# Enhancement of Taiwan Local Government Disaster Management Capacity by National Policy: A Performance Evaluation

Jieh-Jiuh Wang

***Abstract*—**The performance and outcomes of national policy should be examined thoroughly to ensure proper governance, especially when vast expenditure was invested on strengthening disaster management capacity. However, disaster management is not easily quantifiable and disaster frequency, scale, as well as loss are often only understood as probabilities. Hence, the method of evaluation is a crucial issue. This paper examines Taiwan's national disaster policy, namely the Program of Disaster Management Capacity-Building for Local Governments, which had a budget of USD 13,256,000 (currency rate in Sept. 2016) over its 5-year implementation period from 2009 to 2013. To evaluate the effectiveness of national policy, this study employed performance assessment questionnaires for the program's primary participants, namely professional assistant teams, county and city governments, and local governments. The local governments were divided into participant or nonparticipant groups, and the questionnaires were completed both before and after execution of the program for comparison. The questionnaire was divided into five sections: attitude and cognition, mitigation and preparedness, emergency response, recovery and reconstruction, and overall benefits. The results show that all local governments have clearly enhanced their mitigation, preparedness, and emergency response capabilities, and that the relevant members have increased their disaster management knowledge and skills, as well as benefitting from changes in attitude.

***Keywords*—**Disaster management, local capacity-building, national policy, performance evaluation.

## I. Introduction

Disaster Management (DM) refers to a continual and dynamic planning and management process for reducing risk. In the hazard mitigation phase, the management and planning of nonstructural policy and the construction of specific response facilities are used to prevent and minimize the impact of disasters. With the expectation that every country and region list hazard mitigation as a national and regional priority, the United Nations held the World Conference on Disaster Risk Reduction in Hyōgo, Japan, in 2005. The Hyōgo Statement and the 2005–2015 Hyōgo Framework of Action (HFA) were developed during this conference.

Taiwan is situated in the West Pacific typhoon area and west of the circum-Pacific seismic zone on the boundary between the Eurasian Plate and the Pacific Plate, making it a hazard-prone area. According to the *Disaster Prevention and Protection Act* and the *Local Government Act*, the DM system in Taiwan is divided among three hierarchical levels: the central government, county and city governments, and local governments. The city and county governments and local governments are jointly responsible for regional DM implementation. Research into the 1999 Chi-chi Earthquake in Nantou County, Taiwan, has uncovered that the lack of command centers with substantial effectiveness, miscommunication, the lack of an effective cooperation mechanism between the civilian government and the military, and inadequate staffing levels were factors causing insufficient DM capacity[1]-[3]. To promote the city and county governments' DM capability and enhance local governments' DM systems and operational efficiency, the central government approved and promoted the *Program of Disaster Management Capacity-Building for Local Governments* (DMCB) in October 2008.

## II. Performance Evaluation

Proposed by Peter F. Drucker in 1954, performance evaluation was initially applied in enterprise management but thereafter was widely used to evaluate all types of organizations' management effectiveness and personal work results [4]. Performance evaluation uses systematic scientific methods to perform examinations and evaluations on entire organizational, departmental (group), and employee performance and contributions regarding executing and reaching organizational goals, thereby assisting managers to improve work procedures, organizational work force plans, resource applications, and management [5]-[8]. It is not aimed at finding deficiencies or problems, but at determining the causes of these through evaluation in order to avoid waste, to make appropriate utilization and distribution, and to provide ideas for improvement, as well as to enhance production or service quality and quantity [9]-[11].

DM is inherently difficult to quantify. Moreover, disaster frequency, scale, and loss are measured on the basis of probability. Likewise, disasters with large losses are not necessarily the result of ineffective DM performance [12]. The type of evaluation method used is therefore a crucial concern.

In 1997, the Federal Emergency Management Agency (FEMA) and the National Emergency Management Association in the United States co-developed a regional disaster prevention evaluation system called the Capability Assessment for Readiness for state and local governments to evaluate the performance of the states with regard to the Multi-Hazard Mitigation Planning program funded by FEMA.

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Under every function, there is an evaluation index that mainly addresses the following questions:

1. Has the model made an overall consideration for the state government?
2. Has it reached the target and mission?
3. Can the allocated resources really help citizens when disaster occurs?

The evaluation results are used as the basis for U.S. financial institutions to issue disaster relief emergency funds to state and local governments.

