Benefit Evaluation Research in Disaster Prevention and Reduction of Tropical Cyclone based on Social Investigation.

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1 Introduction

Influenced by Typhoon in China,2015-2017

- 6~8 typhoons landed in China's coastal areas.
- Double-typhoon affected China's southeast coast, Chan-Hom and Linfa in 2015, Nesat and Haitang in 2017.

Based on Social Investigation

- Combined with the current general evaluation technology and sociological research methods.
- A primarily description and statistic to proposes a social-economic benefit assessment method.

2 Research Framework

- Based on review of literature and examples in relevant fields, taking into account the disaster prevention system of "Government-led, Sectoral linkage and Public participation" in China, the evaluation of the benefits of typhoon disaster prevention and mitigation focuses on the evaluation of typhoon meteorological services, and the comprehensive assessment of the effectiveness of typhoon defense.
- Combing the whole process of typhoon disaster prevention and mitigation meteorological services, select the relevant indicators and parameters to establish the evaluation index system and calculation formula.

2 Research Framework

➢2.1 Comprehensive Evaluation of Typhoon Meteorological Service

Evaluation Indicators System of Typhoon Meteorological Services

Key Indicator	First-level Metrics	Second-level Metrics
Comprehensive Evaluation of Typhoon Meteorological Service	Typhoon forecast and early warning indicators	Accuracy evaluation of Forecast
		Timeliness evaluation of early warning released
	Public Weather Service Indicators	Channel diversity and early warning coverage of forecast and early warning distribution
		Typhoon Defense Proposal Release
	Decision-making Meteorological service indicators	Timeliness of decision-making meteorological services
		Response, feedback and measures of the local government
	Specialized Meteorological Services indicators	Timeliness of specialized meteorological services
		Response, feedback and measures from industry
	Social feedback indicators	Public feedback
		Media feedback

➢2.2 Typhoon Defense Behavior Evaluation

Evaluation Indicators System of Typhoon Defense Behavior Evaluation

Key Indicator	First-level Metrics	Second-level Metrics
Typhoon Defense Behavior Evaluation	Government Guiding	Typhoon defense organization system
		Typhoon defense emergency management
		Ability of personnel transfer and vessel harbor sheltered
		Water conservancy, emergency shelters and other construction projects evaluation
	Departmental Interaction	Emergency treatment
		Emergency support
	Public Participation	Defense capability

2 Research Framework

➢2.3 Calculation of Benefit Value of Disaster Prevention and Reduction for Typhoon Meteorological Service Nusa and Begonia

Formulas of Benefit Value of Disaster Prevention and Reduction for Typhoon Meteorological Service

（1）Calculation Formula of Number of Casualties Reduced

$$R_m = \mathrm{A}_m \times C_{Rm}$$

$\mathrm{R_m}$ The number of casualties reduced in a typhoon process, unit: 100 Million.
$\mathrm{A_m}$ The actual transfer and resettlement number in a certain typhoon process, unit: person.
$\mathrm{C_{Rm}}$ The ratio of human casualties that may occur if no resettlement measures are taken during a typhoon process, unit: %.

（2）Calculation Formula of Public Savings in Economic Losses

$$P_b = T \times \frac{1}{n}\sum_{i=1}^{n} A_p$$

P_b The public's total amount of derogatory benefits caused by using of meteorological services, units: 100 million yuan.
A_p Impairment losses generated for personal usage of meteorological services, unit: yuan.
n Number of valid samples for investigation, unit: person.
T Population in the area affected by typhoon, unit: person.

（3）Calculation Formula of Comprehensive Benefit Value of Disaster Prevention and Mitigation

$$B = \frac{AMG(1-S)}{1-MG(1-S)}$$

B Comprehensive benefit value of disaster prevention and mitigation in a typhoon process, units: 100 million yuan.
A Direct economic loss in a typhoon process, unit: 100 million yuan.
M Comprehensive evaluation of meteorological service of a typhoon process.
G Typhoon Defense Behavior Evaluation of local government in a typhoon process.
S Inevitable loss coefficient in a typhoon process.

