Study of Urban Community Emergency Management in Huizhou, China

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Abstract. This paper focuses on the study of urban community emergency management in Huizhou, China. An index system for urban community emergency management evaluation which has two levels is established in the study. The index system consists of six primary indicators and twenty-two secondary indicators. The weights of the indicators are determined by using the Analytic Hierarchy Process (AHP). The established evaluation system is used to evaluate the emergency management ability of a community called Xuefu Community in Huizhou, China. Purpose sampling is used in the evaluation. A questionnaire with twenty-three questions is designed and all community staff are invited to answer the questionnaire. Fuzzy Comprehensive Evaluation method is adopted to calculate the scores and resulted are analysed. Suggestions are given to the Xuefu Community and local government based on the analysis.

1. Introduction
The increase of urbanization rate results in the high density of population, construction, and public facilities, which brings challenges to urban emergency management. The grass-roots emergency management plays an important role in emergency prevention and preparation. If local emergency preparedness and self-rescue ability are lacking, an emergency can lead to huge losses. Community is the grass-roots level organization in a city. It is considered that urban community emergency management study is the starting point of the urban emergency management study.

Nowadays in China the community emergency management system relies heavily on the local government. Many communities only have very simple emergency plans which lack details. What’s more, emergency training is relatively poor and receives little attention. More research on the governance concept, organization and governance mechanism of emergency management mode at the community level needs to be done. And the research on emergency management mode at community level mostly focuses on theoretical discussion and policy elaboration while the empirical research based on investigation is lacking [1].

This paper tries to develop an evaluation system for urban community emergency management in China and use it to assess the community emergency management in Huizhou, which can help to reduce losses when typhoon and floods occur in the town.

Huizhou is chosen as the research object because it is not a top-level city in China and the emergency management is relative backward, which makes it more representative. The community emergency management in Huizhou does not refer to the actual situation and the community emergency system is mostly copied from the city emergency system. No enough attention has been paid to the community emergency management. The potential losses in Huizhou communities are high when typhoon and
floods occur. Hence, it is vital to study the community emergency management in Huizhou. This study is the first to conduct an in-depth investigation on Huizhou community emergency management and put forward suggestions so that it can help Huizhou communities find out their shortcomings and make progress. Purpose sampling is used in the evaluation in this study.

2. Establishment of Evaluation System

2.1. The Establishment of Index System
The 4R theory of crisis management [2] is a widely used theory in the research of emergency management. It is believed that conducting urban disaster prevention activities based on the 4R theory can help to enhance emergency response capacity [3]. The theory provides suggestions for crisis management in four different stages [2], which is helpful for building the framework of emergency management. And the four stages are in chronological order, which makes it easy and clear to read and understand. If a researcher builds an emergency management system based on the 4R theory, the people who do not have emergency management knowledge can also understand the system easily. It can help to ensure that the emergency management system can work efficiently. This study also uses the theory to establish the framework of evaluation index system.

After the framework is determined, more detailed indicators need to be determined. China has built a strong nationwide emergency management system but the emergency management at the community level gains not enough attention. Although the reaction speed of emergency response is very fast, the preparation is not well organized in advance at the community level. Communities are not motivated to prepare for emergencies proactively. Compared with China, Japan pays more attention to the preparation at the community level. For example, shelters in Japanese communities prepare emergency supplies in the long term and the local publicity like hazard map is done well. This is because the frequency of disasters is higher in Japan. In order to improve the urban community emergency management capability in China, it is meaningful to learn from the Japanese management system [4]-[5]. This paper learns a lot from Japanese disaster management measures to build the evaluation index system.

Overall, in this study, the 4R theory is used to build the framework of the evaluation index system and indicators from the existing emergency management system in China [6]-[8] and disaster management system in Japan are used as references [5]. Research articles that study Chinese community emergency management are also used as references to check the evaluation index system [1], [3], [9]-[10]. Seven experts from government and universities are invited to revise the index system and experts’ opinions are adopted for revision.

