roads and Transport

In estimating damage to the expansive infrastructure of expressways, major roads, and railroads, we assumed that no flood prevention measures would be taken even after learning the estimated date and time of a flood's arrival. It would be too difficult to install waterstops, mobile levees, and sandbags along the entire stretch of any of these structures. On the other hand, we assumed that damage to facilities with more limited boundaries, like truck terminals and airports, could be reduced by installing waterstops, mobile levees, and sandbags.

As a result, damage to the road and transport sector is estimated to decline from 23,538 [million baht] to 23,260 [million baht] (see Table 1-83).

Table 1-83: Reduction of Damage to the Roads and Transport Sector

Actual damage

Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage								
	Total	Roads					Railways	Civil aviation	Inland water
		Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
Total	23538.11	0.00	11479.00	4456.00	3443.00	260.00	3000.00	900.00	0.00

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Assets protected	Move to a safe location						None		Impossible
	Sell								No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None	0.38	None	0.38	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.00**	**0.50**	**0.50**	**0.50**	**0.38**	**0.50**	**0.38**	**0.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.00**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.00**

Damage after Implementing Measures

Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage								
	Total	Roads					Railways	Civil aviation	Inland water
		Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
Total	23259.60	0.00	11479.00	4456.00	3443.00	197.60	3000.00	684.00	0.00

We assumed that losses due to suspended operations could be reduced because facilities whose boundaries were limited, such as truck terminals and airports, could continue to operate. Losses related to other infrastructure systems were estimated to be the same as the actual loss figures.

As a result, losses due to suspended operations are estimated to decline from 6,938 to 6,845 [million baht] (see

Table 1-84).

Table 1-84: Reduction of Losses in the Roads and Transport Sector

Actual damage
Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses								
	Total	Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
Total	23538.11	6938.29	450.00	3443.70	1336.80	1032.90	0.00	525.00	150.00	0.00

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	None	None	None	None	0.38	None	0.38	None
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**1.00**	**1.00**	**1.00**	**1.00**	**0.38**	**1.00**	**0.38**	**0.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**0.00**

Damage after Implementing Measures
Roads and Transport Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses								
	Total	Total	Roads					Railways	Civil aviation	Inland water
			Expressways	DOH	DRR	Local	Truck terminal	Railways	Civil Aviation	Inland Water
Total	23259.60	6845.40	450.00	3443.70	1336.80	1032.90	0.00	525.00	57.00	0.00

8) Electricity

In estimating damage to expansive infrastructure systems like transmission facilities (towers and transmission lines), we assumed that no flood prevention measures would be taken even after learning the estimated date and time of a flood's arrival due to the difficulty of installing waterstops, mobile levees, and sandbags along the entire stretch of any one of these infrastructure systems. On the other hand, we assumed that damage to facilities whose boundaries were more limited, such as truck terminals and airports, could be reduced by installing waterstops, mobile levees, and sandbags.

As a result, damage to the electricity sector is estimated to decline from 3,186 [million baht] to 2,389 [million baht] (see Table 1-85).

Table 1-85: Reduction of Damage to the Electricity Sector

Actual damage
Electricity Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				Losses			
	Total	Asset damage			Total	Sales losses		
		Power generation	Transmission facilities	Distribution networks		Power generation	Transmission facilities	Distribution networks
TOTAL	3185.76	2425.07	0.00	760.69	5715.63	1091.76	2092.42	2531.42

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	0.00	1.00	1.00	0.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	None	0.75	0.75	None	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.00**	**0.75**	**0.75**	**0.00**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**0.00**	**1.00**	**1.00**	**0.00**	**1.00**

Damage after Implementing Measures
Electricity Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				Losses			
	Total	Asset damage			Total	Sales losses		
		Power generation	Transmission facilities	Distribution networks		Power generation	Transmission facilities	Distribution networks
TOTAL	2389.32	1818.80	0.00	570.52	4809.81	818.82	2092.42	1898.57

We assumed that losses due to suspended operations could be reduced because facilities whose boundaries were limited, such as power generation and distribution facilities, could continue to operate. Losses related to other infrastructure systems were estimated to be the same as the actual loss figures.