In 2003 and 2005, the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications of Japan initiated a disaster prevention capacity evaluation on the disaster preparedness of Japan's metropolises, circuits (territories), prefectures, and urban prefectures. The evaluation is based on all types of potential disaster risks and relevant projects, and the evaluation targets include regional public groups above a certain size. The evaluation dimension includes disaster types, strategy levels, and DM targets, and uses a set of nine targets of evaluation for DM preparedness capacity based on a DM procedure for risk evaluation, mitigation and preparedness, project approaches, and implementation results [13].

The state governments of Australia established the role of Inspector-General for Emergency Management to ensure that the optimal whole government and whole community arrangements exist to respond to emergencies and disasters. The *Disaster Management Act* provides the authority to develop DM standards and to review and assess the effectiveness of DM to enable a level of confidence in DM arrangements. The framework is comprised of three main sections: Principles, the Standard for Disaster Management, and Assurance Activities.

Although Taiwan started its DM evaluation of local governments in 2003, Chuang et al. (2012) argued that the evaluation concentrated heavily on emergency management based on an annual evaluation questionnaire. The question items were drafted by each ministry, resulting in excessive and repetitive items that lacked comprehensive continuity and strategic consistency.

## III. Introduction of the Program of Disaster Management Capacity-Building for Local Governments

### A. Program Introduction

THE DMCB planned that the central government could first provide appropriate budget, resources, technology, and experience to guide local governments to enhance their DM capability in all locations throughout the nation. The regional DM network could then be connected through the assistance of county and city governments and the central government could define relevant tasks and provide technology and recommendations for relevant operations.

The DMCB had four objectives: 1. setting up the DM operation mechanism; 2. cultivating fundamental DM mobility capacity; 3. enhancing regions' DM capacity; and 4. replenishing emergency operation center (EOC) facilities. For the program objectives, 15 work items were set (Table I) on the basis of five dimensions, namely "assessment of the characteristics of hazard potentials," "establishment of the DM system," "cultivation of DM capacity," "installation of disaster emergency response mechanism," and "integration of DM resources."

TABLE I
DISASTER MANAGEMENT CAPACITY-BUILDING TASK ITEMS

| Five Major Dimensions | Task Items |
|---|---|
| Assessment of the Characteristics of Hazard Potentials | 1. To carry out local governments' investigation on regional hazard potentials and to develop/ propose disaster relief and response strategies. |
| Establishment of the DM System | 2. To review the DM division of work and operation mechanism between the county/city and local governments. |
| | 3. To review and revise local governments' regional DM plans |
| | 4. To stipulate local governments' SOP for all types of disasters in accordance with the disaster category set by local governments |
| | 5. To stipulate supply storage mechanism and sign livelihood supply related contracts with non-government groups in order to receive necessary supplies during the disaster. |
| | 6. To revise current disaster reporting, evacuation measure, and disaster investigation and reporting procedures and relevant works. |
| Cultivation of DM Capacity | 7. To compile teaching materials for DM educational trainings; to cultivate the DM literacy of county/city and local government personnel. |
| | 8. To cooperate with plans for disaster prevention community project; to assist and guide local government offices to promote disaster prevention community works during the project period. |
| Installation of Disaster Emergency Response Mechanism | 9. DM response drills for local government offices. |
| | 10. To set DM response mechanism for local governments. |
| | 11. When county/city governments' EOCs are opened, professional assistant team shall station in the center and assist to study, analyze and anticipate the impacts of the disaster. |
| Integration of DM Resources | 12. To establish/ update local governments' DM electronic map data. |
| | 13. To investigate county/city and local governments' DM personnel, supplies, premises, vehicles, equipment, machines and other resources. |
| | 14. To evaluate the shelter capacity of evacuation sites. |
| | 15. To set the evacuation and escape routes for dangerous areas; to choose 1 local government every year as the demonstrator of installing the disaster prevention and evacuation board. |

Source: National Fire Agency, Ministry of the Interior (2013)

### B. Program Framework and Execution

The DMCB had a total budget of USD 13,256,000. The 5-year implementation period was from 2009 to 2013. The program for the county and city governments was divided into three stages, and each stage was 3 years. A total of 135 local governments participated in the program. The National Fire Agency was mainly responsible for setting up communication, coordination, and operation mechanisms to promote the DMCB, and for developing, integrating, and transferring DM technology and policy evaluation in order to execute the DMCB, including making recommendations on reviews of regional DM operations and the format of the DM map,

planning forward local governments' DM missions and regional DM plans, and carrying out the development and evaluations of operation-related recommendations. Local governments were responsible for executing the program, whereas all county and city governments were responsible for controlling the work progress as well as coordinating, integrating, and negotiating local DM capacity and operations.