3 Results and Discussion

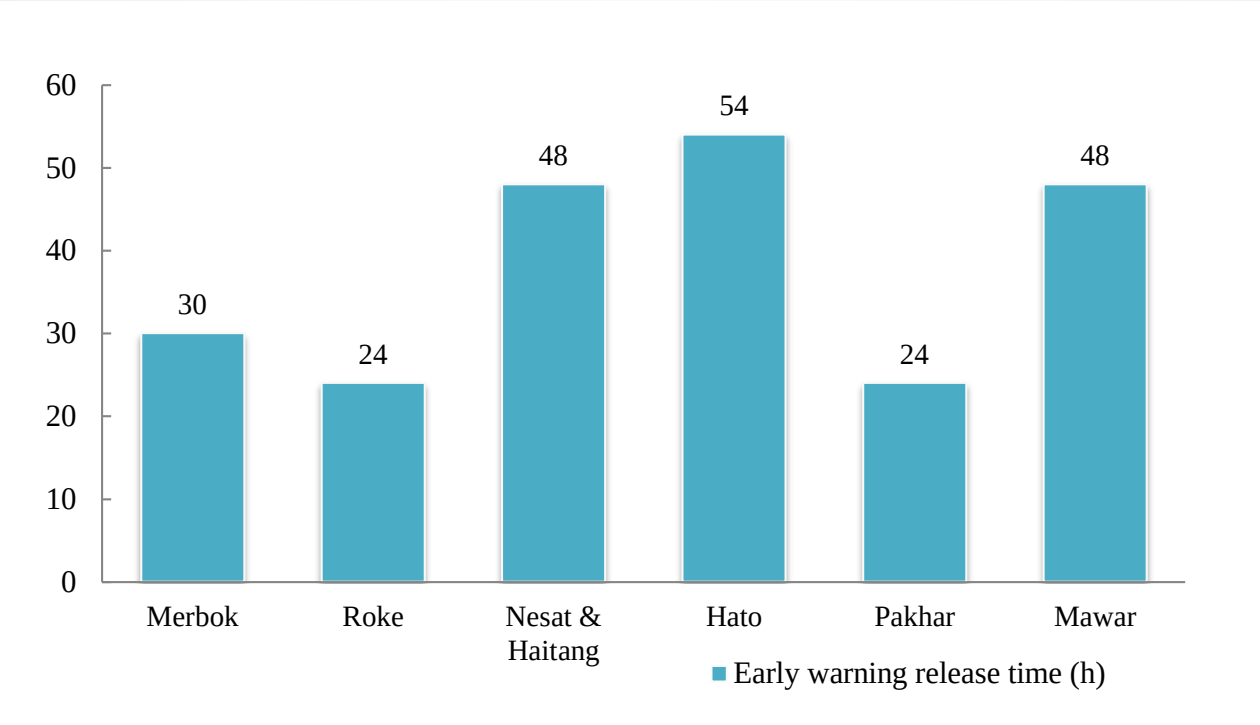
➢ 3.1 Statistics data of damage losses impacted by typhoon

Impacted and Emergency Transferred of resettlement Population, and direct economic loss of 7 Typhoon Processes in 2017. (Data from MCA)

	Merbok	Roke	Nesat & Haitang	Hato	Pakhar	Mawar
Population impacted by typhoon(million)	12.2	—	18.27	123.0	4.61	0.32
Emergency transfer of resettlement number (10 thousands)	1.2	4.007	27.31	55.6	29.35	0.0826
Direct economic loss (100 million yuan)	2.6	0	8.27	188.2	3.85	0.0602

