

# Priority Practices for Addressing Non-economic Loss and Damage caused by Typhoons in Japan: Case Study of Nachikatsuura Town

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## Abstract

This report evaluates the current situation of non-economic loss and damages (NELDs) in the disaster risk reduction (DRR) and climate change adaptation (CCA) interventions in Japan using a case of Nachikatsuura Town. The ultimate objective of this study is to identify the practices that will better mitigate the NELDs in the context of the study location and to provide recommendations to address some issues identified in this study. The NELDs caused by climate-related disasters, such as typhoons, are a challenge that Japan must face. The current measures to address the damages caused by typhoons mostly focus on physical damages, such as damages to assets including houses and crops. There is no empirical evidence on how these interventions affect the NELDs even indirectly. In contrast, the NELDs, which are related to health, education, social capital and local governance, have received less attention. It is important to address the NELDs since they form major part of the impacts of natural disasters and not considering them will not result in complete recover and long-term risk reduction. This study aims to identify and prioritize key NELDs caused by the 2011 Typhoon No.12 and identify appropriate practices to address these NELDs, which is necessary for the full recovery of the affected areas. A survey-based study was conducted in Nachikatsuura Town, Wakayama Prefecture, which has experienced depopulation due to aging of its residents, outmigration, a low birth rate, and which was severely affected by the typhoon. The analytic hierarchy process was applied to the survey data to identify key criteria, indicators and practice options that should be integrated into DRR and CCA decision making processes at the local level. The results indicated which NELDs should be prioritized, and suggested that DRR policy and planning, disaster compensation, and especially shelter policy as the most important intervention that could most effectively reduce NELDs. The results also indicated that the town's disaster management planning and shelter policy could be strengthened by addressing issues associated with mental and chronic diseases, collaboration between the local government and local communities, and participation of communities in decision-making.

**Keywords:** Non-economic loss and damages, Climate change adaptation, Disaster risk reduction, Analytic hierarchy process, Typhoon, Japan

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# Abbreviations

AHP	Analytic Hierarchy Process
CCA	Climate Change Adaptation
COP 16	Sixteenth Session of the Conference of the Parties
CR	Consistency Ratio
DM	Disaster Management
DRR	Disaster Risk Reduction
ELDs	Economic Loss and Damages
FDMA	Fire and Disaster Management Agency, Japan
FGD	Focus Group Discussion
JPY	Japanese Yen
L&Ds	Loss and damages
M&V	Measurability and Verifiability
NELDs	Non-Economic Loss and Damages
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

# 1. Introduction

Loss and damages (L&Ds) caused by climate-related disasters have been identified as one of the most crucial challenges in the context of climate change (Warner & Geest, 2013). In particular, non-economic loss and damages (NELDs), such as loss of health, social and cultural assets, and environmental assets have not been sufficiently mainstreamed in the current approaches to climate change adaptation (CCA) (Hoffmaister & Stabinsky, 2012). In 2010, the sixteenth session of the Conference of the Parties (COP 16) under United Nations Framework Convention on Climate Change (UNFCCC) recognized the importance of addressing L&Ds in a comprehensive manner through Decision 1/CP.16. Subsequently, in 2013 COP 19 established the Warsaw International Mechanism to tackle L&Ds (Decision 2/CP.19) and in 2015 the Paris Agreement reached at COP 21 further reiterated the importance of addressing L&Ds (Decision /CP.21). Despite this sustained international attention to L&Ds, measures to deal with NELDs are limited. The reasons for this include insufficient understanding on NELDs and a lack of means of identifying and estimating the NELDs due to the complex ways in which NELDs can manifest involving individuals, society and the environment (UNFCCC, 2013). Lack of a globally agreed definition of NELDs has further contributed to the problem. Prioritizing NELDs is also problematic as there is no scale to compare them. Without a clear definition and prioritization, it is difficult for decision makers to incorporate NELDs into disaster risk reduction (DRR) and CCA initiatives.

Traditionally, disaster risk management decisions in the DRR community have often been based on the understanding of previous disaster impacts that reflect the underlying vulnerabilities of communities, regions and institutions (EMA, 2002; Chiba et al., 2017). This traditional understanding of L&Ds will cause challenges in climate change because there would be more emphasis on economic loss and damages (ELDs) than NELDs and to make annual plans based on the understanding from the recent past rather than a long term view. In contrast, the CCA community has reported that L&Ds are “negative effects of climate variability and climate change that people have not been able to cope with or adapt to” (Warner & Geest, 2013, p. 369). L&Ds have also been interpreted as residual negative impacts which would still happen after implementing

adaptation efforts (CDKN, 2012). There is an emerging need of addressing NELDs among the CCA community, going beyond the economic aspects which have long been the focus of the discussions on the L&Ds.

Addressing NELDs is important in the context of CCA since inadequate addressing of NELDs will be a major impediment to adaptation as most of the underlying communities' vulnerabilities lie in the non-economic aspects, including dependency on social capital and natural capital. This is especially the case with the rural communities of Japan (Yoshitake & Deguchi, 2008; Tsutsumi, 2017). By not considering the impacts of NELDs, the effectiveness of any adaptation interventions would be significantly reduced.

In Japan, climatic events such as super typhoons with accompanying record-breaking heavy rainfall have increasingly been reported during recent years (MOEJ, 2015). In particular, Typhoon No. 12 in 2011 caused severe L&Ds. The associated record-breaking heavy rainfall caused landslides, inundation and significant physical damages and human casualties. Wakayama Prefecture recorded the highest number of deaths from this event; 56 out of 82 in the country, as well as 240 fully-damaged houses and 1,753 partially-damaged houses (FDMA, 2012). There were 652 evacuees as of 14 September 2011 (Wakayama Prefecture, 2011b).

Taking lessons from past events, the Japanese government has strengthened its measures to facilitate recovery after extreme typhoons. However, the countermeasures are focused on addressing physical damages, such as damages to houses, properties and crops. NELDs such as decline in health (including mental health) and social capital (e.g., community disruption), have not been sufficiently identified and addressed in the existing recovery measures, even though NELDs continue to occur for months and even years after the disaster event (EMA, 2002). Giving greater attention to NELDs is important for Japan as they could exceed ELDs, especially in small rural towns vulnerable to climatic disasters.

Robust frameworks for addressing NELDs have not been established, in part due to the difficulty of understanding, identifying and estimating NELDs (Tol and Fankhauser, 1998; UNISDR, 2004; Hoffmaister and Stabinsky, 2012). NELDs have also not been sufficiently reported in most post-disaster reports and databases



(Swiss Re, 2013). The low attention paid to NELDs can result in significant underestimation of actual disaster losses, leading to insufficient and suboptimal investments in recovery, suboptimal decision-making on DRR and CCA, and a decrease in community resilience to climatic disasters (IPCC, 2014; Morrissey and Oliver-Smith, 2013).

Keeping in view the importance of addressing NELDs to effective DRR and CCA, a survey-based study was conducted to identify and prioritize key NELDs caused by Typhoon No.12 in 2011 in Wakayama prefecture and identify important practices that could address these impacts. This report presents the results of a literature review on important NELDs, from which an initial list of NELD indicators was constructed, and presents the results of the structured questionnaire survey with affected community members in Wakayama prefecture. This report also presents key differences in perspectives between affected local communities and the local government in NELDs, which have important implications for local level DRR and CCA. Finally, this report provides recommendations for enhancing DRR and CCA-related policies and plans.

## 2. Methodology

The study applied the analytic hierarchy process (AHP) to prioritize key NELDs caused by Typhoon No.12 in Nachikatsuura Town. Elements of AHP analysis for NELDs consisted of decision criteria, indicators and practices. These were identified, evaluated and narrowed down through three sequential steps: 1) comprehensive literature review; 2) expert consultation; and 3) focus group discussion in the affected community. Subsequently, a household questionnaire survey was conducted to obtain the inputs from households in this town. The purpose of the questionnaire survey was to prioritize key NELD-related elements from the perspectives of the affected local communities and the town officials. The questionnaire survey also aimed to identify differences between these two stakeholders on the relative importance they give to various NELD elements.

