Identification of Factors Affecting Stakeholders' Intentions to Promote Preparedness in Disaster Waste Management : A Structural Equation Modeling Approach

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by

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Abstract

Preparedness in disaster waste management is a critical stage to achieve resilience. Stakeholders in developing countries find it very difficult to formulate preparedness plans because of complex issues and poor management. They perceive that introducing such a program would need special budgeting and efforts that differ from those used for day-to-day waste management, not realizing that the principal factor is their degree on intention. By using structural equation modeling, this study examines the factors that affect stakeholders` intentions. By exploring the waste management program in Banda Aceh following the Indian tsunami in 2004, we find that the factor of awareness of the difficulty running a 3R (reduce, reuse, and recycle) program was the most important factor to preparedness with a correlation coefficient of 0.89. Other factors that have a significant effect are awareness of cooperation with other organizations (correlation coefficient: 0.83) and concern about previous experience affecting stakeholders' intentions (correlation coefficient: 0.78). Other factors identified are awareness of the insufficiency of performance and facilities (correlation coefficient: 0.67) and concern about disaster waste knowledge (correlation coefficient: 0.22). This study suggests promoting preparedness in disaster waste management could start from carrying out simple tasks such as regularly maintaining waste facilities before moving onto complicated issues such as cooperating with private companies and other governments both horizontally and –vertically

Keywords: Disaster waste management, Preparedness, Structural equation modeling, Developing countries

1. Introduction

This research defines promoting preparedness in disaster waste management (DWM-P) as stakeholders measures or efforts to anticipate the failure of a waste management system when handling disaster waste[1,2)]. Hence, DWM-P is defined as a status or condition of a DWM system for a waste needs long time to manage normally[3,4)]. In DWM, an adequate degree of resilience

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depends on the speed at which a system can initiate a clean-up response in order to reduce, reuse, recycle and reproduce for recovery and then discharge the remaining material in environmentally manner. DWM-P thus requires redesigned program such as pre-planning post DWM[4,5], and capacity building[6]. This research examines the factors of a hierarchical structural model that affect the promotion of DWM-P.

A high level of DWM-P is not only influenced by detailed programs for pre-planning and capacity building. Paton (2001) introduced a general conceptual model of disaster preparedness as a process of public education that aims to enhance community awareness[7]. However, research on DWM-P is generally limited[8]. Despite the psychological aspects, stakeholder participation has been introduces to overcome the challenges of DWM, however, this has only focused on operational efficiency[9]. Moreover, research on stakeholders' intentions to promote preparedness not yet been conducted[9,10].

Shimaoka (1995) proposed a foundation model for investigating disaster waste generation and disposal measures by exploring the Great Hanshin-Awaji Earthquake, of 1995[11]. This line of research was continued by Hirayama (2010), who utilized advanced GIS methods[12]. Foundation models provide data on disaster waste generation. This method could also be used to formulate mitigation plans. However, even though developing countries receive training programs from international donors, most cannot maintain sustainability[13]. This study evaluates stakeholders' responses to and awareness of the adaption of this method for waste management services.

Nakamichi (1995) investigated an initial system for managing 3R (reduce, reuse and recycle) and used the possibility method to explore the Great Hanshin-Awaji earthqauke[14]. Harukaze (1997) extended this model by proposing an intermediate treatment for DWM[15]. A comprehensive model that evaluates intermediate treatment and the 3R methodology was then established by Hu and Sheu (2013), who examined waste from the Great Hanjin Eartqauke[16]. The model assessed the effectiveness of comprehensive-disaster waste handling, from collection, reduce, reuse, recycle, reproduce and discharge of the remaining material and integrated three essential issues, namely cost, environmental considerations, and waiting time. This present study determines stakeholders' perceptions, awareness and preparation by applying this method in developing countries.

Asari et al.(2013) considered issues related to the coordination of stakeholders at the central, prefectural and local government levels when sharing resources such as collection, transfers, and final waste disposal[17], while Tajima et al (2014), explored institutional changes in coordinating and handling waste from the Great East Japan Earthquake 2011[18]. Readiness to coordinate, and willingness to accept waste and provide disposal sites indicate a high degree of preparedness. This study measures stakeholders' preparedness toward public-private cooperation problems in developing countries.

Extending Harukaze`s studies, Feter and Rakes (2012) expanded the notion of intermediate treatment by proposing a conceptual framework incorporating temporary sites and a recycling process[19], while Lauritzen (1998) proposed an economic model for assessing the effectiveness of the emergency construction of disaster waste treatment plants[20]. Because of the procurement processes in developing countries, purchasing equipment can take a long time. This study thus evaluates the impacts of previous experience on fostering DWM-P.

The Indian tsunami of 2004 was one of the hugest calamities suffered by developing countries. this study utilizes the subsequent waste management program in Banda Aceh, Indonesia in order to design the factors that affect promoting DWM-P. Two main questions are thus addressed in this research: what factors influenced promoting DWM-P? and how was the causal correlation between these factors constructed?

2. Development Model

2.1 Post-2004 tsunami waste management program in Banda Aceh

The tsunami DWM program in Banda Aceh was one of the most significant DWM exercises carried out by developing countries. This program took a long time, starting in 2005 and finishing in 2012. Many international agencies supported, such as UNDP, GTZ, JICA, VNG, Apeldroon, CALGAP, CRS, Unicef, Citynet-SWM Cluster, and IOM Turk-World Vision[21,22)].

There were several DWM Program in Banda Aceh. the first DWM activity was collecting, sorting and reusing disaster waste. In this stage, a cash work program was launched to encourage community involvement and improved economic opportunities. This program was run because major equipment for collecting had been damaged, government budgeting for such an emergency response (e.q., debris clean-up) was very limited.

Logistics and equipment mobilization for collecting and transferring waste to a temporary storage area was the second DWM stage. The provision of trucks, bulldozers, and excavators was mostly supported by foreign donors. Cooperating and sharing resources with other local or provincial governments could not be achieved. Hence, logistics issues, the procurement of equipment, highly technical machines and methods to operate and understanding how to maintain such machinery, became significant issues in this stage. Despite the accelerating of knowledge through capacity building and workshops, sustainable motivation and awareness also became potential barriers to fostering preparedness.

Demolishing buildings was the third DWM stage in Banda Aceh. This process involve tearing –down damaged buildings and structures by using high-tech applications such as wrecking balls and building implosions. This was a new experience in terms of DWM for the community in Banda Aceh. Stakeholders in Banda Aceh had no experience and few tools and equipment to conduct these activities. Conventional procurement usually carried out to provide waste facility management could not cover the task and therefore assistance from foreign countries was necessary.