As a result, losses due to suspended operations are estimated to decline from 5,716 to 4,810 [million baht] (see Table 1-85).

9) Telecommunications, Broadcasting, and Postal Services

We assumed that the landline communications sector could mitigate damage by installing waterstops, mobile levees, and sandbags to protect modular jacks and plugs used by households and businesses from inundation. We assumed that the cellular communications sector could mitigate damage by installing waterstops, mobile levees, and sandbags around base stations. We assumed that the broadcasting sector could mitigate damage by installing waterstops, mobile levees, and sandbags around base stations and relay broadcast stations. We assumed that the postal services sector could mitigate damage by installing waterstops, mobile levees, and sandbags to protect counter service facilities and buildings.

As a result, damage to the telecommunications, broadcasting, and postal services sector is estimated to decline from 1,290 [million baht] to 967 [million baht] (see Table 1-86).

Table 1-86: Reduction of Damage to the Telecommunications, Broadcasting, and Postal Services Sector

Actual damage

Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage					Losses				
	Total	Asset damage				Total	Sales losses			
		Landline communication	Cellular communication	Broadcasting	Postal services		Landline communication	Cellular communication	Broadcasting	Postal services
TOTAL	1289.63	742.32	280.92	131.39	135.00	2014.84	652.02	699.09	**488.73**	**175.00**

Changes in Damage Rates due to Flood Prevention

		Landline communication	Cellular communication	Broadcasting	Postal services	Landline communication	Cellular communication	Broadcasting	Postal services
Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible	Impossible
	Sell	No	No	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Telecommunications, Broadcasting, and Postal Services Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage					Losses				
	Total	Asset damage				Total	Sales losses			
		Landline communication	Cellular communication	Broadcasting	Postal services		Landline communication	Cellular communication	Broadcasting	Postal services
TOTAL	967.22	556.74	210.69	98.54	101.25	1511.13	489.02	524.32	**366.55**	**131.25**

We assumed that losses due to suspended operations could be reduced since operations could be sustained by installing waterstops, mobile levees, and sandbags to protect the above-mentioned facilities and equipment from inundation.

As a result, losses due to suspended operations are estimated to decline from 2,015 to 1,511 [million baht] (see Table 1-86).

10) Health Care and Public Health (Hygiene)

According to the Guidelines for Flood Damage Index Analysis (draft, March 2013), floodwaters will reach floor level at a water depth of 0.5 m and power outages will occur at an inundation depth of 0.7 m due to submersion of electrical outlets. In light of this, we assumed that damage would cost the health care and public health sector 100% of the value of its assets in basements and on first floors once the inundation depth exceeded 1.0 m. The value of assets in basements and on first floors was assumed to be 0.50 of the total asset value. We also assumed that about half of the assets in basements and on first floors could be moved to upper floors. We also assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage.

As a result, damage to the health care and public health (hygiene) sector is estimated to decline from 1,684 [million baht] to 1,280 [million baht] (see Table 1-87).

Table 1-87: Reduction of Damage to the Health Care and Public Health (Hygiene) Sector

Actual damage

Health Care and Public Health (Hygiene) Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				Losses			
	Total	Asset damage			Total	Sales losses		
		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices
TOTAL	1684.00	946.80	717.50	19.70	2133.00	884.40	1044.30	204.40

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.50	0.50	0.50	1.00	1.00	1.00
Assets protected	Move to a safe location	0.38	0.38	0.38	1.00	1.00	1.00
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.38**	**0.38**	**0.38**	**0.75**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.38**	**0.38**	**0.38**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Health Care and Public Health (Hygiene) Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				Losses			
	Total	Asset damage			Total	Sales losses		
		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices		Hospitals	Health centers and private medical/dental clinics	Provincial/district health offices
TOTAL	1279.69	719.48	545.24	14.97	1599.67	663.24	783.15	153.29

In estimating sales losses in the health care sector, we assumed that all facilities would lose power unless flood prevention measures were taken, so we set the sales loss rate at 100% even if assets in basements and on first floors were moved to upper floors. We assumed that the damage rate for health care facilities would be 50% if measures to prevent inundation were taken and power outages were avoided, so hospitalized patients would be protected.