### 2.1 Study location

Nachikatsuura Town, Wakayama Prefecture, was selected for the study (Fig. 1). Nachikatsuura is a rural town with abundant social, cultural and environmental assets. It suffered serious impacts from Typhoon No. 12 from August to September 2011. Nachikatsuura is located in the southeast part of the Wakayama prefecture in the Kii Peninsula, the largest peninsula in Japan, bordering the Pacific Ocean. Nachikatsuura is located in a mountainous region, and this partly explains why forests cover 88% of the total area (MAFF, 2015). It is also a tourist destination with UNESCO-designated World Heritage Sites, including Kumano Nachi Taisha Grand Shrine and Nachi Falls. The town lies in a warm-temperate zone, has an average annual precipitation of more than 2,000 mm, with the highest recorded in 2011 of 4,000 mm (Nachikatsuura Town, 2013; JMA, 2017). On an average, the town receives 3.2 typhoons every year (JMA, 2017). The town has a total population of 15,946 (male: 7,405; female: 8,541) with a household count of 8,046 as of 1<sup>st</sup> February 2017 (Nachikatsuura Town, 2017). With 39% of the population above 65 years, a large proportion of whom are single, the town is ranked 9<sup>th</sup> in Wakayama in terms of proportion of aged population (Wakayama Prefecture, 2016). The town government has identified the aging population, declining birth rate and depopulation as serious social issues that the town is facing.

Typhoon No. 12 in 2011 resulted in the most severe disaster that Nachikatsuura has suffered during recent years. The town recorded the highest casualties in Wakayama Prefecture. The main causes of the damages were reported to be debris flow and river flooding, which resulted from the record heavy rainfall that accompanied the typhoon. Consequently, 2,410 households were affected, 29 people died (including one missing), 14,458 people were evacuated (91% of the town population), 103 houses were totally destroyed and 17 public facilities were affected. The economic damages totaled 2,283 million Japanese Yen (JPY) (Nachikatsuura Town, 2013).

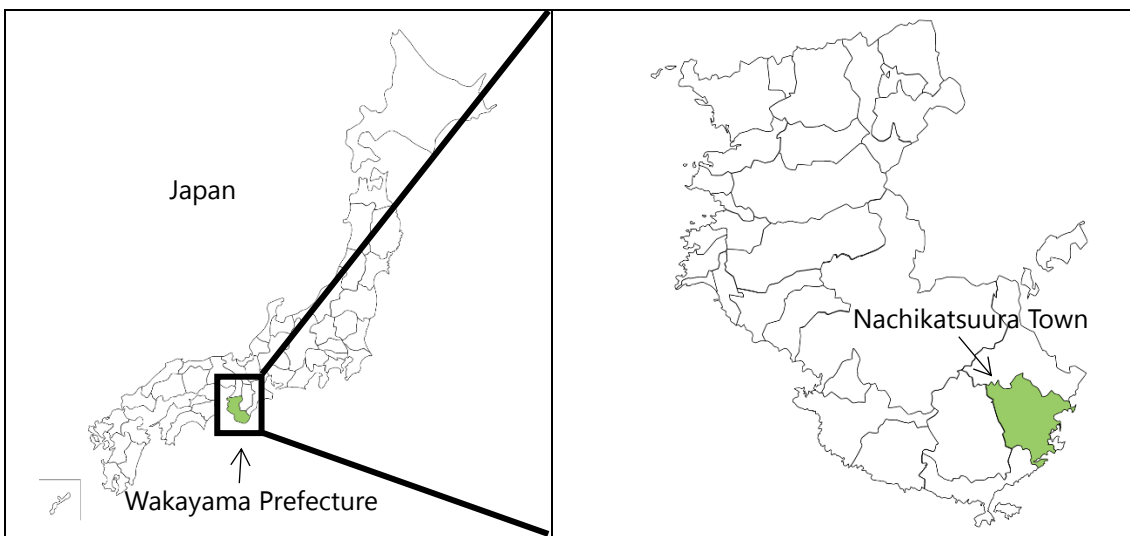


Fig. 1 Nachikatsuura Town, Wakayama Prefecture (Source: Prepared by Authors from Sankakukei (2016))

## 2.2 Analytic hierarchy process

This study used the analytic hierarchy process (AHP) to prioritize key NELDs caused by Typhoon No.12 in Nachikatsuura. The AHP is a multi-criteria decision-making tool that can be used to solve complex decision problems (Saaty, 1990). It has been widely applied to group decision-making and questionnaire surveys under many disciplines, and it is based on a multi-level hierarchical structure consisting of the goal, criteria, sub-criteria (i.e., indicators), and practices (Triantaphyllou and Mann, 1995). It uses a set of pairwise comparisons to derive the weights of importance for each element in a level, using a scale of absolute judgements that represents how much more one element dominates another (Saaty, 2008). Table 1 shows Saaty's fundamental judgement scales for pairwise comparison used in this study.

The AHP was found to be suitable for this study as it helps solving problems that are hierarchical in nature and helps in reconciling opinions of multiple stakeholders in deriving a common agreement (Table 2). This is in contrast to traditional regression techniques, which only estimate the relationships among variables in a single layer. Microsoft Excel was used for the AHP analysis. The aggregation of individual priorities was done by geometric mean of individual priorities (Forman and Peniwati, 1998).

Table 1. Fundamental judgement scales for pairwise comparisons

Scale	Description
1	Equal importance of both options
3	Moderate importance of one over another
5	Strong importance for one over another
7	Very strong importance for one over another
9	Extreme importance for one over another

Source: Prepared by Authors from Saaty (1990)

Table 2. Similarities between the study needs and AHP provisions

Study contextual needs	Provisions in AHP
DRR and CCA decisions often involve multiple stakeholders who differ in their priorities	Allows decision making in a multi-stakeholder environment through discussion on priorities assigned
Comparing NELD indicators on non-economic basis	Helps compare various elements of the AHP process by using fundamental judgement scale
Stakeholders differ in the criteria they employ in prioritizing indicators	AHP considers criteria at the high level of comparing indicators through which indicators can be compared
Indicators provide basis for comparison of practices for addressing NELDs in DRR and CCA	AHP facilitates comparing various practices in a pairwise fashion by keeping each indicator constant and hence all combinations of pairwise comparisons will identify the best practice

Source: Authors

The elements of AHP analysis for NELDs included relevant decision-making criteria, indicators and practices (i.e., risk reduction practices). The NELD-related elements were identified, evaluated and narrowed down through three sequential steps: 1) comprehensive literature review (Chiba et al, 2017); 2) expert consultation; and 3) focus group discussion (FGD) in the affected community (Fig. 2). The published literature was limited but helped to understand the NELD aspects of DRR and CCA. The findings from the literature review were corroborated by 15 experts in a consultation workshop that was conducted in June 2015. The consultation further vetted the NELD-related elements identified from the literature in the context of Japan. The workshop was attended by experts in DRR, CCA, health, education, water, environment, biodiversity and ecosystems, forestry, meteorology, and law. Subsequently, a FGD was held with 9 members of the affected community in the Iseki District, one of the most severely affected districts in Nachikatsuura, to evaluate the key NELD elements from the community perspective in June 2016.