Intermediate treatment was conducted by installing hard machinery such as stone crushers to reduce the volume of construction waste. Owing to its magnitude, this construction waste was reused for the recovery roads and other facilities. Processes of disaster waste such as reusing and recycling promoted community understanding, especially in relation with the ideal of DWM. Furthermore, reproducing of tsunami wood was conducted, and then reusing for public facilities such as government offices, schools.

The final treatment of disaster waste necessitated increasing the capacity of the Gampong Java Banda Aceh landfill site. This activity led to constructing the regional landfill site in Blang Bintang outside Banda Aceh in order to accommodate waste disposal from Banda Aceh and North Aceh. The negotiation among the local government, provincial government, and Ministry of Forestry was one of the most importance experiences of this program.

2.2 Development Model of DWM-P

Constructs such as stakeholder motivation, concern, and intention cannot be measured directly because they are latent variables, or factors[23,24)]. The DWM-P model was thus developed by using a structural equation modeling (SEM) approach to merge factor analysis and regression analysis[23,24)]. This study identified five factors as predictor of stakeholders` intentions, which in turn affected DWM-P. This model is depicted (in **Fig.1**) with circles and arrows from left to right, while the observed variables for the factors are depicted with rectangles and arrows from the right to left. Three factors were directly measured by the observed variables. Two factor were explored in detail because of the significance of the DWM-P issues, with the identified four derivative factors depicted with circles and arrows from left to right. This study identified 14 observed variables x_1-x_{14} to measure the predictors, and four observed variables y_1, y_2, y_3, and y_4 to measure the dependent variables. **Figure 1** describes the overall hierarchical structure of the hybrid DWM-P model with mathematical symbols.

As a public service, the performance of DWM is influenced by the motivation levels of the responsible institution[25)]. Paton (2001) argued that promoting preparedness should encourage public involvement[7)]. According to the theory of planed behavior, the degree of performing DWM-P is affected by the degree of a given stakeholders intention[26,27)]. According o these theoretical framework, DWM-P and stakeholders' intentions was formulated as follows:

$$\eta_1 = \eta_2 \beta_{12} \quad (1)$$

The observed variables were a condition that described the readiness plan and action in DWM-P. For illustration, the measurement model of the factors was formulated as the following mathematical equation:

$$y_1 = \lambda_{11} \eta_1 + \varepsilon_1 \quad (2)$$

$$y_4 = \lambda_{24} \eta_2 + \varepsilon_4 \quad (3)$$

Previous experiences determine the degree of stakeholder intention to perform DWM-P. Positive and negative experiences influence preparedness, according to the study by Terptra (2013) that assessed a flood preparedness program in the Netherlands[28)]. Chan et al. (2012) also explored the influence of previous experience preparedness in China[29)]. For illustration, the measurement model of the factor of concern about previous experience was formulated as shown below:

$$x_2 = \lambda_{12} \xi_1 + \delta_2 \quad (4)$$

In developing countries, stakeholders can not implement 3R and organize a proper final disposal because of complex issues such as poor facilities and low skills[16,17)]. The principal goal of promoting DWM is to optimize 3R implementation. Furthermore, 3R implementation is the main activity in every stage of DWM, such as collection, intermediate treatment, and final disposal. Awareness of the need to improve guidelines and readiness of 3R equipment were significant issues in performing the stage of 3R[16,17)]. Two aspects were derivative factors, and thus the overall factor became a second-order factor model[23,24)]. For illustration, the measurement of this second-order factor model is depicted in the formulation below:

$$x_3 = \lambda_{33}\eta_3 + \delta_3 \quad (5)$$

$$\eta_3 = \gamma_{23}\xi_2 + \zeta_3 \quad (6)$$

DWM is part of public service delivery and needs many years if managed normally. The degree of stakeholder awareness of insufficient facilities and waste management capacity thus affect preparedness[25,30)]. For illustration, the measurement model of this factor is depicted as follows:

$$x_7 = \lambda_{37} \xi_3 + \delta_7 \quad (7)$$

According to Paton (2001) one factor that influence preparedness is community perception about hazard risk such as waste[7)]. As a process of increasing education of hazard risk, such as the impact of waste, stakeholder awareness of updating and increasing knowledge affects stakeholders' intentions to promote preparedness. Two aspects as derivative factors concerned providing data and mitigating the impact. For illustration, the second-order factor was measured as follows:

$$x_9 = \lambda_{59}\eta_5 + \delta_9 \quad (8)$$

$$\eta_5 = \gamma_{45}\xi_4 + \zeta_5 \quad (9)$$

To implement DWM-P, local stakeholder must cooperate with other organization[31]. Furthermore, this should be long-term cooperation, not only for the disaster response but also for the whole process of mitigation, preparedness, response and reconstruction. Cooperation with other organization needs awareness in all level of institution. For government it was needs cooperation with central, provincial and local government, as well as from private organizations to prepare the right equipment. For illustration, measurement model for this factor was measured as follows:

$$x_{13} = \lambda_{513}\,\xi_5 + \delta_{13} \quad (10)$$

$$x_{14} = \lambda_{514}\,\xi_5 + \delta_{14} \quad (11)$$

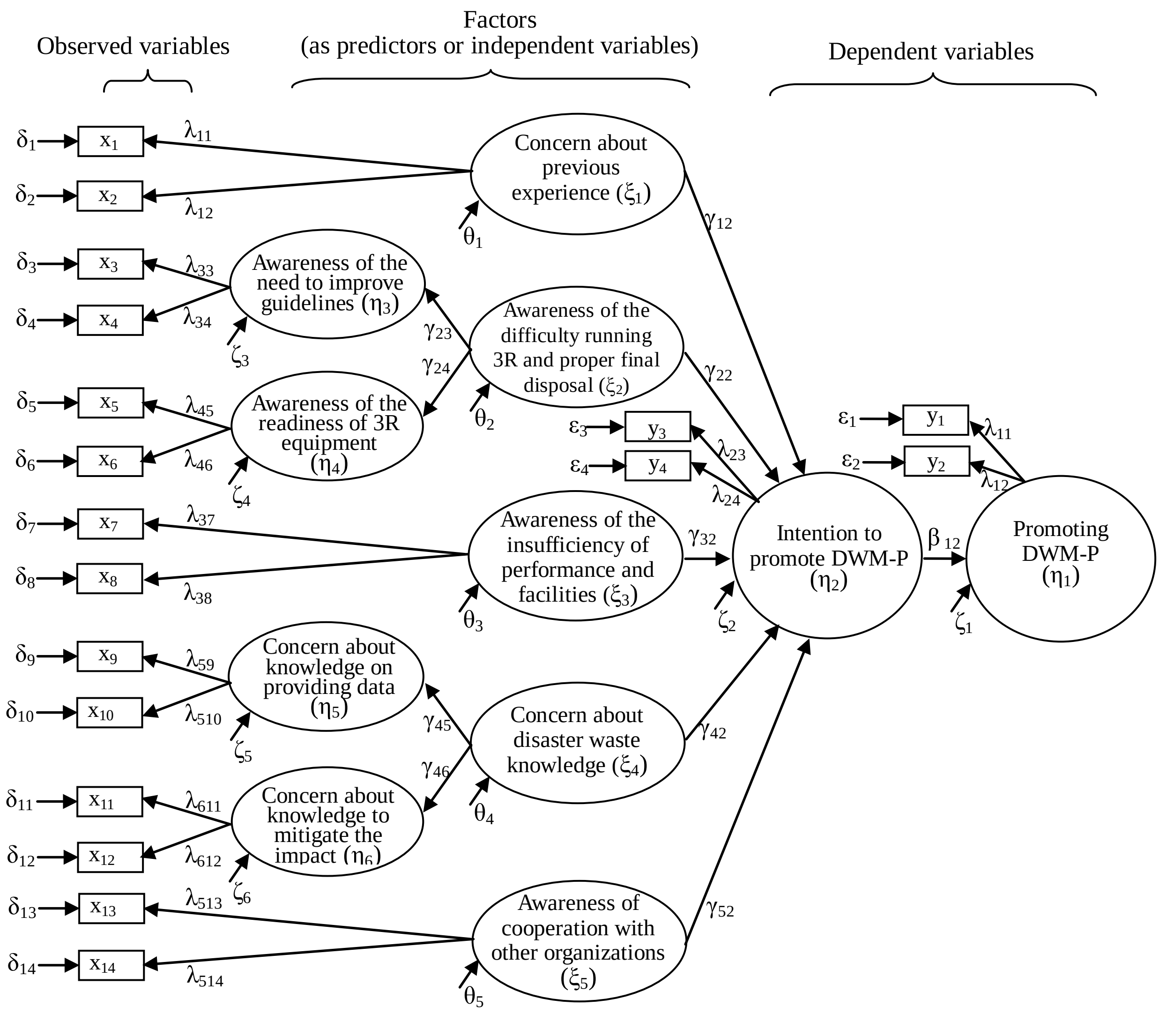

Fig.1 Full hierarchy structural equation model of DWM-P, depicted as a path diagram, hybrid with mathematical symbols.

Figure 2 depicts the simplified DWM-P model. According to this figure, the general mathematical formulation of the model is defined as

$$\eta_1 = \xi_1\,\gamma_{12} + \xi_2\,\gamma_{22} + \xi_3\,\gamma_{32} + \xi_4\,\gamma_{42} + \xi_4\,\gamma_{42} + \xi_5\,\gamma_{52} \qquad (12)$$

where,

- x_i : Observed variable of ξ
- y_i : Observed variable of η
- ξ : Predictor latent variable (factor)
- η : Dependent latent variable (factor)
- λ_{xi} : Loading factor, a relation/path between predictor latent variable & observed variable
- λ_{yi} : Loading factor, a relation/path between dependent latent variable & observed variable
- γ_i : Regression/path predictor latent variable & dependent latent variable
- ζ_i : Residual/Error for η
- θ : Error Measurement ξ
- δ_i : Error Measurement for x
- ε_i : Error Measurement for y
- β : Regression/path one dependent latent variable to others

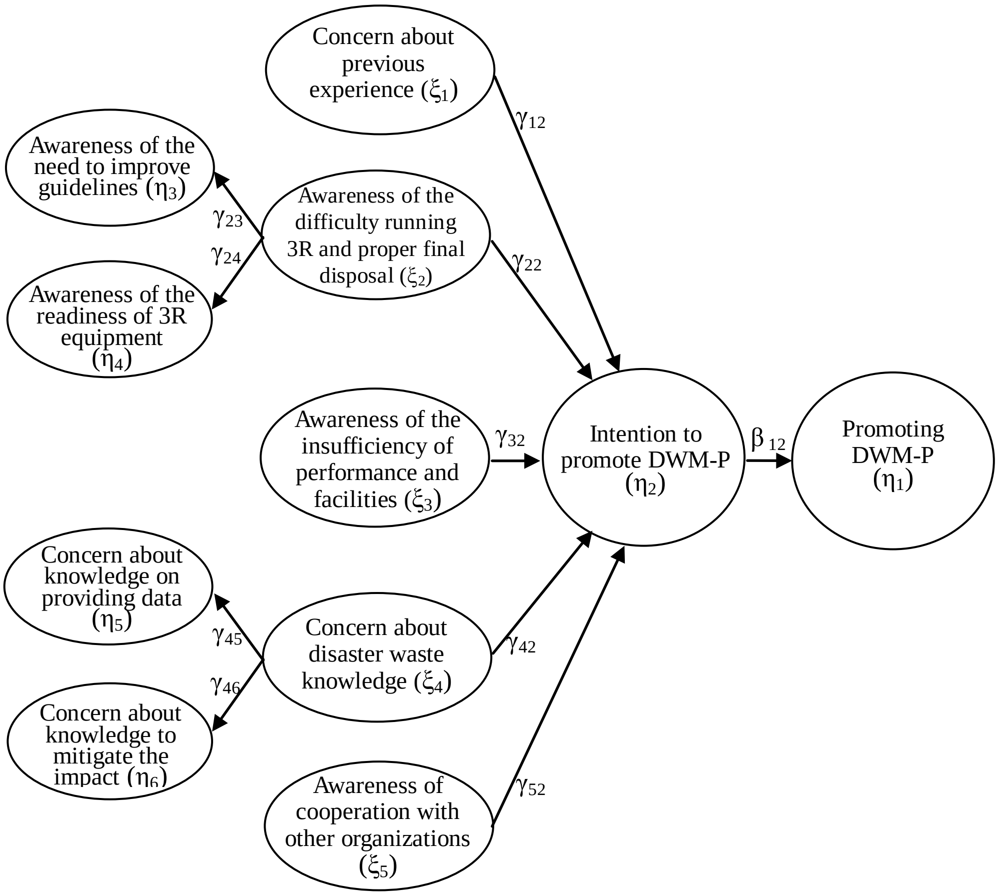

Fig.2 Schematic structural equation model of DWM-P, depicted as a path diagram, hybrid with mathematical symbols.