3 Results and Discussion

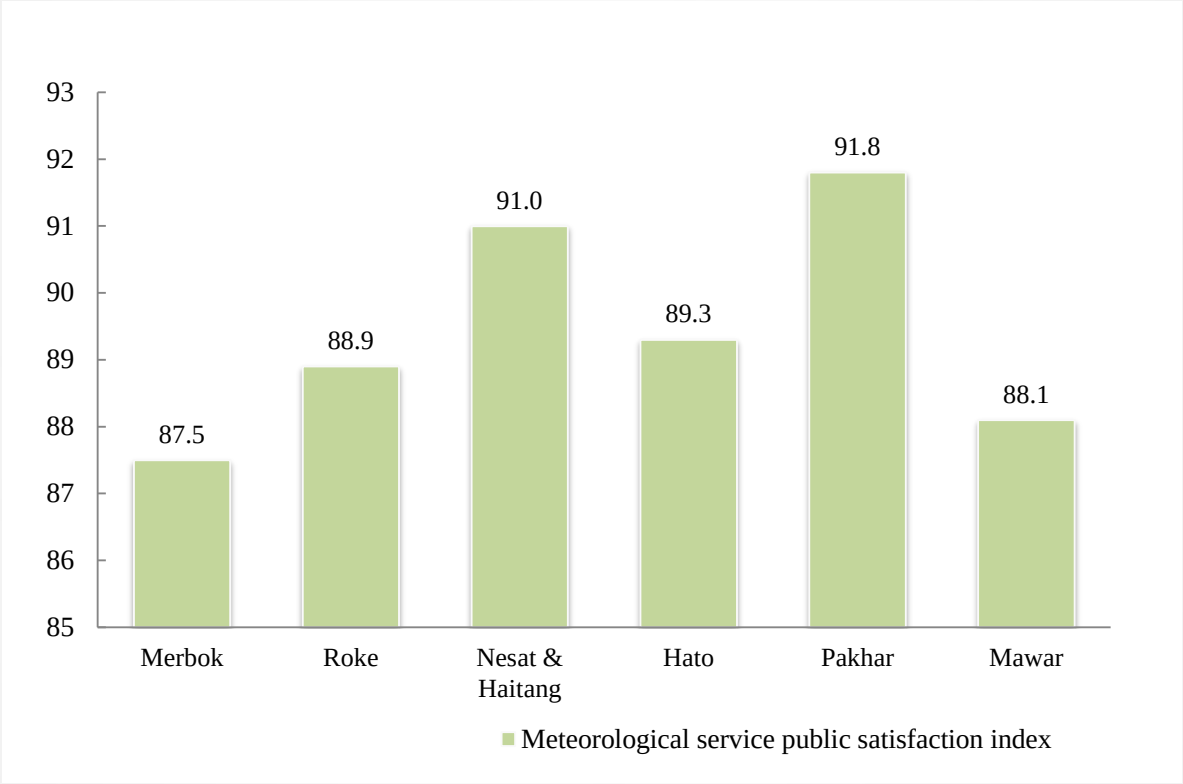
➢ 3.2 Effect evaluation of early warning information released