## IV. Research Design

To evaluate the effectiveness of DMCB national policies regarding promoting regional DM capacity, this study developed a performance assessment questionnaire according to the plan content to investigate the DMCB's primary participants: professional assistant teams, county and city governments, and local governments. The local governments were divided into participants in DMCB (DMCB-J) and nonparticipants in DMCB (DMCB-N) to facilitate understanding of DMCB-J, DMCB-N, and enable comparison before and after DMCB execution. On the basis of the DMCB work items, the content of the questionnaire was divided into 5 sections: attitude and cognition, mitigation and preparedness, emergency response, recovery and reconstruction, and overall benefits (see Fig 1).

Questions related to this section mainly discuss interviewees' understanding of, and information regarding, disasters that had occurred in the region, the types of disasters most likely to occur, the causative factors, and the response strategy. These questions were developed to determine whether DMCB helps to enhance disaster cognition.

Mitigation and preparedness, emergency response and recovery, and reconstruction are three major aspects of DM. Nine items are listed under mitigation and preparedness, and seven under emergency response, according to the content of DMCB task items. These aspects were used to enhance understanding of whether the DMCB has equipped all types of preparedness resources, actions, and quality, before and after execution. Although recovery and reconstruction is not the emphasis of the DMCB, relevant questions were designed to understand currently recruited volunteer organizations' experiences in assisting with post-disaster recovery works.

A four-scale design was adopted for questions related to causative factors within the region, DM work cognition, and interviewees' feelings toward the assistance of DM educational training, teaching materials, and overall planning. The scales were *well understood/very helpful*, *understood/helpful*, *slightly understood/a little helpful*, and *not understood/not helpful*. The quality of items under "mitigation and preparedness" and "emergency response" also used a four-scale design. The percentage of items replied to with "yes" was considered as the achievement rate of each item. Regarding the quality of each item, a comparative analysis of the achievement rate and quality was carried out according to interviewees' cognition of the implementation quality of each item. The items were divided into *very bad*, *bad*, *good*, and *very good* and a score of 1 to 4 was given to each item accordingly to calculate the average score of an item category. An even number scale was used to determine the inclination of respondents. One-way analysis of variance (one-way ANOVA) was also performed on the four types of interviewees (i.e., DMCB-J, DMCB-N, city/county governments, and professional assistant teams) to understand if any marked difference existed between interviewees with different attributes.

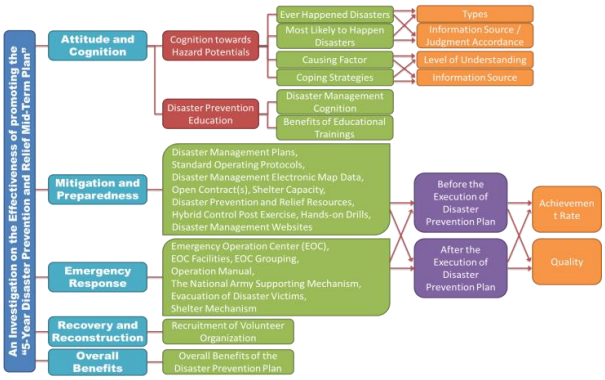



Fig 1. Framework of the questionnaire content

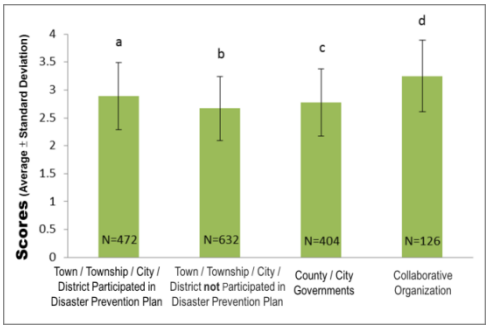
A pretest was conducted in November 2011. This investigation retrieved 96 valid questionnaires with a collection rate of 92.3%. After being conducted from February 25 to March 20, 2013, the questionnaires were sent to county and city governments and handed down to the appropriate county and city government units, local governments (including DMCB-N), and professional assistant teams. A total of 1,907 questionnaires were collected by the county and city governments. Although some questionnaires were not completely answered, they were considered valid and used in the statistical analysis (missed answers are presented as missing values). On the basis of the filtering method, the investigation retrieved 1,658 valid questionnaires with a collection rate of 86.9%. Regarding the interviewees of valid questionnaires, 1,125 were from local government employees, including 472 DMCB-J local governments (28%), 653 non-participants (36%), 407 county and city governments (25%), and 126 professional assistant teams (8%). Over 65% were men (1,117 people) and 973 were nonsupervisors (60%). Some had worked for the organization for 2–5 years (393 people; 23.7%) or had more than 20 years' experience in public service (401 people; 24.2%).