3. Field survey, sample characteristics, and testing model

3.1 Field survey and sample characteristics

The first field survey administered interviews with the stakeholder groups responsible for disaster management including DWM, such as the national, provincial and Banda Aceh governments, the army and NGOs. A memorandum of understanding between Banda Aceh City, Aceh North Regency, and Provincial Aceh for the Blang Bintang regional landfill management was in preparation when this field survey was organizes. Furthermore, one of tsunami waste management program related to community empowerment for running 3R for plastic and using wood to rebuild furniture waste encountered in this field survey, which ran between September and October 2012. The questionnaire was distributed in October and November 2012.

A second field survey was run in January and February 2013 to gain a representative sample for the testing model. Bentler and Chou (1987) suggested that a sufficient sample is five time the parameter to be estimated[32]. Tabachinick and Fidell (2007), recommended 10 times the parameter to be estimated[33], while Byrne (2001) suggested 100 times[34], and Kline (2005) more than 20[35]. To fulfill the sample criteria, the second stage of the questionnaire was distributed in January and February 2013.

Stakeholders, involved in DWM consist of governmental bodies, formal agencies (both national and international), NGOs (both national and international), private companies, communities, and volunteers. In this study, sample was designed to covers all stakeholders in Banda Aceh. Under normal conditions, the Department of Public work of the provincial government, and Department of Cleansing of the Banda Aceh City government are responsible for waste management. However, in a disaster event, the main responsibility with the Department of Public Works.

The questionnaire was administered to 161 respondents for the testing model. the sample consisted of 32 respondents from the provincial government, 49 from the local government in Banda Aceh, 14 from NGOs and two from industrial companies in Banda Aceh. The rest of the data came from the local government, with 5 respondent from parliament and 21 from Indonesia's sub-district army. Hence, the further assessment of the model's sample classified five groups; all stakeholders (integrated), provincial government, local government, sub-district, army and NGOs.

3.2 Testing Model: Causal correlation of the factors affecting DWM-P

This study utilizes LISREL program student version 8.8[36,37] to examine the model and resolve equation depicts the model. Model testing result shown as a path diagram in **Fig.3**. From the perspective of multiple regression, the correlation coefficient path diagram indicates the degree of influence[38]. Awareness of the difficulty running 3R was the most significant factor with correlation coefficient of 0.89. Two other factors also had a significant effect on performing DWM-P: awareness of cooperation with other organizations (correlation coefficient:0.83) and concern about previous experience (correlation coefficient:0.78). Concern about knowledge had a smaller correlation coefficient (0.22). The correlation coefficient of the factor of awareness of the insufficiency of performance and facilities was 0.67.

Derivative factors, depicted with circles and arrows from the main factors, showed the significant issues when performing DWM-P. Two factors explored more detail, awareness of the difficulty running 3R and concern about disaster waste knowledge showed that the factors of awareness of the need to improve guidelines and awareness of the readiness of 3R equipment were validated as significant derivative factors, with correlation coefficient of 0.98 and 0.87.

Furthermore, knowledge to providing data and to mitigate the impact had coefficients of 0.94 and 0.74.

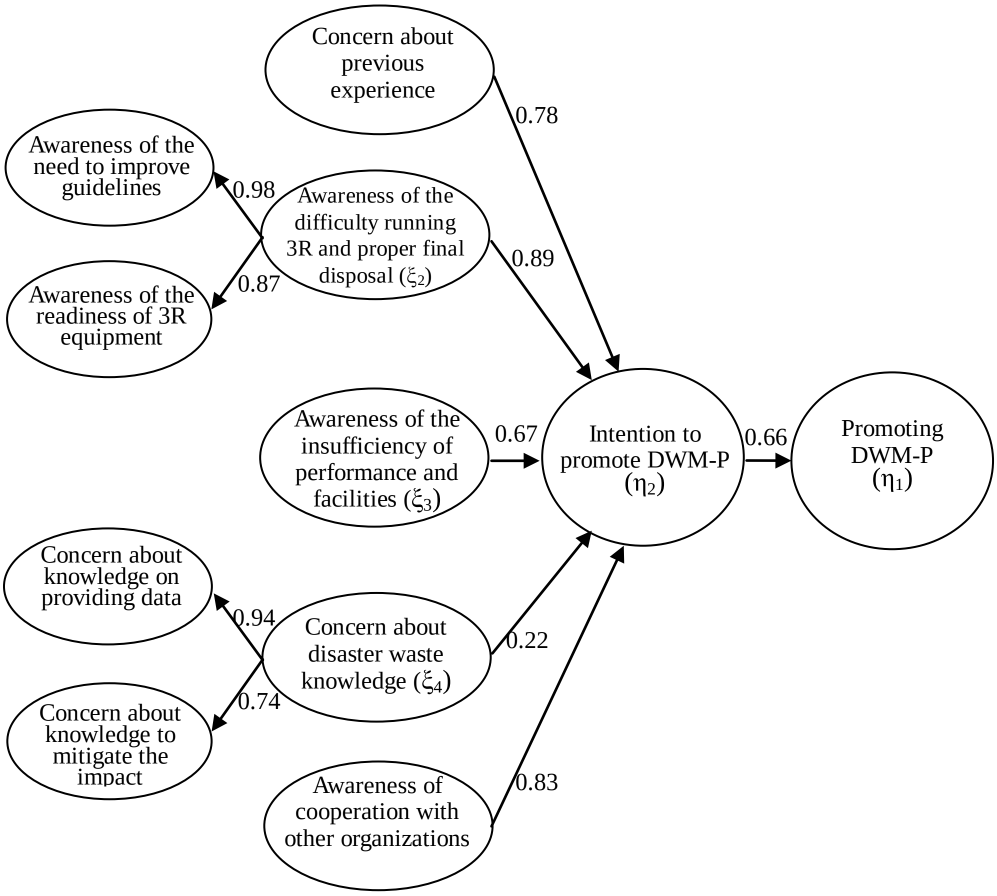

Fig.3 Schematic structural equation model of DWM-P, depicted as a path diagram, hybrid with mathematical symbols.

Table 1 describes the statistical results of evaluating the model for each stakeholder group. The eight criteria used were those proposed by Bentler and Chou(1987)[33], Byrne (2001)[34], and Kline (2005)[35]. As depicted in **Table 1**, the factors in the model meet more than 70% of the criteria, except the model for the sub-district army (60% of criteria). This result was sufficient to estimate the model[34,35]. For illustration, a good result of criteria such as GFI had a value of 0.99 when assessed for the provincial government, while a bad result of criteria found on PNFI, which had a value of 0.14 when the assessment of the sub-district army. Another un-expected value was found for PGFI (0.20) in the assessment of the provincial government.