As a result, losses due to suspended operations are estimated to decline from 2,133 to 1,600 [million baht] (see Table 1-87).

11) Housing and Household Goods

We used the damage rates provided in the Manual for Economic Analysis of Flood Control Measures (draft, April 2005) for the housing and household goods sector. We assumed that about half of assets in basements and on first floors could be moved to upper floors. We also assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage.

As a result, damage to the housing and household goods sector is estimated to decline from 45,908 [million baht] to 35,208 [million baht] (see

Table 1-88).

Table 1-88: Reduction of Damage to the Housing and Household Goods Sector

Actual damage

Housing and Household Goods Sector - Total Damage (by Province) [in Thai baht]

Province	Damage		Losses	
	Inundation/destruction of houses	Inundation damage to household goods	Evacuation expenses	Cleanup expenses
TOTAL	**7,848,349,383**	**38,059,345,564**	**35,925,945,652**	**1,966,524,852**
		45,907,694,947		37,892,470,504

Changes in Damage Rates due to Flood Prevention

Assets unprotected		0.27	0.51	1.00	1.00
Assets protected	Move to a safe location	Impossible	0.39	Impossible	0.75
	Sell	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.21	0.39	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.21**	**0.39**	**0.75**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.27**	**0.39**	**1.00**	**0.75**

Damage after Implementing Measures

Housing and Household Goods Sector - Total Damage (by Province) [in Thai baht]

Province	Damage		Losses	
	Inundation/destruction of houses	Inundation damage to household goods	Evacuation expenses	Cleanup expenses
TOTAL	**6,104,271,744**	**29,104,205,433**	**26,944,459,238**	**1,474,893,637**
		35,208,477,177		28,419,352,874

We assumed that losses in the housing and household goods sector would decline by up to 50% due to the fact that losses include evacuation and cleanup expenses and that neither evacuation nor cleanup would be necessary if inundation was prevented.

As a result, losses in the housing and household goods sector would decline from 37,892 [million baht] to 28,419 [million baht] (see

Table 1-88).

12) Education

Damage to the education sector included buildings, equipment and supplies (textbooks, desks, chairs, blackboards, windows, doors, laboratory instruments, personal computers, etc.). We assumed that all these items, except for the buildings, could be moved to upper floors. Damage to buildings was assumed to be 0.5 of the total damage. We also assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage. As a result, damage to the education sector is estimated to decline from 13,051 [million baht] to 6,525 [million baht] (see

Table 1-89).

Table 1-89: Reduction of Damage to the Education Sector

Actual damage

Education Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage						
	Total	Basic education	Private education	Non formal education	Higher education	Vocational education	Non-Ministry of Education agencies
Total	**13051.00**	**1163.00**	**215.00**	**61.00**	**9402.00**	**519.00**	**1690.00**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe locatio	0.50	0.50	0.50	0.50	0.50	0.50
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	0.75	0.75	0.75	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**

Damage after Implementing Measures

Education Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage						
	Total	Basic education	Private education	Non formal education	Higher education	Vocational education	Non-Ministry of Education agencies
Total	**6524.97**	**581.50**	**107.50**	**30.50**	**4700.98**	**259.50**	**845.00**

The bulk of losses in the education sector arose from the interruption of operations since many schools were used as shelters for flood victims. Even if educational institutions had preventive measures in place that would successfully protect their assets from inundation, their facilities would be used as evacuation shelters anyway if the surrounding area flooded, forcing residents to evacuate. In light of this, we assumed that the damage rate would not change even if the assets were protected. As a result, losses in the education sector would remain the same at 1,798 [million baht]. (see Table 1-90).