## V. Survey Results

### A. Attitude and Cognition

#### Cognition of Hazard Potential

Regarding interviewees' understanding of the causes of, and response strategies for, disasters within the region, 70% had a basic understanding of the mechanism of disaster (1,156 people) and response strategy (1,141 people). The results of one-way ANOVA on the causative factors and response strategies of DMCB-J, DMCB-N, county/city governments, and professional assistant teams shows significance (causative factor $F = 37.9$, $df = 3$, $p < .01$; response strategy $F = 33.4$, $df = 3$, $p < .01$). In addition, professional assistant teams scored significantly higher than DMCB-J did; and DMCB-J scored higher than county and city governments did. DMCB-N exhibited the lowest understanding of the mechanisms (see Figure 2).

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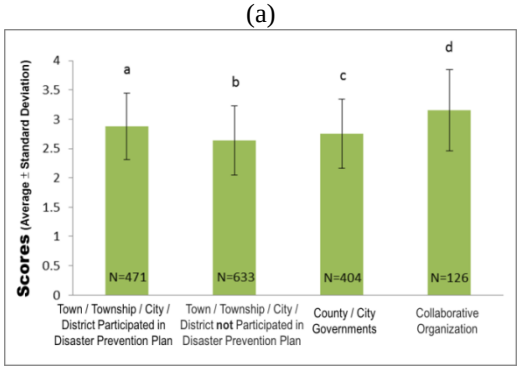



(b)

Fig 2. Interviewees' understanding of (a) causative factor and (b) response strategy. Letters (a, b, c, and d) denote a clear difference in the one-way ANOVA ($p < .01$).

The major information source for professional assistant teams was DMCB (102–116 people; 81%–92.1%), followed by practical experience (63–85 people; 50%–67.5%) and literature review (60–78 people; 47.6%–61.9%). The major information source for county and city governments and DMCB-J was practical experience (county and city governments: 290–331 people, 71.8%–81.9%; DMCB-J: 336–400 people, 71.6%–84.7%) followed by DMCB (county and city governments: 188–209 people, 46.5%–51.7%; DMCB-J: 216–260 people, 45.8–55.4%). The principal information source for DMCB-N interviewees was practical experience (505–559 people, 78.8%%–86.3%) followed by literature review (130–143 people, 20.2%–22.1%) (see Fig 3).

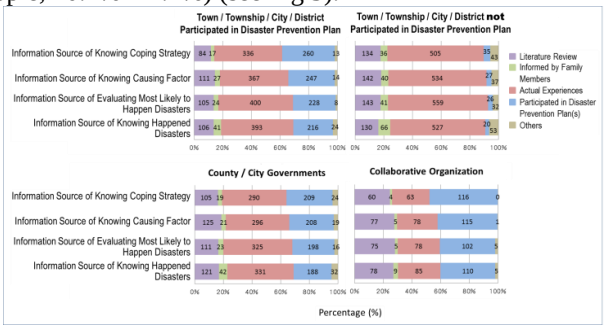



Fig 3. Source of interviewee-relevant disaster cognition

## DM Education

Approximately 84% of the interviewees had never participated in DM educational training before the DMCB. Among them, the proportion of professional assistant teams was the highest, at 93.7% (118 people), followed by DMCB-J at 87.2% (407 people) and county and city governments at 83% (333 people). The DMCB-N interviewees had the lowest proportion at 80.6% (520 people).

Regarding interviewees' knowledge of DM tasks (see Fig 4) and the assistance provided by DMCB lecture materials and educational training (see Fig 5**Error! Reference source not found.**), the one-way ANOVA results showed differences in the four major cognition types (understanding: $F = 18.61$, $df = 3$, $p < .01$; assistance of lecture materials: $F = 28.55$, $df = 3$, $p < .01$; assistance of educational training: $F = 23.28$, $df = 3$, $p < .01$). In addition, interviewees of professional assistant teams had a superior understanding of DM tasks compared with other interviewees; officials of county and city governments and DMCB-J had a considerable level of understanding, and DMCB-N interviewees' level of understanding was lowest.