Table 2 describes the distribution of the correlation coefficient for each stakeholder group. The correlation coefficient of intention for each group tended to be similar, with a range from 0.12 to 0.98. These values were used to determine the factor affecting DWM-P for each stakeholder group. The smallest correlation coefficient was for the factor of concern about disaster waste knowledge for the assessment of the sub-district army (correlation coefficient : 0.12). The highest correlation coefficient was the derivative factor from awareness of the difficulty running 3R to awareness of the need to improved guidelines for the NGO measurement.

Table 1 Statistical results of testing the model for stakeholder group.

Stakeholder Group	Evaluation criteria							
	χ2	GFI	RMSEA	p value for RMSEA	AGFI	CFI	PNFI	PGFI
Provincial government	9.24	0.99	0.038	0.52	0.97	0.98	0.33	0.20
Local government	9.19	0.92	0.039	0.29	0.84	0.98	0.57	0.44
Sub district Army in	8.12	0.98	0.035	0.30	0.96	0,20	0,14	0,49
NGO	9.85	0.71	0.001	0.83	0.62	0.92	0.63	0.53
All stakeholders	9.36	0.98	0.043	0.60	0.98	1.00	0.49	0.30
Statistical criteria[33,34,35]		> 0.9	< 0.05	> 0.05	> 0.8	> 0.9	0.6-0.9	> 0.6

Stakeholders from the provincial government stated, that the factor of concern about previous experience was the principal one for performing DWM-P (correlation coefficient: 0.76). The local government argued that the most important factor was awareness of the insufficiency of performance and facilities (correlation coefficient: 0.73). The sub-district army concluded that awareness of cooperation with other organizations was the principal factor to foster preparedness (correlation coefficient: 0.43). NGOs also designated the factor of awareness of cooperation with other governments as the most significant for performing DWM-P (correlation coefficient: 0.76). However, all stakeholders argued that awareness of the difficulty running 3R was the most important factor in performing DWM-P (correlation coefficient: 0.89).

Table 2 Correlation coefficients of the model for each stakeholder group.

Path diagram		Correlation coefficient				
From	To	Provincial	Local	Army	NGO	All
Concern about previous experience	Intention to promote preparedness	**0.76**	0.61	0.26	0.48	0.78
Awareness of the difficulty running 3R and proper final disposal	Intention to promote preparedness	0.71	0.65	0.33	0.58	**0.89**
Awareness of the insufficiency of performance and facilities	Intention to promote preparedness	0.50	**0.73**	0.29	0.56	0.67
Concern about disaster waste knowledge	Intention to promote preparedness	0.25	0.14	0.12	0.40	0.22
Awareness of cooperation with other organizations	Intention to promote preparedness	0.61	0.52	**0.43**	**0.76**	0.83
Intention to promote preparedness	Promoting DWM-P	0.58	0.65	0.73	0.82	0.66

Of the derivative factors, concern about knowledge to mitigate the impact (correlation coefficient: 0.86) was the principal factor. According to stakeholders from the local government, the factor of concern about knowledge to provide data was the principal one. Awareness of the need to improved guidelines was the most significant for the sub-district army with correlation coefficient of 0.92 and NGOs with a correlation coefficient of 0.98. The overall stakeholder assessment also found that awareness of the need to improved guidelines was the most significant derivative factor with a correlation coefficient of 0.98. **Table 3** depicts the results of all models for each stakeholder group.

Table 3 Causal correlation coefficient of model derivative factor for each group stakeholder.

Path diagram		Correlation coefficient				
From	to	Provincial	Local	Army	NGO	All
Awareness of the difficulty running 3R and proper final disposal	Awareness of the need to improve guidelines	0.23	0.23	0.92	0.98	0.98
Awareness of the difficulty running 3R and proper final disposal	Awareness of the readiness of 3R equipment	0.58	0.62	0.81	0.83	0.87
Concern about disaster waste knowledge	Concern about knowledge on providing data	0.59	0.89	0.79	0.96	0.94
Concern about disaster waste knowledge	Concern about knowledge to mitigate the impact	0.86	0.76	0.92	0.75	0.74

4. Discussion

4.1 Method and model

An SEM approach was used to determine the factors in the model and develop the causal correlations between them. This study, thus determined the factors affecting stakeholders' intentions to promote DWM-P. By identifying five factors, namely concern about previous experience, awareness of the difficulty running 3R, concern about the disaster waste knowledge, awareness of the insufficiency of performance and facilities, and awareness of cooperation with other organizations. These factors were the cause of the recent conditions in DWM-P. The factors identified summarized 14 DWM-P issues, while structure of the model summarized the influences of each factor, since all factors have a positive correlation.

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The factors concern about previous experience dominated with a negative effect, such as environmental pollution. However, Srinivas (2008)[39] study of the impact of the Indian tsunami on Banda Aceh indicated that stakeholder did not clearly understand how to solve environmental pollution such as air, water and soil pollution. Furthermore, stakeholder understanding of the consequences of environmental pollution on public health, the multilayer negative impacts of disaster waste, and lack of control of hazardous waste were also un-clear in the programs run by both environmental agency and the DWM agency. For example, there was no specific program for improving environmental concerns in the White Paper or master plan of waste management.

Awareness of the difficulty running 3R, includes the availability of a contingency plan or guide-lines when disaster waste is generated. The challenge for developing countries is to incorporate the plan into the annual waste service, since under normal conditions this is very poor. Other indicator of these factors included the availability of equipment and logistics to collect, transfer, and transport waste to intermediate treatment, and final disposal. Since the condition of service was is very poor, DWM waste went un-noticed despite the proposed White Paper or master plan to improve waste management.

Stakeholders' motivations to update their understanding of disaster waste i.e waste generation, waste composition, hazards and disaster waste impact were results according to the higher order factor assessment. According to the result, **Fig.3** and **Table 1**, the response of variables or issues cannot be described significantly by the factors of concern about knowledge to provide data and to mitigate the impact. The correlation here was very low. According to the studies by Shimaoka (1995), Hirayama (2010) and Takatsuki, et al (2010), this issues are fundamental for developing countries.

The indicators of the accuracy of service in developing countries are mostly similar. For example, under normal conditions, the accuracy of service is judged by the total amount of waste transferred to final disposal. The vehicle by the total amount of waste transferred to final disposal. The vehicle transfer time is not accurately compare with the maximum amount of waste. Further, cooperation with private companies is inefficient, while the performance of vehicles associated with the maximum amount of waste and facility number (number of trucks, excavator, etc) should be prepared in detail. One Problem associated with performance and facilities was indicated by the investigation into Bangkok flood waste management in Thailand in 2011[40)] to address this issue, two first order factors were proposed by dividing the second-order factor into performance and facilities.