The index system of urban community emergency management is constructed and summarised in the Table 1. The final hierarchy of the system is designed to have two levels. The first level is designed to have six indexes while the second level has twenty-two indexes in total. The indicators in the first level are called primary indicators while the indicators in the second level are called secondary indicators. Table 1 below also shows the reference marks for the goal and all indicators.

| Evaluation of Urban Community Emergency Management (A) | Goal | Primary Indicators | Criteria |
|------------------------------------------------------|------|--------------------|----------|
| Emergency Law and Management System (B1)             |      | Implementation of emergency laws and regulations (C1) |          |
|                                                      |      | Local laws and regulations (C2) |          |
|                                                      |      | Working system building (C3) |          |
|                                                      |      | Management team building (C4) |          |
| Emergency Planning and Investment (B2)               |      | Emergency plan (C6) |          |

Table 1. Evaluation Index System of Urban Community Emergency Management
2.2. Determination of Index Weights

This study tries to assess the emergency management of a community quantitatively. The clearest way to evaluate the performance of a community is to give a score to it so that everyone can understand the quality of its emergency management easily and directly. The evaluation index system has been constructed. In order to give a correct and reasonable score to the community when using the index system to evaluate the emergency management, the exact weight of each indicator should be calculated. The Analytic Hierarchy Process (AHP) is a general theory of measurement which can help to solve the complex decision-making problems effectively [11]. It is useful for solving the problems that combined qualitative and quantitative factors and is widely used in the research of emergency management. This paper uses the AHP to determine the index weights of the community emergency management evaluation system. Two experts who have rich experience in emergency management were invited to answer the questionnaire and the results were used to build the comparison matrices. The index weights of all indicators are summarised in Table 2.

Table 2. Summary of the index weights of all indicators

| Goal                                      | Primary Indicators | Weight | Secondary Indicators | Weight |
|-------------------------------------------|--------------------|--------|----------------------|--------|
| Evaluation of Urban Community Emergency Management (A) | B1 0.1000          | C1 0.3750 |
|                                           |                    | C2 0.3750 |
|                                           |                    | C3 0.1250 |
|                                           |                    | C4 0.1250 |
|                                           | B2 0.3000          | C5 0.0769 |
|                                           |                    | C6 0.2308 |
|                                           |                    | C7 0.2308 |
3. Evaluation of Emergency Management of Xuefu Community in Huizhou

The emergency management capability of Xuefu Community in Huizhou City is evaluated in this part based on the evaluation index system of urban community emergency management established above. In order to ensure the validity and authenticity of the evaluation result, this study uses purpose sampling. All community staff are invited to answer a well-designed questionnaire that can be used to calculate the final score. And a lot of community emergency information is collected at the same time. The evaluation helps to assess the emergency management capability of Xuefu Community.

3.1. Information of the Xuefu Community

Xuefu Community, located at the southernmost end of Henanan Street in the southern new town of Huizhou, was founded in 2012. The administrative area of the Xuefu Community is about 1.3 square kilometres. Xuefu Community is a community dominated by residential districts. The permanent population of Xuefu Community is around 5300 households with a total of 23000 people. There are eight closed residential districts, three schools, three kindergartens and one community health station in the community.

For the emergency management, Xuefu Community has established its own management system and adopted an up-to-date management method but the emergency management is still relatively weak. The emergency management of Xuefu Community does not refer to the actual situation of the community. In fact, the emergency management system in Xuefu Community is mainly copied from the superior emergency system and it has no big difference from other urban communities’ systems in Huizhou city. The community office does not conduct regular risk assessment in the community and not enough attention has been paid to the production of the list of potential risks. The frequency of emergency training and drill is also relatively low. In the process of organizing emergency work, Xuefu Community lacks the guidance from relevant experts as community level is considered less important and no investigation on emergency management has been carried out in the community. Hence, this study is meaningful for Xuefu Community and other urban communities in Huizhou.

3.2. Emergency Management Capability Evaluation

In the process of comprehensive evaluation for emergency management capability of Xuefu Community, all staff members in the community office are invited to answer a questionnaire. The questionnaire, which includes twenty-three questions, is designed based on the new evaluation index system to give scores to different aspects of emergency management in a disaster like typhoon or flood. In the questionnaire, there are five different evaluation levels including excellent, good, general, poor, and
very poor. Each evaluation level corresponds to a score so that the evaluation result can be quantified. The corresponding scores are written in the Table 3.

| Evaluation level | Excellent | Good | General | Poor | Very poor |
|------------------|-----------|------|---------|------|-----------|
| Score            | 5         | 4    | 3       | 2    | 1         |

As the study uses purpose sampling, ten community staff members are all invited to answer the questionnaire. They are the people who know Xuefu Community management best. According to their answers, their working durations in Xuefu Community are summarised in the Table 4.

| Working durations in the community | Less than 2 years | 2 to 5 years | 5 to 8 years | Longer than 8 years |
|-----------------------------------|-------------------|--------------|--------------|--------------------|
| Number of people                  | 3                 | 2            | 0            | 5                  |

It is clear that most of the community staff have worked in the community office for more than two years and half of the staff have worked there for more than eight years, which means that those staff know the situation of Xuefu Community very well. Hence, their answers to the questionnaire have a vital reference value for studying the emergency management in Xuefu Community. By collecting emergency management related data from those community staff, the result of the emergency management capability evaluation will be reliable and useful suggestions can be given.