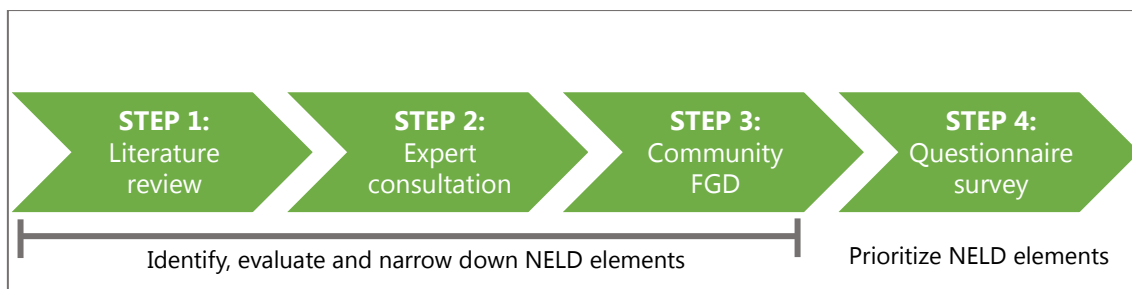
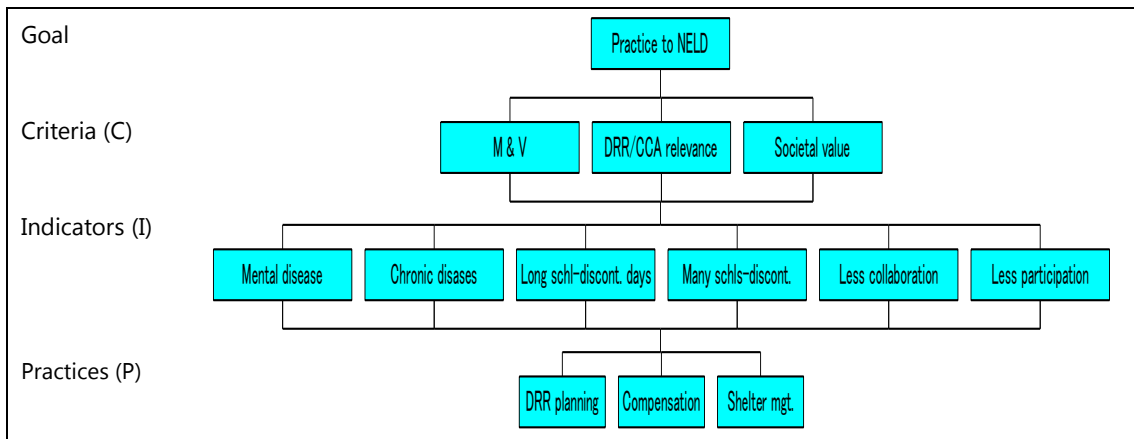


Fig. 2 Workflow for implementing the study (Source: Authors)

### 2.3 Structure of the decision hierarchy

Fig. 3 shows the hierarchy diagram of the AHP, which reflected the key NELD-related elements identified through the steps described above. The goal of the problem was defined as 'selection of best risk reduction practices for addressing NELDs caused by the Typhoon No.12', with the assumption that NELDs should be addressed for better recovery. The indicators and practices that were identified from the literature review and were further vetted through consultations were included in the AHP analysis.



Note: M&V = measurability and verifiability

Fig. 3 Hierarchy diagram of AHP analysis (Source: Authors)

The expert and community consultations have identified three crucial NELD impacts of the typhoon: 1) health deterioration; 2) loss of educational opportunity for children; and 3) disruption in local governance. For each of these impact areas, the two most important indicators were listed and prioritized for inclusion in the AHP analysis. These NELD impacts are defined later in the report (section 3.1).

## 2.4 Questionnaire survey

The purpose of the questionnaire survey was to prioritize key NELD-related elements (i.e., criteria, indicators and practices) from the perspectives of the affected local communities and the local government. The questionnaire survey also aimed to identify differences between these two stakeholders on the relative importance they give to various NELD elements. Stakeholders represented in the questionnaire survey were the affected households and town officials of Nachikatsuura who are engaged in DRR and social welfare. The questionnaire survey was conducted at the household level for communities and at the individual level for town officials.

A total of 175 questionnaires were returned by the community members which is 322 (54%) of the sample. The sample size was derived from the formula  $(n = [t^2 \times p(1-p)]/m^2)$  where  $n$  is sample size;  $t$  is confidence level (1.96);  $p$  is estimated prevalence (2,410 affected households/8,084 total households); and  $m$  is confidence interval (0.05)). Stratified random sampling was conducted to ensure representative participation according to the socio-economic profile of the town;

the stratification was done according to household's status in terms of gender, age, and annual income (Table 3). The stratification was done by obtaining demographic statistics from the study location, randomly identifying the sample groups and sending the questionnaire to the randomly selected households. Both low-income and above-low income households were included, with low-income being defined as an annual income of 2 million JPY or less. Twenty-two questionnaires were returned by the town officials from the Disaster Prevention, Social Welfare, Inhabitant, Education, Tourism and Industry and Construction departments.

Table 3. Sample characteristics for the households

Gender		Age		Annual income	
Male:	137 (78%)	Youth:	9 (5%)	Low:	41 (23%)
Female:	31 (18%)	Middle-aged:	67 (38%)	Above low:	120 (69%)
Unknown:	7 (4%)	Elderly:	92 (53%)	Unknown:	14 (8%)
		Unknown:	7 (4%)		
Total: 175					

Note: Unknown stands for unreported by the respondent

Source: Authors

The questionnaire surveys were conducted in October and November 2016, in cooperation with the Disaster Prevention Division of the town office. The questionnaire forms were developed in consultation with the Division and relevant experts. A thorough explanation was included and clear and easy to understand terms were used. The anonymous questionnaire forms were firstly distributed to the affected households via a circular and then collected by community leaders. The questionnaire forms to the town officials were distributed and collected by the Disaster Prevention Division. The AHP analysis was conducted using Microsoft Excel and the results were presented by comparing between the perspectives of the affected local communities and the town officials. The Consistency Ratio (CR) was used to test the uniformity of results across the responses. The CR represents the consistency of pairwise comparisons, and if the CR is less than 10% (0.1), it is considered acceptable (Saaty, 1990). Depending on the unstructured nature of the parameters, inconsistency of up to 0.15 can be allowed, though even a CR ratio of 0.2 or more could be acceptable for very abstract parameters (Bhushan and Rai, 2004). Hence, considering the abstract

nature of the parameters used in this study, especially for lay people, a high inconsistency ratio may not be an exception in this study. The results are presented as the geometric mean of all scores given by individual's pairwise comparisons.



## 3. Results and Discussion

### 3.1 NELD criteria, indicators and practices

#### 3.1.1 NELD criteria

Criteria represent the underlying logic that humans apply while prioritizing competing alternatives and is related to the worldview that determines their decision making. Stakeholders differ in the criteria they employ for prioritizing options that are put before them. Understanding the differences in criteria helps in understanding the choices that they make in DRR and CCA.

In the study context, identifying the criteria employed by stakeholders is a crucial first step in prioritizing NELD indicators and in turn the practices for addressing NELDs. Three criteria that governed the decision making process for prioritizing indicators and practices for addressing the NELDs were: 1) measurability and verifiability (M&V); 2) relevance to DRR/CCA policy and planning; and 3) compliance with societal value. M&V refers to whether or not the NELDs were objectively severe, measurable and verifiable to enable the NELDs to be adequately addressed and replicated in other communities in the town (GIZ, 2014). Relevance to DRR/CCA policy means whether or not the identified NELD indicators and practices are applicable within the DRR/CCA policy and planning domains. Any indicators and practices that are not applicable and identifiable by the relevant communities could fail to attract attention due to attitudinal and capacity constraints and hence fail to be adopted. Similarly, compliance with societal value refers to the extent to which the identified indicators and practices are socially relevant, which is necessary for them to be accepted by society.

#### 3.1.2 NELD indicators

The literature review helped in identifying several impact indicators in the context of typhoons (Table 4). These indicators were further narrowed down for the context of the study location in Japan through expert and community consultations (Table 5). In this section, literature pertinent to the important indicators prioritized from the expert and community consultations are presented

to provide a deeper understanding on these indicators.