In developing countries, cooperation with private companies and other governments in waste management rarely occurs under disaster conditions. Furthermore, the procedures for asking for cooperation from private companies or other governments typically need a long time; for examples the construction of the Blang Bintang Regional landfill site took more than three year. Similarly, in an emergency response, the reconstruction and rehabilitation of the disaster zone mostly only three years. To foster preparedness within this time limitation and improve the likelihood of cooperating with other organizations, first order factors were examined directly.

4.2 Implication for policy and programs

Waste management policy in developing countries tends to be very poor, making it impossible to introduce DWM-P program. According to the stakeholders' intentions identified herein, giving the best service for daily waste management is part of preparedness. Moreover, fostering preparedness is not only associated with constructing an annual program; preparedness should gradually increase the level of service of daily waste and absorb any DWM challenges from any level of disaster.

Fostering DWM-P was a process of increasing system of waste management. For illustration, during data collection in Banda Aceh, the following statement was recorded in an interview: after the tsunami waste program in 2012, we began to forget how to handle disaster waste efficiently. We have not yet introduced a special program for preparedness. Actually, it is importance to introduce and foster DWM-P. This stakeholder understood the importance of DWM-P, but did not know how to introduce such a program. Several key stakeholders perceived that introducing a program needs special budgeting, special effort, and different waste management approaches. DWM-P could thus be designed with simple actions such giving punctual service to complex actions such as preparing regional landfill sites.

With the average cost 27% of the total budget in an emergency response[19], DWM has significant issues in the disaster recovery program. By fostering preparedness this cost is expected to decrease. According to the factors identified, the policy and program of fostering DWM-P in developing countries have several issues. The redesign of capacity building is the first program to be evaluated. Further, running programs such as improving knowledge, understanding DWM, and increasing skills could build habits according the position and responsibility. Improving equipment and sharing information by using GIS as well as adopting a methodology for service provision are other significant programs. Sharing information encourages the development of skills related to delivering information, waste mapping, delivering previous experience in DWM and encouraging local networks.

Improving performance, facilities and cooperation with other organizations are other critical points in fostering DWM-P. Cooperation should be both horizontal (i.e. with other government and institution at the same level) and vertical (with governments at the provincial and national level). Several programs were identified such as improving performance facilities and improving guidelines to reduce the difficulty of running 3R (as well as improving method for running 3R). Other potential programs for fostering preparedness need cooperation with other institutions, such as improving data provision methods, mitigate the impact, procedures for asking for public-private cooperation, and procedures for asking other governments to cooperate.

5. Conclusion

This study demonstrated the problems and examined the issues of promoting DWM-P. By mapping factors that may affect stakeholder preparedness in Banda Aceh, we can draw the following conclusion:

- Five factors affect stakeholders' intentions to promote preparedness. The significant factor were awareness of the difficulty running 3R and proper final disposal (correlation coefficient: 0.89), awareness of cooperation with other organization (correlation coefficient: 0.83), previous experience (correlation coefficient: 0.78). Other factors identified are awareness of the insufficiency of performance and facilities (correlation coefficient: 0.67) and concern about disaster waste knowledge (correlation coefficient: 0.22).
- Stakeholders from provincial government argued that the factor of concern about previous experience was the most importance (correlation coefficient :0.76).
- Stakeholder from the local government stated that the factor of awareness of the insufficiency of performance and facilities was the most influential (correlation coefficient :0.73).
- Stakeholder from the sub-district army and NGOs argued that concern about coordination with other stakeholders was the most important (correlation coefficient 0.43 and 0.76, respectively).
- Concern about disaster waste knowledge was the factor with the smallest correlation coefficients with a range from 0.12 to 0.40.
- Although the factor of about concern disaster waste knowledge was less influential, the derivative factor of increase knowledge on providing data was necessary. This can be performed by constructing archival data on previous experience, such as on disaster waste characteristics and on the method applied. Transferring knowledge between

employees in the responsible organization should also be encouraged in order to anticipate future events.

- A program to address insufficient performance and facilities could be proposed in line within increasing waste management under normal conditions. This conclude conducting simple actions such as encouraging the regular maintenance of facilities, providing a delivery services on time, and anticipating complex issues when cooperating with other organizations.
- Proposing a cooperation program with other organizations does not mean asking for help. Such a program should be designed to avoid additional external support and resources, as much as possible.
- Guidelines and pre-planning advice for DWM should be proposed in line with the responsibilities of the national, provincial and local governments. Although strengthening the role of local government is important, high-level government (both provincial and central) must ensure the performance of service.

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Appendix

A. <u>Sem Aproach</u>

In regression, a dependent variable y is predicted from p predictors as

$$y= a +b_1x_1 + b_2x_2 +\ldots+ b_px_p + e. \quad (1)$$

SEM extend regression by allowing (i) latent variables, in which the xs are unobserved factors (measurement model). Other is (ii) latent regressions, in which both xs and ys are latent variables; (iii) multiples equations simultaneously with dependent variables y_1, y_2,..,y_m latent or observed; and (iv) a dependent variable in one equation tobe a predictor in another equation, and vice versa[19,20,21].

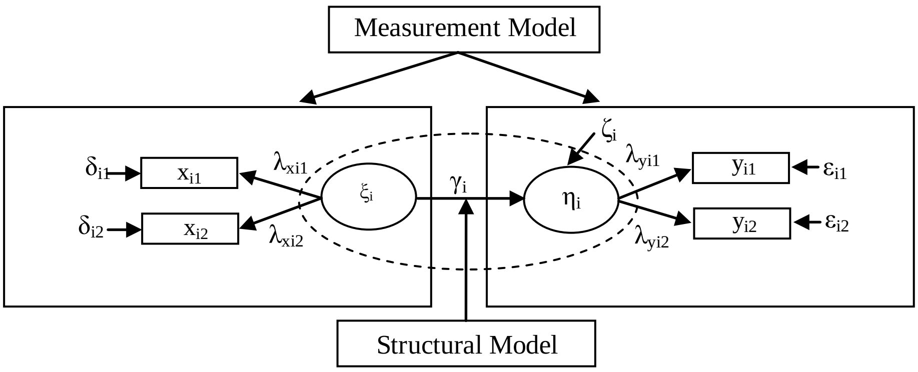

Fig.1 A lisrel structural equation model demarcated into measurement model.