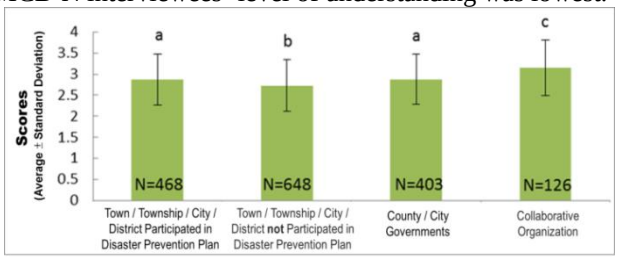
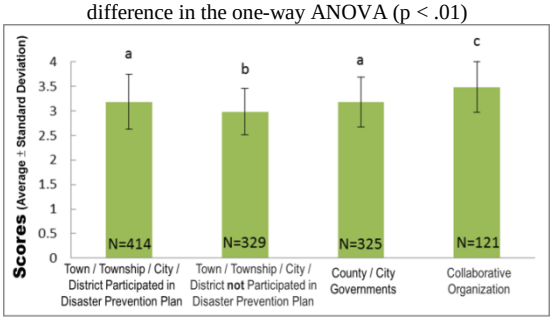



Fig 4. Interviewees' understanding of DM tasks; a, b, c, d denote a clear difference in the one-way ANOVA ($p < .01$)

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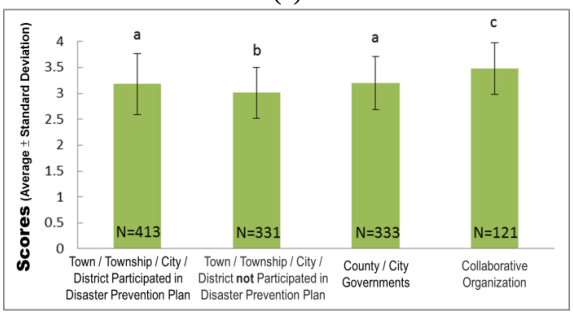


(b)

Fig 5. Supports from the DMCB (a) lecture materials and (b) educational trainings; a, b, c, d denote a clear difference in the one-way ANOVA ($p < .01$)

### *B. Mitigation and Preparedness*

The cognition of interviewees regarding all mitigation and preparedness items before and after the execution of the DMCB is shown in Figure 6 (achievement rate) and Figure 7 (average score). Before the implementation of the DMCB, mitigation and preparedness tasks with an overall achievement rate below 60% included establishment of dedicated DM websites (34.2%), collection (update) of local governments' DM electronic map data (39.9%), hybrid control post (table-top) exercises (51.2%), and stipulated SOPs for various types of disasters (59.3%). Regarding the quality of tasks, all of the items showed an

unfavorable performance and the average score was from 2.29 to 2.79, below 3 (good). After the implementation of DMCB, the achievement rate for all mitigation and preparedness items exceeded 90% overall (92.2%–99%) and the quality of all items was above 3 (good) with average scores ranging from 3.28 to 3.36. This shows that DMCB helped to enhance the achievement rate, quality of mitigation and preparedness, resources, and actions. Performance on the installation of specialized DM websites, installation (updating) of local governments' DM electronic map data, implementation of hybrid control post exercises, and stipulation of all types of disaster SOPs was particularly marked.

Notably, among the four categories of interviewees, the achievement rate for all categories of DMCB-N mitigation and preparedness items generally showed a higher level of self-cognition. Apart from the establishment of specialized DM websites (45%), hybrid control post exercises (56.2%), and the collection (update) of local governments' DM electronic map data (58.2%), which showed achievement rates lower than 60%, other items exhibited an achievement rate of approximately 70%–80%. However, their quality level was lower than 3 and the average score was from 2.54 to 2.96, indicating an unfavorable performance. Such a result may be explained by the absence of guidelines and assistance for DMCB-N. The DMCB-N's recognition of quality is based on a lack of appropriate knowledge being transferred by education and training.

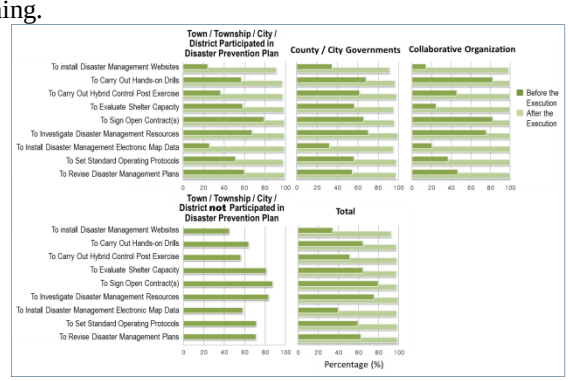


Fig 6. Achievement rate for mitigation and preparedness items before and after the execution of DMCB