Table 4. List of NELD indicators reported in the literature that formed the basis for expert and community consultations

NELD impacts	NELD indicators
Health	Death, Injury; Waterborne disease; Infectious disease; Mental disease; Malnutrition
Sociocultural assets	Displacement; Social hostilities/disruption, conflicts, disputes; Women's hardship; Decrease in place attachment; Damage to cultural heritage; Children discontinued school; Disruption of institutional network on local governance
Environmental assets	Loss of species abundance; Loss of ecosystems

Source: Prepared by Authors from Chiba et al. (2017)

Table 5. List of criteria, indicators and practices prioritized in this study through expert and community consultations

Criteria	Indicators	Practices
Measurability and verifiability	Mental diseases	DRR policy and planning
Relevance to DRR/CCA policy	Chronic diseases	Disaster compensation
Compliance with societal value	Period of school discontinuation	Shelter policy
	Number of school discontinued	
	Collaboration between local government and community	
	Community participation in decision-making	

Source: Authors

**Health:** Health deterioration is one of the critical NELDs caused by typhoons and can manifest in the form of physical injury, infectious diseases and mental illnesses

(Hajat et al., 2003). The two most relevant indicators identified were mental diseases and exacerbation of chronic diseases. While mental diseases were reported in the literature, exacerbation of chronic diseases was pointed out by the expert consultation (Shaw, 2014). In Nachikatsuura, school counselors were dispatched to provide mental-care due after Typhoon No. 12 (Wakayama Prefecture, 2011b). Reports indicate that chronic diseases such as hypertension and stroke worsened because medicines were damaged during the typhoon (Wakayama Medical University, 2012).

**Education:** Loss of educational opportunity for children is an important NELD associated with discontinuation of education. Climate-related disasters were reported to be one of the major causes of loss of child education worldwide (UNICEF, 2012). The two most pertinent NELD indicators identified were the period of school discontinuation and the number of school discontinued. These indicators were regarded as significant by the consulted experts. The community consultation indicated that 3 kindergartens, 7 elementary schools and 4 junior-high schools in Nachikatsuura were closed during different periods of time after the typhoon (Nachikatsuura Town, 2013). Some of the schools were closed for a year and a half. The main reasons include damage to schools by debris flow, damage to piped-water connection in the town and loss of access to public transportation.

**Local governance:** Similar to loss of health and education, loss of local governance was found to be an important NELD that received little attention in CCA and DRR interventions. Local governance plays an important role in the formulation and execution of collective action at the local level (Shah and Shah, 2006, p.1) and local governments play an important role in supporting self-governance at the community level. Oftentimes, local governments themselves suffer loss and damages that can affect their ability to govern. Disruption of institutional networks, and pressures on institutional cohesion and coordination leading to institutional conflicts are some of the ways in which local governance is affected by disasters.

The two most applicable indicators that capture loss and damage in terms of local governance are reduced local government-local community collaboration, and reduced participation of communities in decision-making. These aspects are

described later in the report (please see section 3.4.2). NELDs associated with local governance were observed after the typhoon. It was reported that the Nachikatsuura town office was unable to easily secure places to dispose disaster waste, as collaboration with local communities had declined because of inadequate hearing of community needs. In addition, the town office did not sufficiently provide avenues for local communities to express their opinions through interactive sessions.

Health, education and local governance represent different axis of a multi-dimensional space for measuring the effectiveness of practices to mitigate NELDs (Fig. 4). As shown in the figure, practices could either equally satisfy all three axis (as in the case of practice A); some practices may tend to satisfy one axis more than others (as in the case of B that satisfies more of education than health and governance); and others satisfy none (as in the case of C that lies at the corner of the three axis). The mitigation practices preferred by stakeholders may depend on location-specific conditions and may not be determined by a desire to equal satisfy all axis. For example, in locations where educational services are lacking, practices that have high effectiveness on the education axis may be chosen.

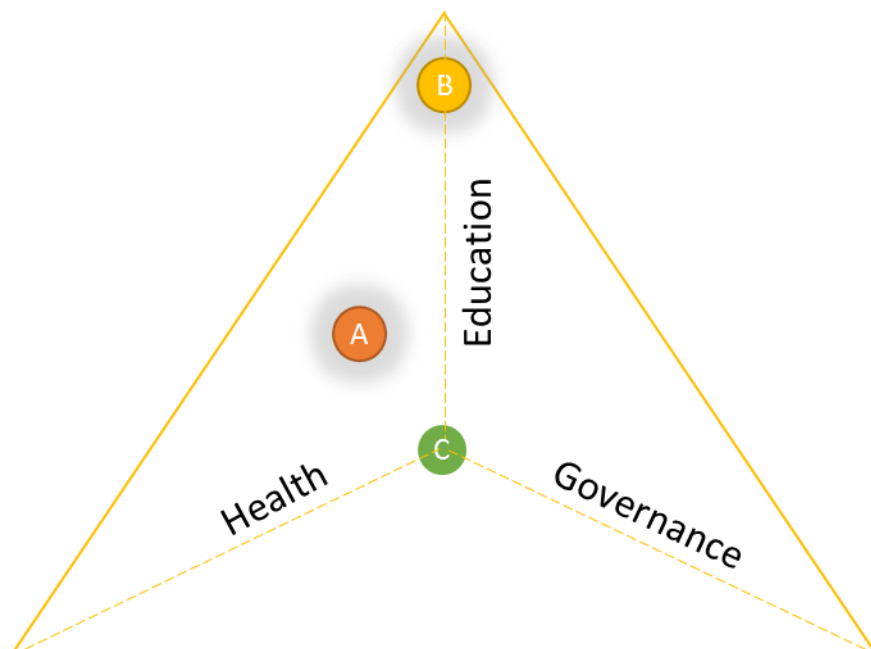


Fig. 4 Schematic showing a multi-dimensional space where practices could fall according to their effectiveness. The closer a practice to a particular axis will be the higher its effectiveness in that particular domain. (Source: Authors)

### 3.1.3 Practices for addressing NELDs

There is a growing need from policymakers, practitioners and donor agencies for significant investments in climate change resilience and adaptive capacity to mitigate loss and damage, including the NELDs (Anderson, 2011). Despite the growing need, there is a dearth of literature on practices that can effectively address the NELDs in the context of DRR and CCA demanding effective frameworks and tools to identify and evaluate DRR and CCA practices in decision making (Carter et al., 2007). Policymakers, practitioners and donor agencies need to identify and invest effective DRR and CCA practices, assess the outcomes of their investments and reassure whether their investments deliver measurable and verifiable results (Anderson, 2011).

There are significant challenges to identify and implement effective practices to address NELDs. CCA practices need to be relevant to local contexts (Mansanet-bataller, 2010) and vulnerabilities and exposures can be different, depending on socio-economic characteristics at the local level (Chiba et al., 2017). In addition, identifying the practices for NELDs is a challenge since a clear definition of NELDs has not been agreed among policymakers, practitioners and researchers, meaning that there are a wide range of interpretations of NELDs (Chiba et al., 2017). This makes it difficult to reach a consensus and choose effective practices to respond to the NELDs. In this situation, adopting a robust decision making approach, such as multi-criteria decision making methods including the AHP, could facilitate deeper discussion among relevant stakeholders, leading to an agreement on NELD practices based on the current level of understanding (Prabhakar, 2014).

The expert and community consultations helped provide deeper insight into the practices that can address NELDs. Three relevant NELD practices were identified: 1) DRR policy and planning; 2) disaster compensation; and 3) shelter policy. The experts and communities felt that the local disaster management plan of Nachikatsuura can play a valuable role in reducing NELD-related risks by implementing the disaster preparedness, response and recovery components of the plan (Nachikatsuura Town, 2016). Disaster compensation was felt to be important, and was in fact provided to those who suffered death and injury, and whose houses were partially or completely destroyed (Wakayama Prefecture, 2011a). The shelter policy was also considered important to mitigating NELDs, as

it secured safe locations for the local communities. Shelters can help reduce the psychosocial and infectious health effects of disasters by offering clean water, sanitation and communication facilities (Nachikatsuura Town, 2016).

### 3.2 The community perspective

Fig. 5 to 17 present results of pairwise comparisons of criteria, indicators and practices from the perspective of the affected communities in Nachikatsuura. To find possible associations between the demographic characteristics and AHP results, the survey results are discussed by gender, age and annual income.

Among those who returned the questionnaires, 78% were male and 18% were female. Youth, middle-aged and elderly were 5%, 38% and 53% respectively. Low income households were 23%. They worked in a public office, other offices, self-employed business, agriculture, or forestry and fisheries, or were employed part-time or were unemployed.

The respondents reported a variety of loss and damages including damages to houses, properties, lands, agricultural and fishery assets, and loss of income. The reported NELDs were associated with health issues, loss of educational opportunity and disturbance to local governance.