Early Warning Release Time Distribution for 7 Typhoon Process in 2017

3 Results and Discussion

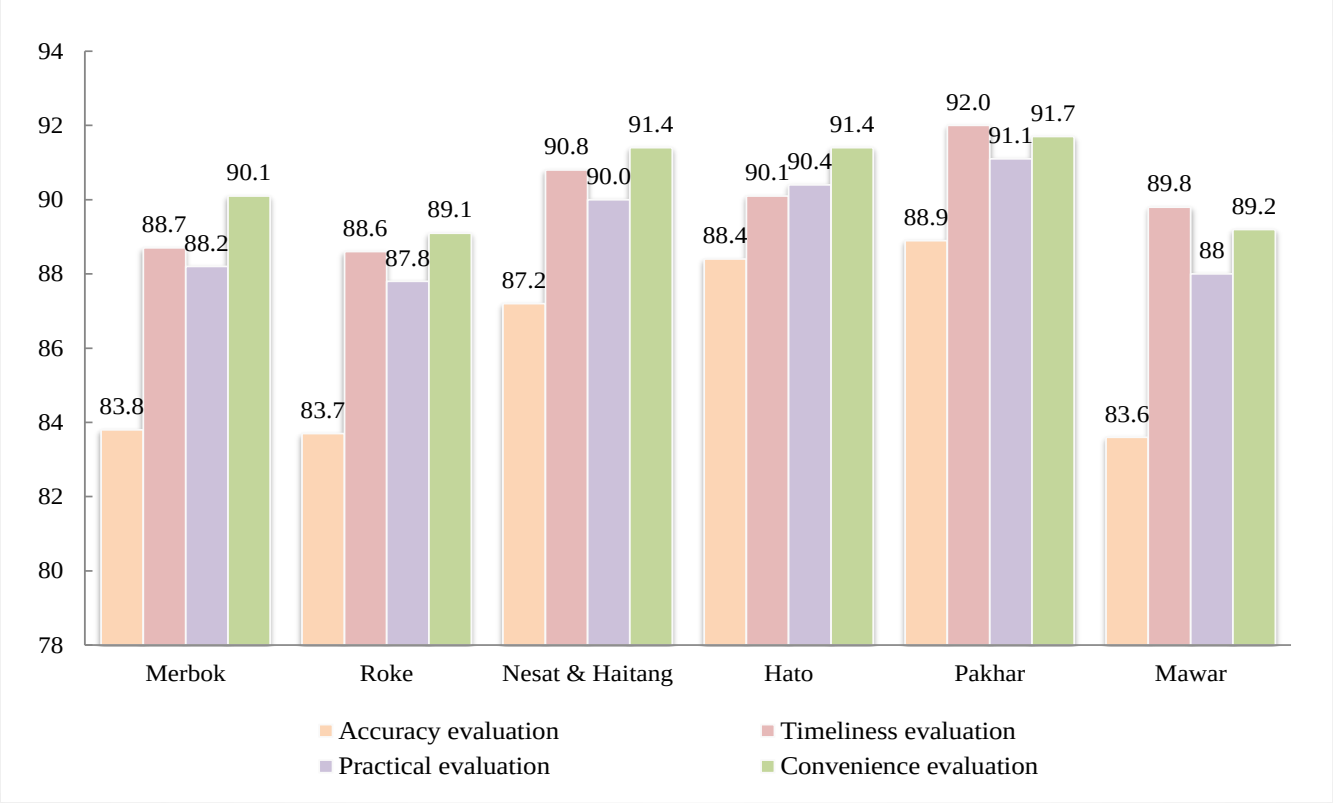
➢ 3.3 Public evaluation of typhoon meteorological service