The evaluation results of all secondary indicators can be calculated based on the questionnaire answers. For each indicator, the given evaluation level can determine the score of the indicator. The weight vector of the goal of evaluation of urban community emergency management (A) can be obtained and fuzzy relation matrix of A is determined by combing all rating vectors. Finally, the overall rating vector is calculated.

\[
A = (0.1, 0.3, 0.1, 0.1, 0.3, 0.1) ^{0.2375 \ 0.5500 \ 0.2125 \ 0 \ 0 \ 0.1154 \ 0.6001 \ 0.2846 \ 0 \ 0 \ 0.4750 \ 0.1500 \ 0.3750 \ 0 \ 0 \ 0.1364 \ 0.5545 \ 0.3091 \ 0 \ 0 \ 0.2099 \ 0.6454 \ 0.1447 \ 0 \ 0 \ 0.2250 \ 0.3750 \ 0.2000 \ 0 \ 0) \]

(1)

Therefore, the final overall score for the Xuefu Community is 3.9669/5. Combined with the evaluation levels shown in Table 3, the overall emergency management capability of the Xuefu Community is very close to good, but the score is still a bit lower than the good level, which means there are a lot for Xuefu Community to improve.

All the results are summarised in the Table 5. The final scores of all indicators can be found so it is easy to see the weakness of emergency management in Xuefu Community.
3.3. Result Analysis

Although the emergency management capability of Xuefu Community has been assessed and scores have been obtained, the results need to be analysed in depth. The calculation results summarised in the table are not clear and intuitive enough for readers to understand the emergency management capability of Xuefu Community easily. Only if the community staff get to know every aspect of emergency management well in the community and residents are aware of the existing emergency management problems, the community can make great progress in emergency management. In order to demonstrate both the strengths and weaknesses to the community staff and residents, this section tries to make use of graphs to show the result analysis. What’s more, the application of the evaluation system can be seen during the analysis process as well.

According to the calculation in the last section, final overall score of evaluation of urban community emergency management (A) is 3.9669. It can be said that overall, the urban community emergency management in Xuefu Community is generally satisfactory but it does not really reach the good level. If more good actions can be taken, the emergency management level will be greatly improved. Hence, it is necessary to compare the scores of all indicators because comparison helps people notice more subtle differences.

There are six primary indicators under the goal in the evaluation system. They represent the different aspects of the community emergency management. In order to give a general overview of the scores of six aspects, the distribution of primary indicator scores is demonstrated in Figure 1.
As four is the threshold value of good level, Figure 1 is drawn to summarise the number of indicators that are lower and higher than four points. It can be seen that two indicators’ scores are lower than four while four indicators’ scores are higher than four. Hence, 66.7% of the primary indicators are higher than 4 and 33.3% are lower than 4, which means that primary indicators mostly reach the good level, and the overall situation is good.

After the overview, analysis needs to be more detailed. The score of each primary indicator needs to be analysed. The final scores of B1 to B6 are summarised and compared in the Figure 2 below.

It is obvious that Xuefu Community is not doing well in the respect of emergency planning and investment (B2) and emergency warning (B4). Both the scores of B2 and B4 are lower than 4. It shows that the weaknesses of emergency management in Xuefu Community is B2 and B4. At same time, Xuefu Community is doing relatively well in the respect of emergency law and management system (B1), emergency training (B3), emergency response (B5) and recovery (B6). The score of B3 is the highest, which means that B3 is the strength of Xuefu Community. The scores of B1, B5 and B6 are higher than four, which means the B1, B5, B6 of Xuefu Community have reached good level.