Table 1-90: Reduction of Operating Losses in the Education Sector

Actual damage

Education Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses						
	Total	Total	Basic education	Private education	Non formal education	Higher education	Vocational education	Non-Ministry of Education agencies
Total	**13051.00**	**1797.90**	**922.00**	**74.00**	**84.00**	**170.00**	**364.00**	**185.00**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	1.00	1.00	1.00	1.00	1.00	1.00
	Sell	No	No	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	1.00	1.00	1.00	1.00	1.00	1.00
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Education Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses						
	Total	Total	Basic education	Private education	Non formal education	Higher education	Vocational education	Non-Ministry of Education agencies
Total	**6524.97**	**1799.03**	**922.02**	**74.00**	**84.00**	**170.00**	**364.01**	**185.00**

13) Cultural and Natural Heritage

The only way to minimize damage to cultural heritage assets would be to use sandbags, waterstops, mobile levees, etc. that would protect historical heritage structures and sites from inundation or by moving museum exhibits to upper floors. Since not all museum exhibits can be moved to upper floors, we assumed the damage rate to be 0.5. We also assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage. As a result, damage to the cultural and natural heritage sector is estimated to decline from 4,432 [million baht] to 3,322 [million baht] (Table 1-91).

Table 1-91: Reduction of Damage to the Cultural and Natural Heritage Sector

Actual damage

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				
	Total	Heritage structures and sites	Heritage repositories	Natural heritage assets	Intangible cultural heritage assets
Total	4431.57	4331.60	97.19	0.00	0.00

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00
Assets protected	Move to a safe locatio	Impossible	0.75	Impossible	Evacuation of performers
	Sell	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	No	No
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.75**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**0.75**	**1.00**	**1.00**

Damage after Implementing Measures

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage				
	Total	Heritage structures and sites	Heritage repositories	Natural heritage assets	Intangible cultural heritage assets
Total	3321.59	3248.70	72.89	0.00	0.00

A large part of the cultural heritage asset losses consisted of expenses incurred for moving culturally valuable articles within the same building, and revenue losses due to temporary suspension of operations and cancellation of events. In light of this, we assumed that expenses for moving exhibits within museums would be double the moving expenses actually incurred. We assumed that the damage rate would not change for intangible cultural heritage assets because scheduled events would have to be canceled anyway once the surrounding area flooded regardless of whether or not performers could safely evacuate. The damage rate for natural heritage assets is also assumed to remain the same since there is no way to protect them from inundation. As a result, losses in the cultural and natural heritage sector would decline from 3,076 [million baht] to 2,923 [million baht] (Table 1-92).

Table 1-92: Reduction of Operating Losses in the Cultural and Natural Heritage Sector

Actual damage

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses				
	Total	Total	Heritage structures and sites	Heritage repositories	Natural heritage assets	Intangible cultural heritage assets
Total	4431.57	3076.48	609.98	4.42	16.34	2445.74

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	1.00	1.00	1.00
	Sell	No	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	0.75	No	No
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**0.75**	**1.00**	**1.00**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Cultural and Natural Heritage Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses				
	Total	Total	Heritage structures and sites	Heritage repositories	Natural heritage assets	Intangible cultural heritage assets
Total	3321.59	2922.88	457.49	3.32	16.34	2445.74

14) Natural Environment and Waste Management

Damage to the natural environment and waste management sector mainly included damage to waste disposal facilities and equipment as well as destruction of biodiversity conservation-related assets (roads, offices, wildlife and plants). The only way to minimize damage to these assets would be by using sandbags, waterstops, mobile levees, etc. to protect waste disposal facilities and equipment from inundation. In light of this, we assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage. As a result, damage is estimated to decline from 375 [million baht] to 285 [million baht] (

Table 1-93).