In general, the results indicate that the demographic and socio-economic characteristics of the respondents did not influence the relative weights given for various criteria for prioritizing indicators and practices (Fig. 5, 6, 7 and 8). The overall comparison matrix was consistent with a CR of 0.001. In addition, the CRs of the sub-category groups of gender, age and annual income were within an acceptable level with a CR in the range of 0.1-0.15. The CR was marginally higher among the responses from youth households, showing relatively lower agreement on the indicators and practices.

Societal value (C-3) appears to be the most important criteria for prioritizing indicators and practices followed by relevance to DRR/CCA policy (C-2) and measurability and verifiability (C-1) in the context of Nachikatsuura town. These results are particularly interesting as social acceptability is an important issue for non-economic loss and damage (Collins et al., 2014). They also indicate that the

acceptance of NELDs could differ from society to society and that a society that puts high emphasis on societal values may put high emphasis on NELDs. Gender, age and annual income followed a similar trend as that of the overall weights, indicating non-significant influence of these parameters on the relative weightages given to indicators and practices (Fig. 6, 7 and 8). This trend appears to be inconsistent with the observations made by Acedo et al. (2007), who reported that age and gender could significantly influence the decision. A plausible reason for the difference could be that Japanese society is more likely to emphasize relational harmony and interdependence in their selection (Pascale, 1978; Kitayama et al., 2010).

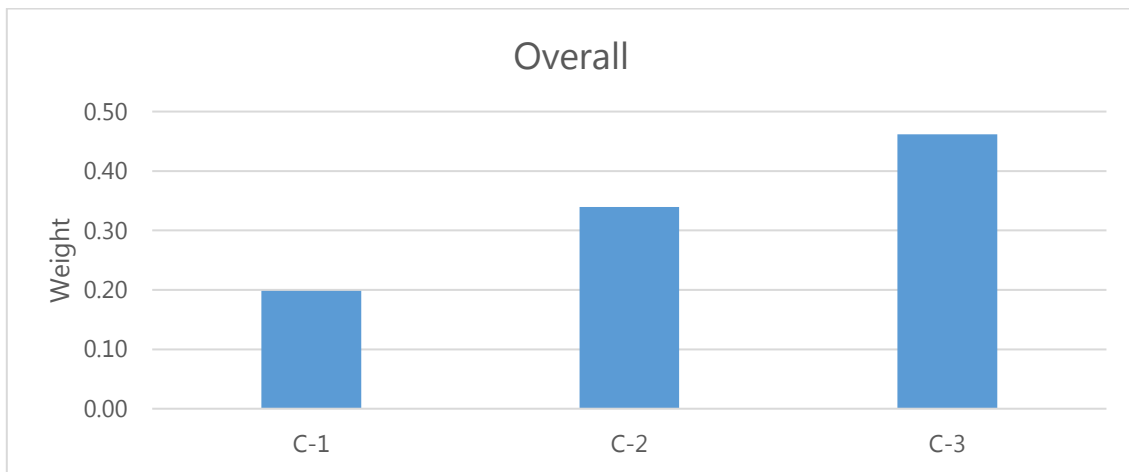


Fig. 5 Pairwise comparison of criteria (overall) (Source: Authors)

(C-1: Measurability and verifiability; C-2: Relevance to DRR/CCA policy; C-3: Societal value; CR = 0.001)

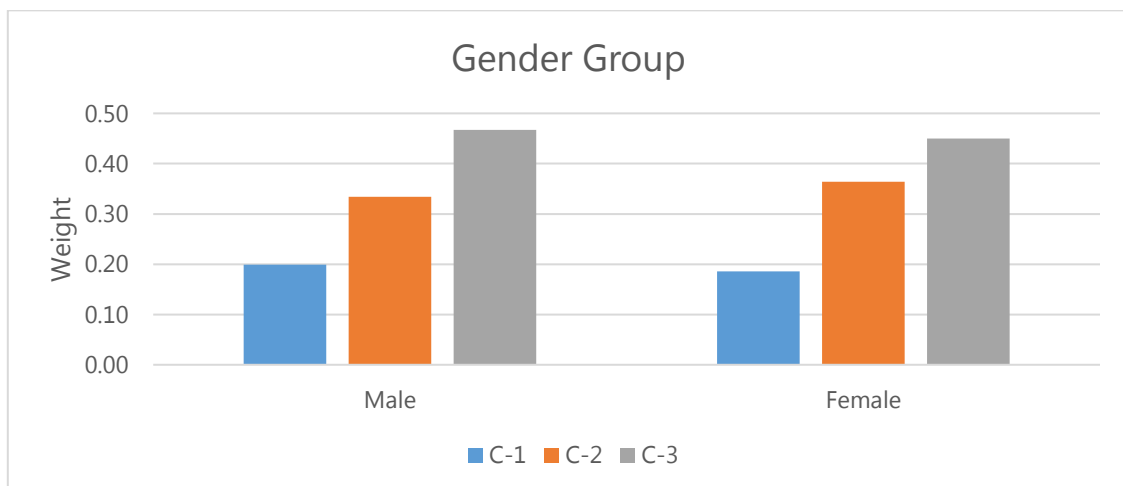


Fig. 6 Pairwise comparison of criteria by gender group (Source: Authors)

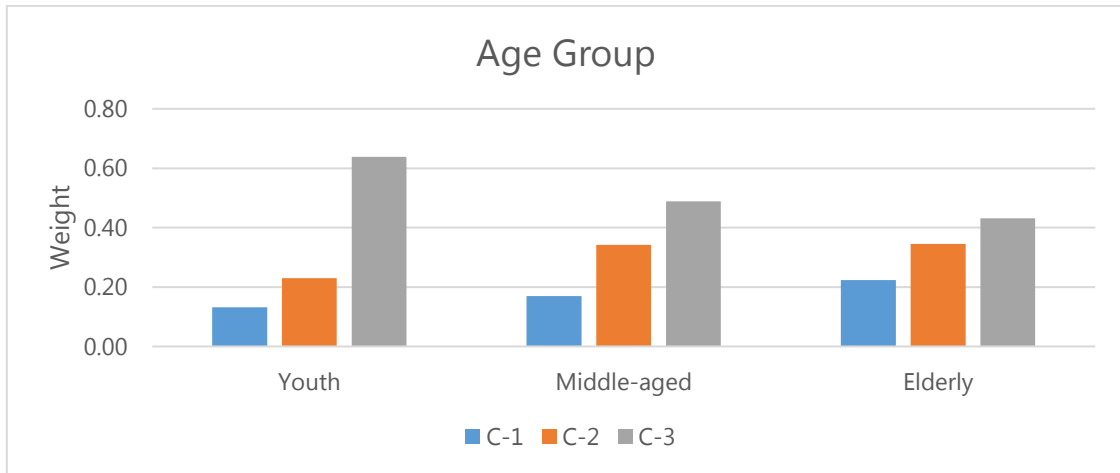


Fig. 7 Pairwise comparison of criteria by age group (Source: Authors)

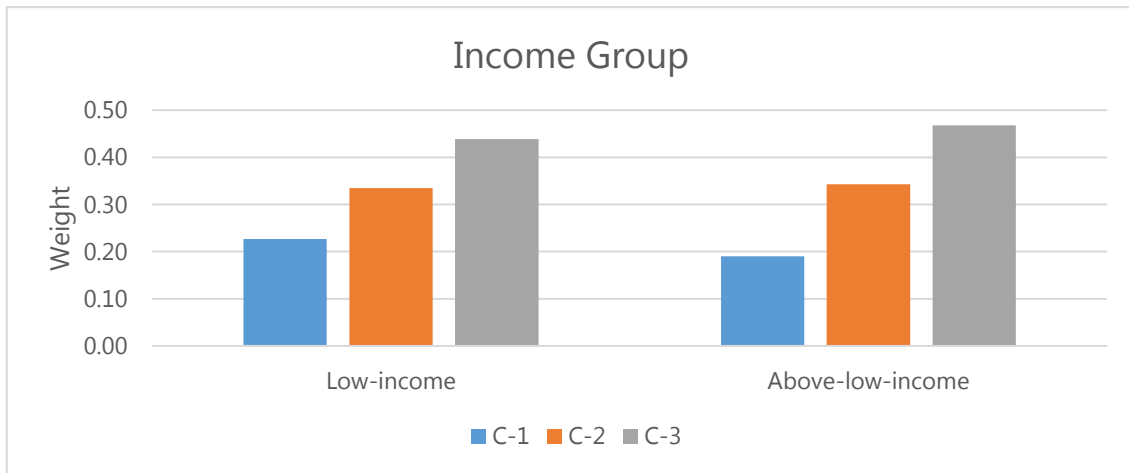


Fig. 8 Pairwise comparison of criteria by income group (Source: Authors)