The scores of primary indicators can reflect the performance of Xuefu Community in the six aspects but when determining the final overall score, their participations to the final evaluation score need to be considered as well. In another word, the weight of each indicator also plays an important role. The weights of primary indicators have been summarised in the Table 2 which shows that B2 and B5 are the key indicators in the evaluation. The performance of the key indicators is vital as the proportion of B2 and B5 has reached 30%. However, in Figure 2 it can be seen that B2 only gets 3.8312 while B5 gets
4.0653. As the final overall score of A is 3.9669, it is obvious that B2 is the main weakness of the emergency management in Xuefu Community. At same time, it is thanks to the relatively high score of B5 that the final overall score can be close to 4. With a score of 4.0653, B5’s performance in Xuefu Community is good. In another word, it can be said that B5 is the strength of Xuefu Community. For Xuefu Community, the most effective way to improve the overall score is paying more attention to B2. If more detailed emergency plan can be prepared and more investment can be made, the overall score will be able to reach the good level easily.

For the sake of a more in-depth insight into the emergency management capability of Xuefu Community, all the scores of secondary indicators need to be analysed. A histogram Figure 3 is drawn to give an overview of the distribution of secondary indicator scores.

![Figure 3](image-url)

**Figure 3. Distribution of the secondary indicator scores**

In Figure 3, the score distribution is not concentrated and the scores range from 3.6 to 4.3. If the threshold value of good level is taken as the boundary, it can be seen that eleven indicators’ scores are lower than four while ten indicators’ scores are higher than four and one indicator’s score is equal to four. In another word, 50% of the secondary indicators reach the good level whereas 50% of the secondary indicators are lower than the good level. If we divide the secondary indicators into two groups by using the threshold value boundary, we can see that the score distribution is concentrated in each group. When looking into the secondary indicators whose scores are lower than four, it can be seen that the column of (3.7, 3.8] is conspicuous. There are seven indicators in that range. When it comes to the indicators whose scores are equal to or higher than four, the column of (4.1, 4.2] is conspicuous. There are five indicators in the range of (4.1, 4.2]. Compared with the primary indicators’ distribution in Figure 1, the distribution of secondary indicators in Figure 3 reflects a more real situation of Xuefu Community.

As the distribution has been analysed, it is time to analyse the specific scores of secondary indicators. The scores of secondary indicators are summarised and compared in the Figure 4 below. Compared with the Figure 2, Figure 4 contains more comprehensive information. There are twenty-two secondary indicators covering almost all the aspects of emergency management in more detail. Hence, the analysis based on Figure 4 is going to be more specific.
Figure 4. The scores of secondary indicators of Xuefu Community

In Figure 4, the heights of most columns are close, but four columns are conspicuous. They are C2 column with a score of 4.3, C12 with a score of 3.6, C13 with a score of 3.6 and C17 with a score of 4.3.

On one hand, as 4.3 is the highest score among the secondary indicators, C2 and C17 are the two best aspects of emergency management in Xuefu Community. The local emergency laws and regulations in Xuefu Community are made with the support of Huizhou local emergency management bureau, which can be the reason why C2 gets an ideal score. For C17, the reason is that community hospitals in Xuefu Community have ability to face the emergency situation. On the other hand, 3.6 is the lowest score so C12 and C13 are the worst aspects. This is because the emergency monitoring has not yet covered all areas of Xuefu Community and the information management system of community office is not up to date. The scores of other secondary indicators fall between 3.8 and 4.2. The indicators with relative low scores need to be focused on. As mentioned in Figure 3, there are eleven indicators whose scores are lower than four. Apart from C12 and C13, there are still night indicators whose scores are lower than four including implementation of emergency laws and regulations (C1), working system building (C3), risk assessment (C5), emergency plan (C6), infrastructure construction (C7), emergency equipment (C8), reserve resources (C9), emergency drill (C11) and professional rescue (C16). Xuefu Community is not doing very well in these aspects and more attention should be paid to improving them.

4. Suggestions for Emergency Management in Xuefu Community

According to the analysis in the last section, the weaknesses and strengths of emergency management in Xuefu Community have been summarised. Hence, suggestions can be given based on the analysis result. As the improvement of emergency management capability needs not only the efforts of the local urban community, but also the cooperation of the city government, the suggestions are given from the perspective of Xuefu Community and Huizhou government in this section.

4.1. Suggestions from the Perspective of Local Urban Community

The overall score of Xuefu Community is lower than the good level. The community can start from the following aspects to enhance the emergency management ability.

Firstly, it is urgent for Xuefu Community to strengthen the ability of emergency warning. Xuefu Community needs to check whether the existing monitoring system, information management system and broadcasting system are still working normally. If any of the monitors and loudspeakers do not work properly, the community office should hire workers to repair them as soon as possible. More monitors and loudspeakers should be installed at the same time to cover more areas in the community so that the community can respond to emergencies more quickly. The information management system may also need to be maintained and updated. It is important to train community staff to use the system.