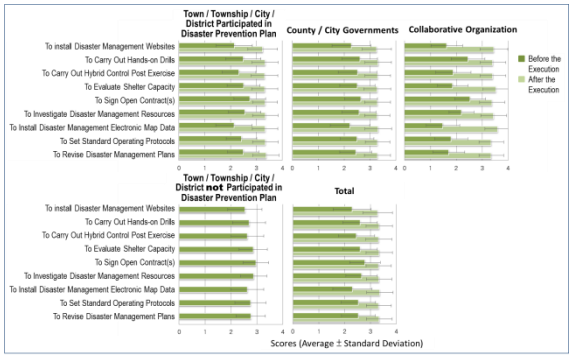


Fig 7. Quality of mitigation and preparedness items before and after the execution of DMCB

### *C. Emergency Response*

For interviewees with different attributes, their cognition of all emergency response items before and after the implementation of the DMCB are shown in Fig 8 (achievement rate) and Fig 9 (quality, average score).

After the implementation of the DMCB, the achievement rate for all emergency response items was close to 100% (98%–99.6%), the quality was above 3 (good), and the average score ranged from 3.4 to 3.45. The results suggest that the DMCB might have enhanced the quality of emergency response especially with respect to the improvement of EOC facilities and the stipulations of EOC operation manuals, which comprised the physical difference before and after the DMCB. Moreover, compared with the mitigation and preparedness items, all emergency response items showed a relatively higher achievement rate than before the implementation of the DMCB. This also shows that before the implementation of the DMCB all local governments' DM tasks were focused on only the response phase.

DMCB-N also believed that they have well-prepared emergency response projects, and exhibited higher self-cognition. The achievement rate for all emergency response items was higher than 60%. Nevertheless, the actual quality still tended to be relatively low and most items' average score was lower than 3. Apart from the establishment of EOC (3.09) and EOC groupings (3.01), the overall performance was unfavorable. This shows that members of the DMCB-N group might not have understood the definition and standards entailed in being "well-prepared;" this understanding is critical for examining and assessing relevant tasks in the response phase, enabling effective enhancement of the level of necessary preparation for response operations.

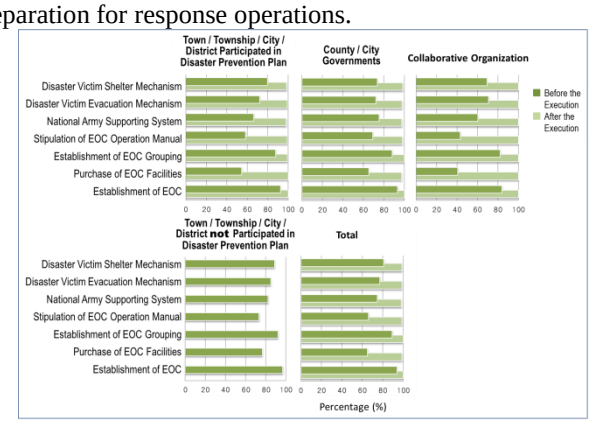


Fig 8. Achievement rate for emergency response items before and after the execution of DMCB

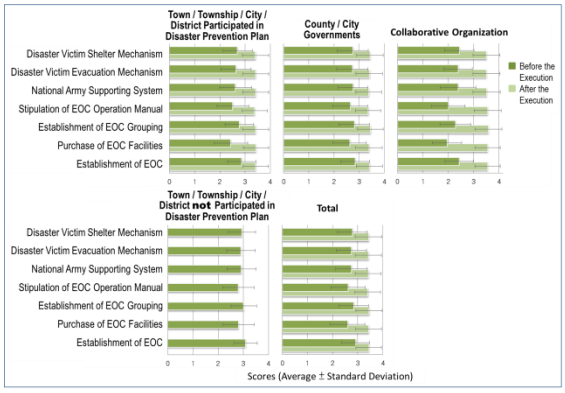


Fig 9. Quality of emergency response items before and after the execution of DMCB

### D. Recovery and Reconstruction

The recruitment and organization of volunteer organizations is an essential aspect of post-disaster recovery activities. After deducting 24 missing values, only 63 interviewees (3.9%) had experience recruiting volunteer organizations (see Fig 10).

Of the interviewees from volunteer organizations, 25 assisted in Typhoon Morakot events (2009), 10 assisted in Chi-chi Earthquake events (1999), 5 assisted in Typhoon Saola events (early August 2012), 4 assisted in Typhoon Nari events (2011), 4 assisted in Typhoon Megi events (2010), 4 assisted in Severe Tropical Storm Talim events (June 2012), and 3 assisted in Typhoon Tembin events (August 2012).