The respondents were asked to pair-wise compare among six indicators covering the NELDs on health, education and local governance identified through consultations (Fig. 9). These indicators play a crucial role in characterizing the effectiveness of practices in mitigating the NELDs. There is no single indicator that can comprehensively represent the effectiveness of a practice or a set of practices and hence there is a need to identify a set of indicators that collectively are able to measure effectiveness on the effectiveness axis shown in Fig. 4. The pairwise comparisons of indicators under each criterion showed CRs of 0.001, 0.003 and 0.003 for C-1, C-2 and C-3, respectively. Such a favorable consistency ratio indicates high agreement among the responses across all gender, age and economic classes. In addition, CR values in gender, age and annual income groups were at an acceptable level with a CR value of 0.1.



Reduced collaboration of local government with local communities (I-5) emerged as an important indicator among all the three groups of indicators, followed by less participation of community in decision-making (I-6) and mental diseases (I-1). These results are consistent with the observation that social acceptability is an important criterion, as there is a high degree of association between social acceptability and need for consultation within society (Sato et al., 2005). In other words, societies that put high priority on social acceptability tend to prefer public consultation and compliance as part of the decision making process. Hence, any practices and interventions that positively influence these indicators can make a significant contribution to mitigating the NELDs (JMRC, 2014).

Mental diseases, less collaboration and less community participation emerged as the top three indicators for all the gender, age and economic groups, except for the elderly households, where chronic diseases (I-2) replaced mental diseases as a preferred indicator (Fig. 10, 11 and 12). This could be because the elderly are more likely to emphasize worsening of chronic diseases because of their higher exposure to them.

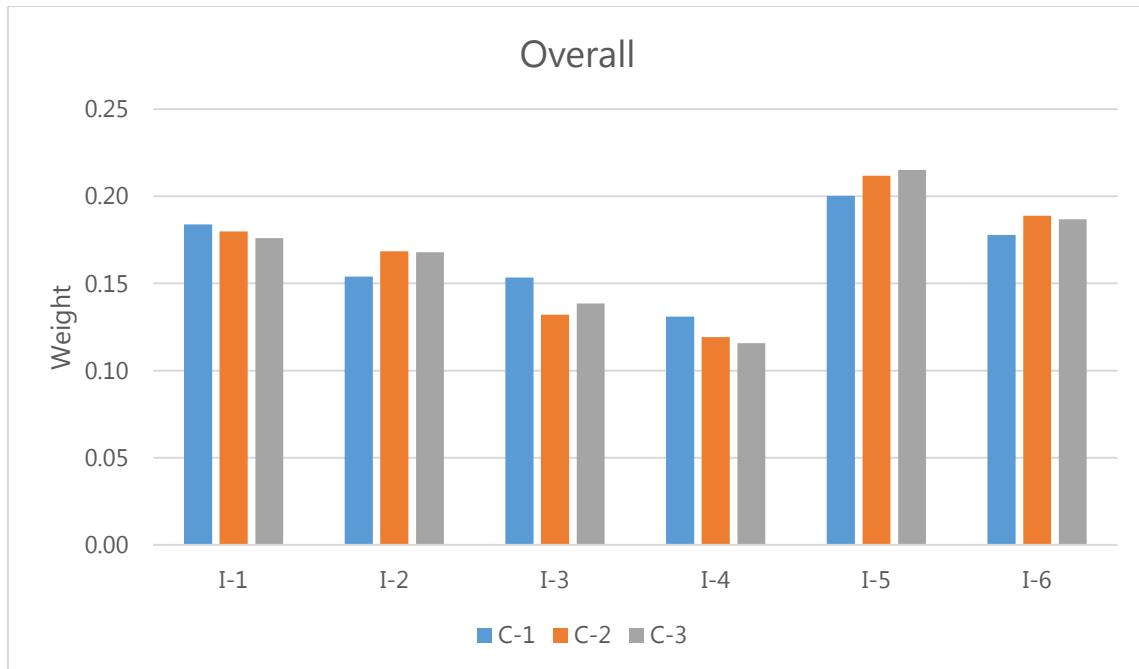


Fig. 9 Pairwise comparison of indicators (overall) (Source: Authors)  
(I-1: Mental diseases; I-2: Chronic diseases; I-3: Period of school discontinuation; I-4: Number of school discontinued; I-5: Less collaboration of local government; I-6: Less participation of community. CR (C-1) = 0.001; CR (C-2) = 0.003; CR (C-3) = 0.003)

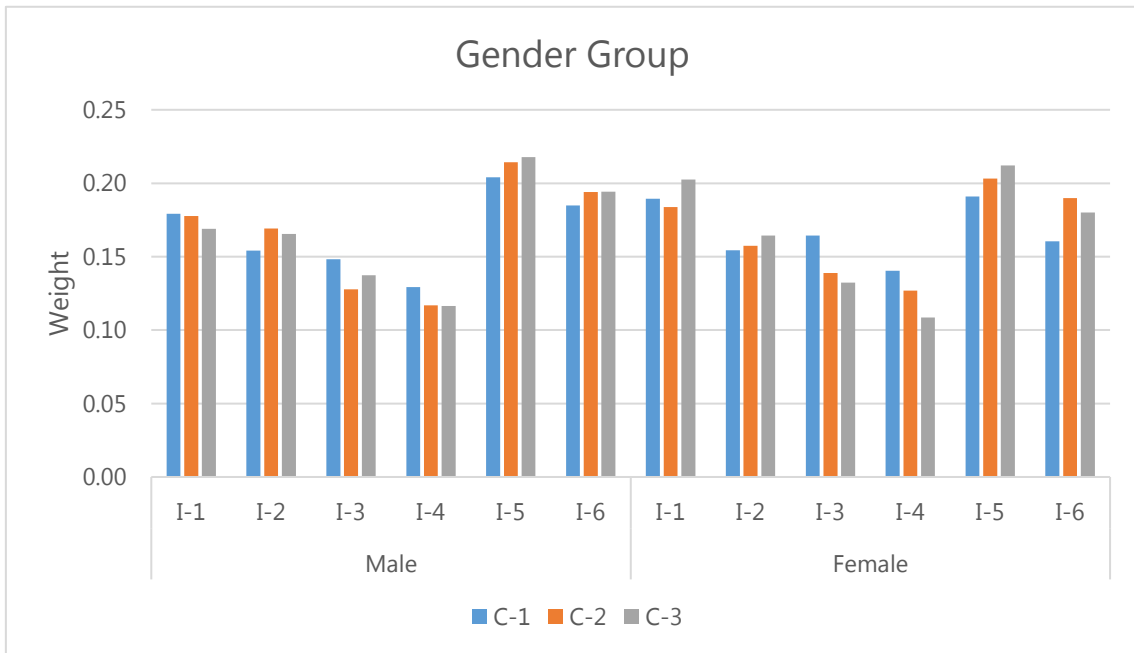


Fig. 10 Pairwise comparison of indicators by gender group (Source: Authors)