Table 1-93: Reduction of Damage to the Natural Environment and Waste Management Sector

Actual damage

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai bah

Province	Damage			
	Total	Municipal solid waste	Biodiversity	Industrial waste
Total	**375.06**	**34.00**	**13.00**	**328.00**

Changes in Damage Rates due to Flood Prevention

Assets unprotected		1.00	1.00	1.00
Assets protected	Move to a safe locati	Impossible	Impossible	Impossible
	Sell	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	No	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**1.00**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai bah

Province	Damage			
	Total	Municipal solid waste	Biodiversity	Industrial waste
Total	**284.50**	**25.50**	**13.00**	**246.00**

Losses in the natural environment and waste management sector came from increased expenses for transporting waste to other waste disposal facilities after flooding impaired the operational capacity of waste management facilities and damaged the waste management infrastructure. In light of this, we assumed that installing waterstops, mobile levees, and sandbags would mitigate flood damage. As a result, losses in the natural environment and waste management sector would decline from 176 [million baht] to 148 [million baht] (Table 1-94).

Table 1-94: Reduction of Operating Losses in the Natural Environment and Waste Management Sector

Actual damage

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses			
	Total	Total	Municipal solid waste	Biodiversity	Industrial waste
Total	**375.06**	**175.61**	**101.00**	**64.00**	**11.00**

Changes in Damage Rates due to Flood Prevention

		Municipal solid waste	Biodiversity	Industrial waste
Assets unprotected		1.00	1.00	1.00
Assets protected	Move to a safe location	Impossible	Impossible	Impossible
	Sell	No	No	No
	Flood prevention (sandbags, waterstops, mobile levees, etc.)	0.75	No	0.75
Words in blue: No measures taken	**Damage rate after implementing flood prevention measures (Maximum inundation depth ≤ Waterstop height)**	**0.75**	**1.00**	**0.75**
	Damage rate after implementing flood prevention measures (Maximum inundation depth > Waterstop height)	**1.00**	**1.00**	**1.00**

Damage after Implementing Measures

Natural Environment and Waste Management Sector - Total Damage (by Province) [in Thai baht, millions]

Province	Damage	Losses			
	Total	Total	Municipal solid waste	Biodiversity	Industrial waste
Total	**284.50**	**147.98**	**75.74**	**63.99**	**8.25**

(3) Comparison of Damage before and after Implementing Preventive Measures (Summary)

The table below shows damage before and after implementing preventive measures for all sectors.

Table 1-95 Damage before and after Implementing Preventive Measures for AllSctors

Sector	Damage [million baht]		Losses [million baht]	
	Before implementing measures	After implementing measures	Before implementing measures	After implementing measures
Agriculture, forestry, and fisheries	5, 666	4, 414	34, 715	27, 971
Industry	513, 881	387, 229	493, 258	369, 944
Tourism	5, 134	3, 908	89, 673	89, 673
Financial and insurance	943	719	115, 276	87, 922
Flood control, drainage, and irrigation	8, 715	8, 715	N/A	N/A
Water and sanitation	3, 497	3, 497	1, 984	1, 984
Roads and transport	23, 538	23, 260	6, 938	6, 845
Electricity	3, 186	2, 389	5, 716	4, 810
Telecommunications, broadcasting, and postal services	1, 290	967	2, 015	1, 511
Health care and public health (hygiene)	1, 684	1, 280	2, 133	1, 600
Housing and household goods	45, 908	35, 208	37, 892	28, 419
Education	13, 051	6, 525	1, 798	1, 799
Cultural and natural heritage	4, 432	3, 322	3, 076	2, 923
Natural environment and waste management	375	285	176	148
Total Damage mitigation rate (vs. before implementing measures)	631, 299 100%	481, 717 76%	794, 650 100%	625, 550 79%