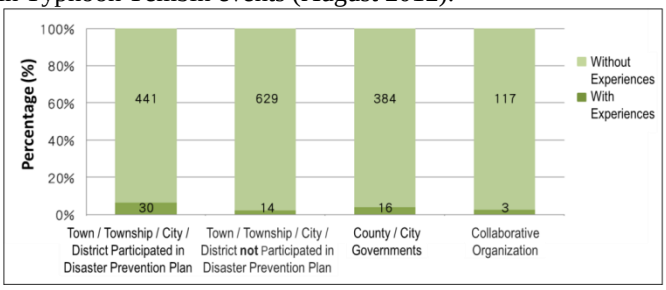


Fig 10. Interviewees' experience recruiting volunteers

### E. Overall Benefits

Regarding assistance effected by the implementation of DMCB with respect to the enhancement of local governments' DM capacity, a total of 251 DMCB-N samples were obtained after deducting 458 missing values. Professional assistant teams showed the highest rating regarding DMCB support ($3.67 \pm 0.52$), followed by county and city governments ($3.33 \pm 0.60$). The DMCB-J group reached $3.26 \pm 0.63$. The results of one-way ANOVA indicated that these three categories of interviewees had a significant difference in their scores ($F = 21.1$, $df = 2$, $p < .01$). Professional assistant teams provided a relatively high rating regarding the support of DMCB, whereas interviewees of DMCB-J and county and city governments rated the benefits of DMCB quite similarly (see Fig 11).

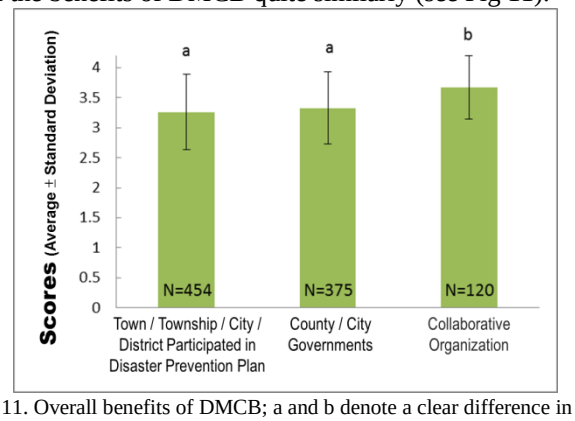


Fig 11. Overall benefits of DMCB; a and b denote a clear difference in the one-way ANOVA ($p < .01$)

## VI. Discussion

### A. Reliability of the Questionnaire

This research did examine the questionnaire reliability through statistics to ensure the reliability of the results. From interviewees' feedback regarding cognition of hazard potential, it is known that typhoons, floods, earthquakes, and debris flows are the four major recognized hazards (disasters that had occurred, and were most likely to occur, within the region). This result corresponds with Taiwan's current disaster statistics. In the 44 years between 1958 and 2001, typhoons were the natural disasters that occurred most frequently (213 times), followed by floods (37 times) and earthquakes (17 times).

### B. Effectiveness of DMCB

Through the use of DM educational and training courses and lecture materials, DMCB-J showed a relatively high level of participation and satisfaction, demonstrating the success of DMCB in education and training. Because the DMCB also requested DMCB-N to participate in relevant educational training, it also brought some benefits to nonparticipating local governments with respect to support for DMCB educational training.

After the implementation of DMCB, all mitigation, preparedness, and emergency response items of DMCB-J reached an achievement rate close to 100% and the average scores were all above 3 (*good*), proving that DMCB helped to enhance the overall activities of DM, namely specialized DM websites, DM electronic map data, hybrid control post exercises, disaster response SOPs, and EOC facilities.

In summary, from the perspectives of professional assistant teams, county and city governments, and DMCB-J, the implementation of DMCB provided effective assistance regarding the enhancement of local governments' DM capabilities (with an average score of 3). This shows that the implementation of DMCB definitely helped to enhance local governments' DM capabilities, exhibiting considerable benefits and clear effectiveness.

## VII. Conclusion

Ideally, the disaster management is mostly autonomous for local governments. However, due to the past history of a strong central government controlled governance structure, the local governments do not have the resources and flexibility to adapt to their unique situation. In the absence of appropriate laws, regulations, resources, and risk communication, local governments did not have good practices nor able to take care of themselves during disaster.