Secondly, Xuefu Community have to take actions to improve the emergency planning and increase investment. The work of risk assessment and emergency plan needs to be more detailed. The secretary
of Xuefu Community should be responsible for guiding risk assessment and corresponding emergency plan preparation in the community. It is vital for the secretary to apply for funds from the superior as well. The infrastructure construction, emergency equipment and reserve resources all need funds and support from the superior. Community staff should prepare a detailed list to show how the funds will be used based on the work of risk assessment and emergency plan. If funding application is approved, the community staff should reasonably arrange and use the funds to improve the emergency preparedness ability to the maximum extent.

Thirdly, the community office should also strengthen its own capacity-building. It is necessary to make sure that staff know emergency laws and regulations well and the working efficiency is increased. Xuefu Community should also increase the frequency of organising emergency drills and increase resident participation. What’s more, it is suggested that Xuefu Community can invite professional rescue organizations to attend and guide emergency activities in the community.

Lastly, Xuefu Community can try to actively learn from the experience of outstanding urban communities in China. After seeing the excellent practices of other urban communities, Xuefu Community will be able to improve its own practices.

4.2. Suggestions from the Perspective of City Government

Without support from the city government, the development of emergency management capacity will be limited. Huizhou government can give a hand to Xuefu Community in three aspects. First, the government can provide funds to help Xuefu community to prepare more reserve resources and construct shelters and the government can hire professionals to guide community work. Second, the government can organise regular emergency management trainings for all community secretaries in the city so that the requirements of city government can be implemented in communities through community secretaries. Third, it is necessary to evaluate the emergency management of all communities in the city regularly and make a ranking list based on their scores. The communities will be able to know about their performance. It can help to encourage the communities to make more efforts to improve the emergency management ability.

5. Conclusions

This study proposes a new evaluation index system of urban community emergency management. With the help of seven experts, the preliminary index system is revised and the final index system contains six primary indicators and twenty-two secondary indicators which covers every aspect of urban community emergency management. The six primary indicators include emergency law and management system, emergency planning and investment, emergency training, emergency warning and recovery. The details of all indicators and hierarchy can be seen in Table 1. The weights of indicators are determined by mathematical calculation. The Analytic Hierarchy Process (AHP) is adopted to carry out the calculation based on the professional knowledge from two experienced experts. Table 2 summarises the weights. With the indicators and their weights, the new evaluation index system can be used to assess the emergency management capability of a community.

The new index system established in this study is used to evaluate the emergency management capability of Xuefu Community. The overall evaluation score of Xuefu Community is 3.9669 which is slightly lower than the good level. It can be said that Xuefu Community’s performance in emergency management is generally good but there are still a lot to improve. According to the analysis, the emergency planning and investment and emergency warning are the weaknesses of emergency management in Xuefu Community because the scores of them are lower than 4. In order to improve the emergency management ability effectively, Xuefu Community can focus on the aspects with low scores. After obtaining the analysis results, this study also gives some suggestions from the perspective of Xuefu Community and Huizhou government to help Xuefu Community to improve its management level. The community has to take actions to overcome its shortcomings mentioned in the analysis section and learn from other outstanding communities while the Huizhou government should give more support and encouragement.
6. Recommendations for Future Work
As this study has evaluated Xuefu Community and made suggestions, it is meaningful to track the long-term changes of the Xuefu Community after the improvement according to the suggestions in this paper. If the future score of each indicator is compared with the present score of each indicator, it will effectively test the effectiveness of the suggestions proposed in this thesis.

In this study, the new evaluation index system of urban community emergency management capacity has only been used to assess Xuefu Community. It is necessary to apply the evaluation system to more places. More questionnaires need to be sent to more urban communities so that the emergency management scores of more communities can be calculated. If the scores of different communities can be obtained and compared, more communities will realize their shortcomings in emergency management and it will be also useful for checking the effectiveness of the evaluation system.

Some indicators and indicator weights may not be well designed and need to be adjusted. If the evaluation and field surveys of a large number of communities are completed and the results are analysed, some small issues of the system may be found. The outcomes may be useful for the calibration of the evaluation index system and some indicators and indicator weights can be adjusted based on the further study [12].

Acknowledgments
First and foremost, we would like to thank Sophia University for support. We would like to thank Xie Yili and Li Xuening for introducing us to government experts. We would also like to thank all those who fought hard against COVID-19.

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