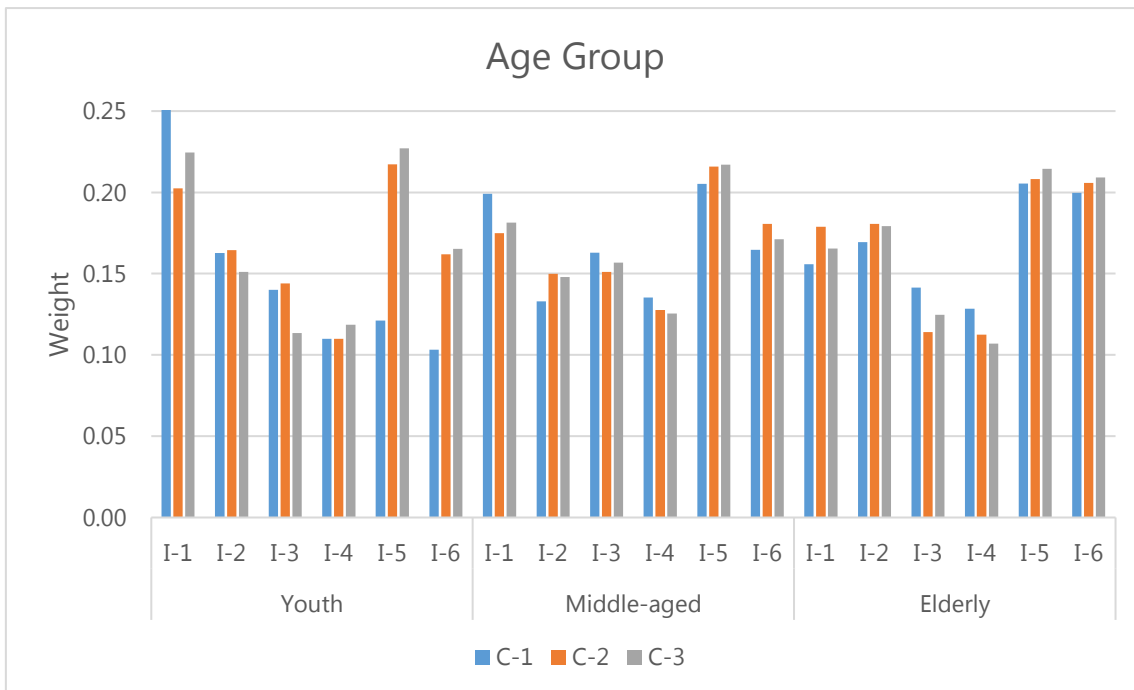


Fig. 11 Pairwise comparison of indicators by age group (Source: Authors)

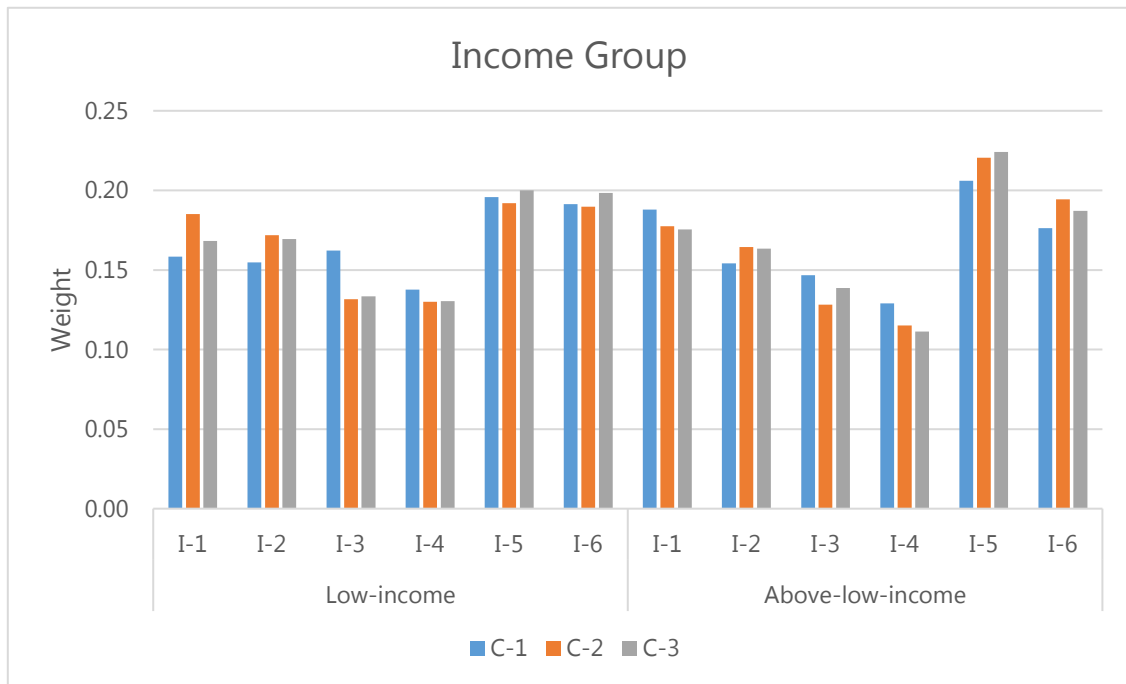


Fig. 12 Pairwise comparison of indicators by income group (Source: Authors)

The ultimate objective of this study was to identify the practices that will better mitigate the NELDs in the context of the study location. Not all practices will be able to equally satisfy all the indicators; hence, one of the means of assessing their effectiveness is to look at the performance across a set of indicators. The indicators presented previously to measure their effectiveness plays a critical role in characterizing these practices. Shelter policy (P-3) was found to be the most effective practice followed by DRR policy and planning (P-1) and disaster compensation (P-2). Overall, the results indicate a favorable CR for all the indicators for assessing the practices in question (Fig. 14). Gender, age and annual income were at an acceptable CR of <0.1.

The shelter policy received high priority as in the study location the sex ratio favored males, there were many elderly and there were also low-income households (Fig. 15, 16 and 17), all of whom stressed the importance of the shelter policy. The higher weightage of the majority of indicators for shelter policy is explained by the fact that shelters have helped communities to address health and education issues more than other practices.

There are slight differences within the gender and age groups in how the

indicators explained the effectiveness of the practices. Females thought DRR policy and planning helps in governance-related issues, as indicated by high weightage in these indicators, than men. Similarly, youth thought DRR policy and planning helps in education and governance than the elderly respondents, who opined that shelters provide greater education and governance benefits. Wealthier respondents agreed with the youth that DRR policy and planning impacts education and governance more than the shelters. These results could be seen in terms of the social groups and their ability to think strategically. Several studies (Shah et al., 2012; Yirka, 2012; and Spears, 2011) reported that wealthier social groups tend to think strategically and in terms of economic aspects in long-term decision making, which is in line with the observations made in this study that they preferred investments in education and governance over shelters.

Fig. 13 displays the overall decision tree for addressing the NELDs in Nachikatsuura. Societal value (C-3) appears to be dominant criteria for decision making and it resulted in emphasis on local governance indicators, such as collaboration of local government with local communities (I-5) and participation of community in decision-making (I-6), and health indicators, such as mental diseases (I-1). The local governance and health indicators in turn determined the shelter policy (P-3) to be the most effective policy to address the NELDs in Nachikatsuura.

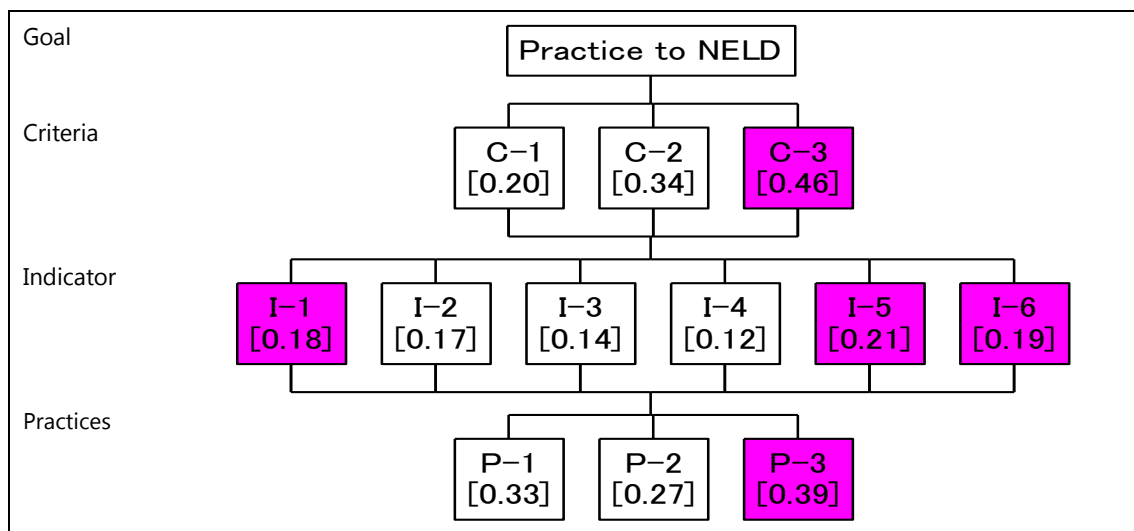


Fig. 13 Overall weights from the perspective of the affected local communities (Source: Authors)