The Taiwanese government has invested an enormous amount of resources in promoting DMCB as a national policy. Through appropriate facilities and equipment, DM maps, DM plans, and the establishment of SOPs, the government has appropriately and effectively enhanced the DM capacity of local organizations and personnel. All local governments have shown enhanced mitigation and preparedness and emergency response capabilities, and the relevant members have exhibited growth in DM-related knowledge and benefitted from a change in attitude.

Beginning with attitude and cognition, DMCB-J interviewees showed a better understanding in their cognition towards DM works, causative factors, and response strategies than DMCB-N interviewees did in this investigation. Through education and training programs during the implementation of DMCB, local government officials established a positive DM

attitude, gained DM knowledge, and recognized the importance of DM tasks.

With the help of collaborative teams, DMCB established or improved the hazard mitigation and preparedness of local governments not only by providing guidelines and technical assistance but by networking county and city governments, utility services, military units, and volunteer groups. Activities such as the investigation of hazard-prone areas, production of maps, stipulation of manuals and SOPs, examination of shelters, installation of signs and boards of evacuation maps, and the establishment or renovation of EOCs and ICT equipment represent a real improvement in mitigation and preparedness. These outcomes form the basis for strengthening disaster response.

## REFERENCES


[1] Y. F. Chan, K. Alagappan, A. Gandhi, C. Donovan, M. Tewari, and S. B. Zaets, "Disaster management following the Chi-Chi Earthquake in Taiwan," Prehospital and Disaster Medicine, vol. 21, no 3, pp. 196-202, 2006. https://doi.org/10.1017/S1049023X00003678

[2] K. T. Chen, W. J. Chen, J. Malilay, and S. J. Twu, "The public health response to the Chi-Chi earthquake in Taiwan, 1999," Public Health Reports, vol. 118, no 6, pp. 493-499, 2003. https://doi.org/10.1016/S0033-3549(04)50285-6

[3] E. B. Hsu, M. Ma, F.Y. Lin, M. J. Van Rooyen, and F. M. Burkle, "Emergency medical assistance team response following Taiwan Chi-Chi earthquake," Prehospital and Disaster Medicine, vol.17, no. 1 , pp. 17-22, 2002. https://doi.org/10.1017/S1049023X00000066

[4] Z.L. Chen, Z.R Chen, and C. H. Wang "A study on development of performance indicators for evaluating agricultural extension organizations," *Journal of Agriculture and Forestry*, vol. 54, no. 4, pp. 339-358, 2005.

[5] Y. Y. Kuo, "Performance evaluation on government organizations," *RDEC Bimonthly*, vol. 25, no. 4, pp. 30-38, 2001.

[6] C. Y. Li, "Research the enterprise flow internal performance evaluation indicators establishment--- Take the systems science theory as the discussion," M.S. thesis, Dept. Business Admini., Chung Yuan Christian Univ., Taoyuan, Taiwan, 2004.

[7] P.C. Sun, "The records management based on the perspective of performance evaluation,"*Archives Quarterly*, vol. 2, no. 4, pp. 11-21, 2003. (in Chinese)

[8] C. C. Yang, M. C. Ho, and K. H. Chen, "A preliminary model for the evaluation of non-profitable design organization performance," *The Journal of Design Research*, vol. 2, pp. 183-192, 2002

[9] C. H. Li and W. P. Fang, *Theory and Practice of Enterprise Performance Evaluation*, Taipei: Super A Plus Consultant Service Co. Ltd.,1996.

[10] H. C. Teng, "The relative efficiency and associated factors analysis of teaching hospitals and visiting staffs," M.S. thesis, Dept. Public Health, Kaohsiung Medical Univ., Kaohsiung City, Taiwan, 1995.

[11] L. F. Xie, "Multiple criterion evaluation study and its practice on organizational performance evaluation," M.S. thesis, Dep. Industrial Engineering and Engineering Management, National Tsing Hua Univ., Beijing, China, 1988.

[12] B. J. Shih, S. S. Ke, and K. H. Chen. (September 2014). The Study of government's capability on disaster prevention and response by the strategy-oriented annual evaluations. [Online]. Available: http://ncdr.nat.gov.tw/enhance/Upload/200812/admin_20081226152020_96%20政府災害管理績效評估計畫之探討.pdf (in Chinese)

[13] M. R. Chuang, C. L. Hsu, S. I. Chang, and W. C. Li. (September 2014). Status quo and visions of Local governments disaster management. *epaper of Disaster Management* [Online]. 87. Available: http://www.tainan.gov.tw/disaster01/warehouse/A00000file/NCDR87期資料.pdf (in Chinese)



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