Early Warning Release Time Distribution for 7 Typhoon Process in 2017

3 Results and Discussion

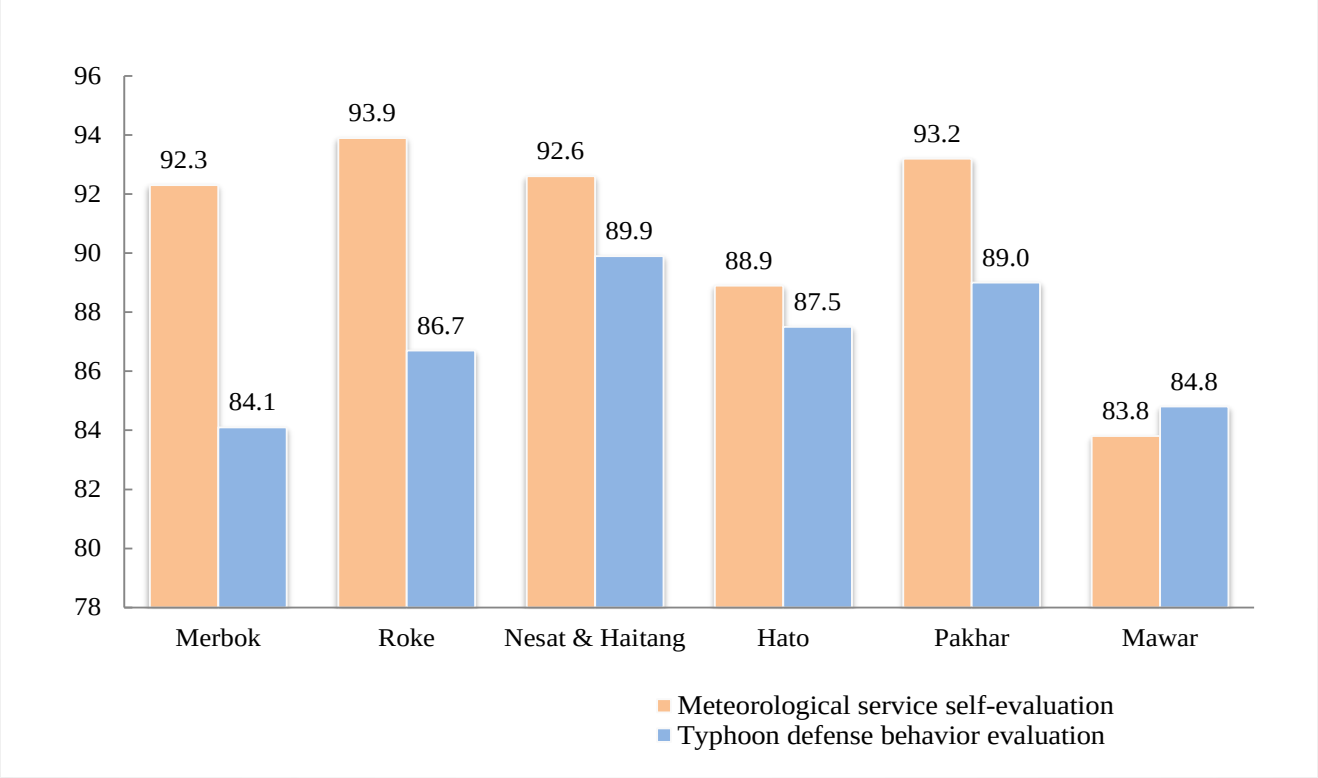
➢ 3.3 Public evaluation of typhoon meteorological service



Typhoon public weather service accuracy, timeliness, practicality and convenience evaluation

3 Results and Discussion

➢ 3.4 Typhoon meteorological service self-evaluation results and typhoon defense behavior evaluation



Results of Seven Typhoon Meteorological Service Self-evaluation and Defense Behavior Evaluation.

3 Results and Discussion

➢ 3.5 Comprehensive Benefit Value of Disaster Prevention and Mitigation

Summary of Comprehensive Benefit Value of Disaster Prevention and Mitigation of 7 Typhoon Weather Process in 2017

	Merbok	Roke	Nesat & Haitang	Hato	Pakhar	Mawar	Total
Number of casualties Reduced (person)	1800	4568	45093	109136	49045	88	209730
Average saving losses of public (yuan / person)	89.9	84.2	66.9	108.3	103	75.6	
Public saving losses （10 thousands Yuan)	1096	—	1222	13325	475	24.2	
Comprehensive benefit value of disaster prevention and mitigation (100 million yuan)	5.5	—	19.8~25.6	314.8	8.26	0.1	348.46~354.26

3 Results and Discussion

➢ 3.6 Discussion

(1) The typhoon meteorological service evaluation of the effectiveness of disaster prevention and mitigation can be basically operational, but there are still many specific details need to be adjusted and improved, such as the independent survey agencies in the process of investigation and decision-making departments and linkage departments of the **data acquisition** is still **difficult to get, survey sample gallery still need to build and improve**.

(2) According to the evaluation results of typhoon meteorological services disaster prevention and mitigation benefits in 2017, the relationship between some conclusions still needs further study. The consistency of some self-assessment data and early warning information release data needs to be **standardized and unified.**

(3) The last is the **comparability** of evaluation results still needs **further verification and testing**. The overall benefit value of disaster prevention and mitigation for typhoon meteorological services is about 35 billion yuan in 2017. **How to verify** the scientific and rationality of this benefit values should also be one of important content in the future research.

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