According to the **Fig.1**, A latent factor ξi (KSI) is measured by observed variable x_{i1} and x_{i2} and a latent factor ηi (eta) is measured by observed variable of y_{i1} and y_{i2}. The analysis factor (measurement factor model) describe by the mathematic formula as below[19];

$$x_{i1} = \lambda_{xi1}\xi_i + \delta_{i1} \quad (2)$$
$$x_{i2} = \lambda_{xi2}\,\xi_i + \delta_{i2} \quad (3)$$
$$y_{i1} = \lambda_{yi1}\eta i + \varepsilon_{i1} \quad (4)$$
$$y_{i2} = \lambda_{xi2}\eta i + \varepsilon_{i2} \quad (5)$$

Refers to the **Fig.1**, there only 1 causal correlation (regression equation), a latent factor ξi (KSI) as a predictor of latent factor ηi (eta) which as dependent variable in overall of the hierarchy model. The structural measurement of the model describe as the mathematic formula as below[20)]

$$\eta i = \xi_i\,\gamma_i + \zeta_i \quad (6)$$

where,

x_{i1}, x_{i2} : Observed variable of ξ

y_{i1}, y_{i2} : Observed variable of η

ξ (KSI)	: Predictor latent variable (factor)
η	: Dependent latent variable (factor)
λ_{xi1}, λ_{xi2}	: Loading factor, a relation between predictor latent variable & observed variable
λ_{yi1}, λ_{yi2}	: Loading factor, a relation between dependent latent variable & observed variable
γ_i	: Regression of predictor latent variable & dependent latent variable
ζ_i	: Residual/Error for η
δ_i	: Error Measurement for x
ε_i	: Error Measurement for y

B. Theory of Plan Behavior and Development Model of DWM-P

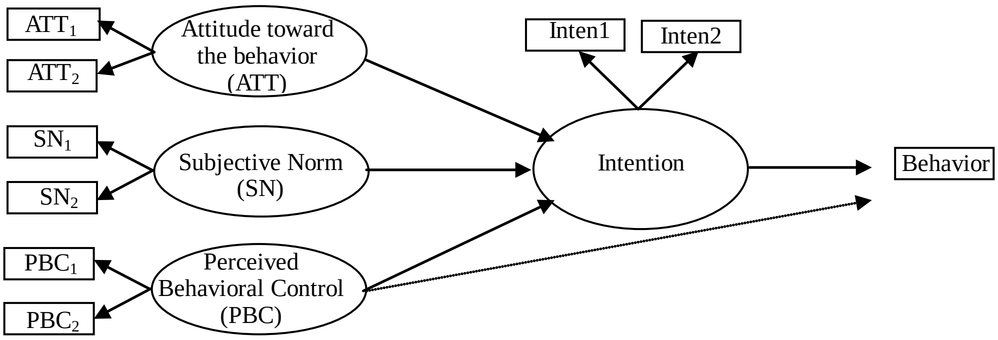

Fig.2. A diagram for the theory of plan behavior (TPB)[19,20,21].

Fig.2 A diagram for the theory of plan behavior (TPB). Circles represent latent variable/factors and squares represent observed variables. A single-head arrow represents a causal relationship. Latent variables of attitudes -ATT, Subjective Norm-SN and Perceived Behavioral Control-PBC, each measure by two indicators, (with error, as indicated by arrows pointed at them from the left), predict the latent construct of intention (also measured by two indicators), which in turn predicts observed behavior. The dashed arrow from PBC to behavior represent the un validated of the predicted relationship.

Fig.3 A hierarchical of structural equation model of DWM-P. This model is an extension of construct latent variable of PBC in TPB. This study proposed five factors, that predict the latent factor of intention which in turn predicts construct DWM-P as final goal (the end of hierarchical). The construct DWM-P was measured by observed variable y_1 and y_2.. The construct of intention was measured by two indicators or observed variables y_3 and y_4 . Two factors were constructed to be higher factor model (become second order factor model) to make the factors more meaningful and closer to the variation aspect of increasing DWM-P. The factors were Factor Awareness to difficulty to run 3R and proper final disposal and factor concern to the knowledge of disaster waste. all factor as predictor or independent factor measured by 14 observed variables x_1-x_{14}

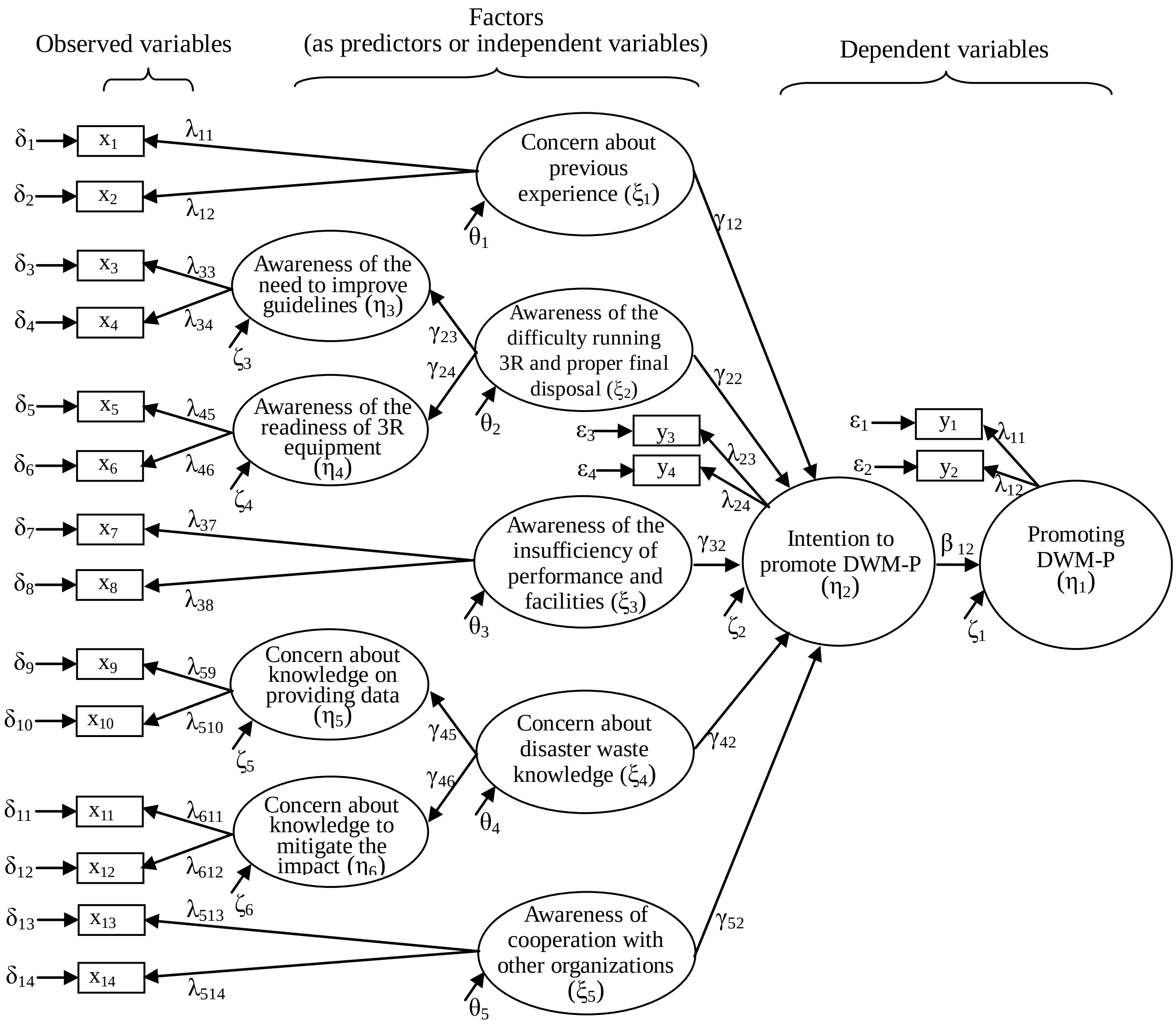

Fig.3 Full hierarchy structural equation model of DWM-P, depicted as a path diagram, hybrid with mathematical symbols.

C. <u>Mathematic equation (formula) of DWM-P Model</u>

To solving the model of DWM-P, several mathematic model were formulated below
Base on the matrix y and matrix x that defined from some detail equation of model of latent factor

Model factor of Concern about previous experience(ξ_1)

$x_1 = \lambda_{11}\xi_1 + \delta_1$ (1)

$x_2 = \lambda_{12}\xi_1 + \delta_2$ (2)

Model factor Awareness of the difficulty running 3R and proper final disposal (ξ_2)

$x_3 = \lambda_{33}\eta_3 + \delta_3$ (3)

$x_4 = \lambda_{34}\, \eta_3 + \delta_4$ (4)
$x_5 = \lambda_{45}\, \eta_4 + \delta_5$ (5)
$x_6 = \lambda_{46}\, \eta_4 + \delta_6$ (6)
$\eta_3 = \gamma_{23}\, \xi_2 + \theta_2$ (7)
$\eta_4 = \gamma_{24}\, \xi_2 + \theta_2$ (8)

Model factor Awareness of the insufficiency of performance and facilities (ξ_3)
$x_7 = \lambda_{37}\, \xi_3 + \delta_7$ (9)
$x_8 = \lambda_{38}\, \xi_3 + \delta_8$ (10)

Model factor Concern about disaster waste knowledge (ξ_4)
$x_9 = \lambda_{59}\, \eta_5 + \delta_9$ (11)
$x_{10} = \lambda_{510}\, \eta_5 + \delta_{10}$ (12)
$x_{11} = \lambda_{611}\, \eta_6 + \delta_{11}$ (13)
$x_{12} = \lambda_{612}\, \eta_6 + \delta_{12}$ (14)
$\eta_5 = \gamma_{45}\, \xi_4 + \theta_4$ (15)
$\eta_6 = \gamma_{46}\, \xi_4 + \theta_4$ (16)

Model factor Awareness of cooperation with other organizations (ξ_5)
$x_{13} = \lambda_{513}\, \xi_5 + \delta_{13}$ (17)
$x_{14} = \lambda_{514}\, \xi_5 + \delta_{14}$ (18)

Intention to promote DWM-P (η_2)
$y_3 = \lambda_{23}\, \eta_2 + \varepsilon_3$ (19)
$y_4 = \lambda_{24}\, \eta_2 + \varepsilon_4$ (20)

Promoting DWM-P (η_1)
$y_1 = \lambda_{11}\, \eta_1 + \varepsilon_1$ (21)
$y_2 = \lambda_{12}\, \eta_1 + \varepsilon_1$ (22)
$\eta_1 = \beta_{12}\, \eta_2 + \zeta_1$ (23)
$\eta_2 = \xi_1\, \gamma_{12} + \xi_2\, \gamma_{22} + \xi_3\, \gamma_{32} + \xi_4\, \gamma_{42} + \xi_4\, \gamma_{42} + \xi_5\, \gamma_{52} + \zeta_2$ (24)

This study used software LISREL student version 8.8 to build model and resolved the matrix for equation 1 -24

D. Observed Variables (Questionnaire)

Symbol	Observed variables (questionnaire)							
x_1	Disaster waste management need special treatment because they needs many year if managed with normal equipment	true	1	2	3	4	5	false
x_2	I believed the negative impact of disaster waste management for public health such as generating of rodent, and insect.	true	1	2	3	4	5	false
x_3	I am worry, there were no clearly guideline to handling was management in my town	likely	1	2	3	4	5	unlikely
x_4	I am sure that the responsible institution will choose the best method to handling disaster waste for safety life and environmental consideration including psychological stress	likely	1	2	3	4	5	unlikely
x_5	I am not sure that the responsible institution could be ensure the equipment, tools to collecting, transfer and fostering 3 R in treatment of disaster waste properly	likely	1	2	3	4	5	unlikely

x_6	I am not sure that the responsible institution could be ensure the equipment and tools for handling final disposal of disaster waste properly	likely	1	2	3	4	5	unlikely
x_7	I am not sure that department of park and beautiful design a method to evaluate the performance of their facility while deliver waste management services	agree	1	2	3	4	5	disagree
x_8	I am not sure that department of park and beautiful design a mechanism to ensure additional facility in daily waste management	agree	1	2	3	4	5	disagree
x_9	I am not sure responsible institution have a mechanism and system to ensure hazard of disaster waste generation	agree	1	2	3	4	5	disagree
x_{10}	I am not sure responsible institution have a good system for sharing information of disaster and disaster waste management	agree	1	2	3	4	5	disagree
x_{11}	I am not sure that my local disaster agency or responsible department have mechanism an system to monitoring the impact of disaster waste generation	agree	1	2	3	4	5	disagree
x_{12}	I am not sure that my local disaster agency or responsible department have a guide line to reduce impact of disaster waste	agree	1	2	3	4	5	disagree
x_{13}	I am not sure that my local disaster agency or responsible department have a good mechanism to ensure additional facility in emergency respond for handling disaster waste	agree	1	2	3	4	5	disagree
x_{14}	I am not sure that my local disaster agency or responsible department have an emergency plan with other organization such as MOU to handling disaster waste	agree	1	2	3	4	5	disagree
y_1	I will active, participate to improving skill, knowledge of disaster waste management	agree	1	2	3	4	5	disagree
y_2	As of my position, I will active to update and improving any facility to treat waste and enhance maintenance facility with regular schedule	agree	1	2	3	4	5	disagree
y_3	As of my position, I will ensure that activity associated to increasing and promoting preparedness of disaster waste always registered in annual program list in my department	agree	1	2	3	4	5	disagree
y_4	As of my position, I will introducing policy design to encourage disaster waste management preparedness	agree	1	2	3	4	5	disagree