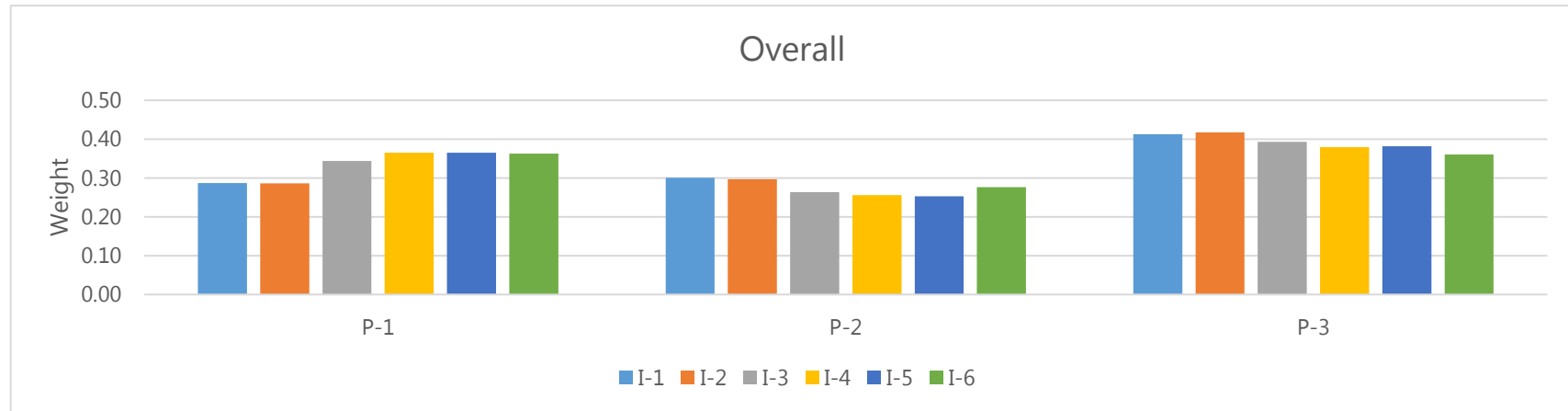


Fig. 14 Pairwise comparison of practices (overall) (Source: Authors)

(P-1: DRR policy and planning; P-2: Disaster compensation; P-3: Shelter policy; CR (I-1) = 0.010; CR (I-2) = 0.005; CR (I-3) = 0.003; CR (I-4) = 0.003; CR (I-5) = 0.008; CR (I-6) = 0.009)

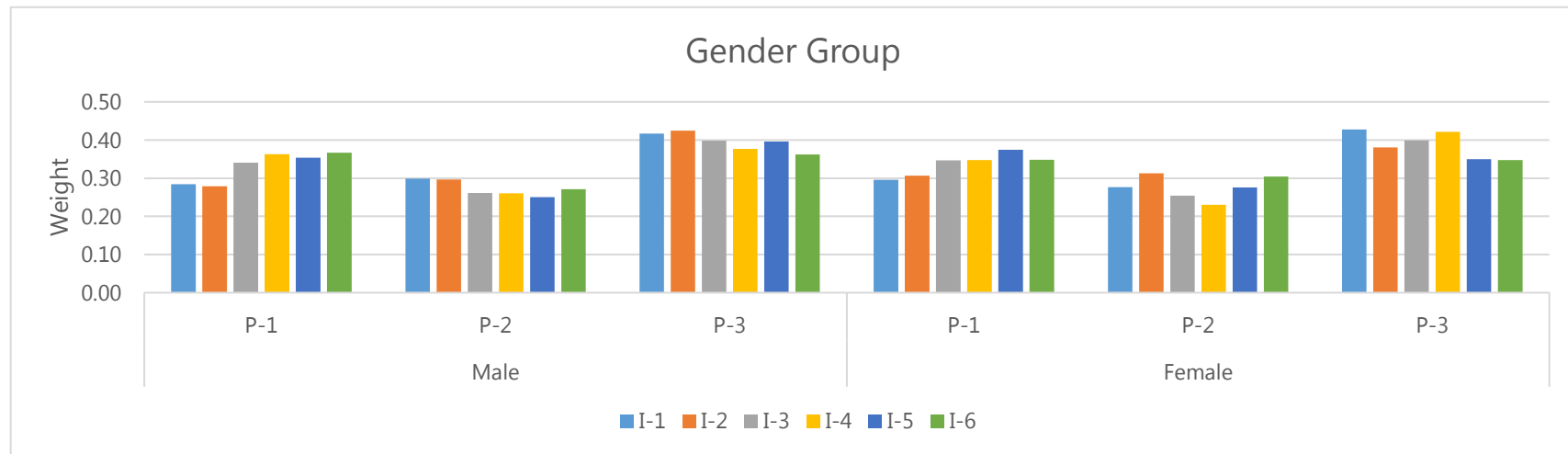


Fig. 15 Pairwise comparison of practices by gender group (Source: Authors)

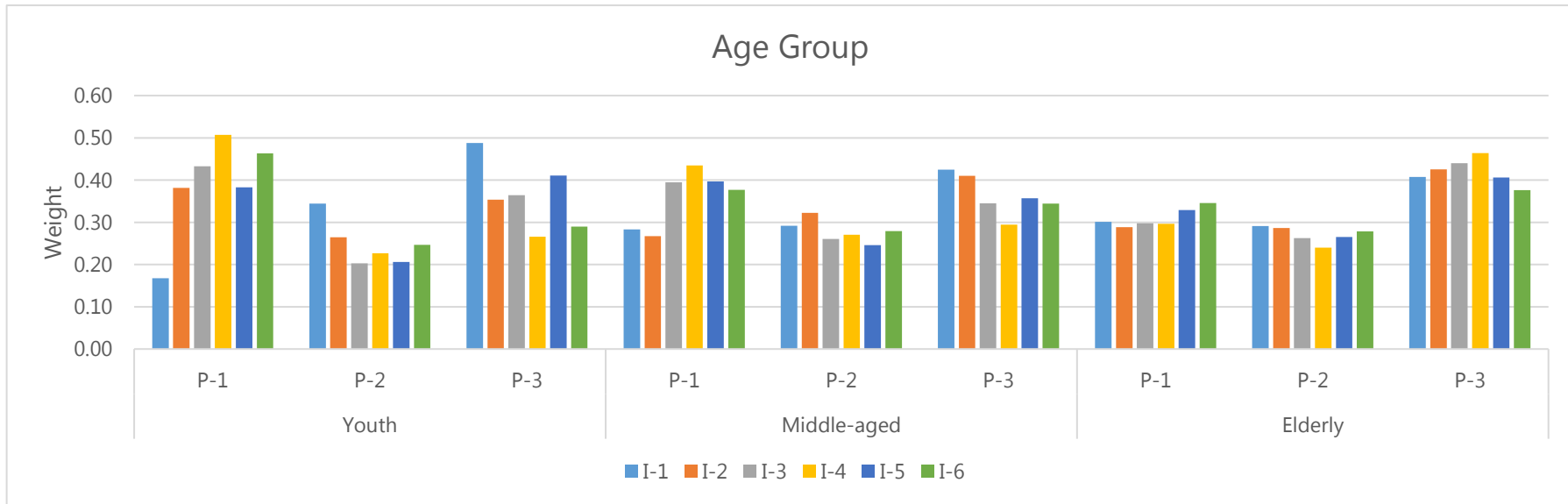


Fig. 16 Pairwise comparison of practices by age group (Source: Authors)

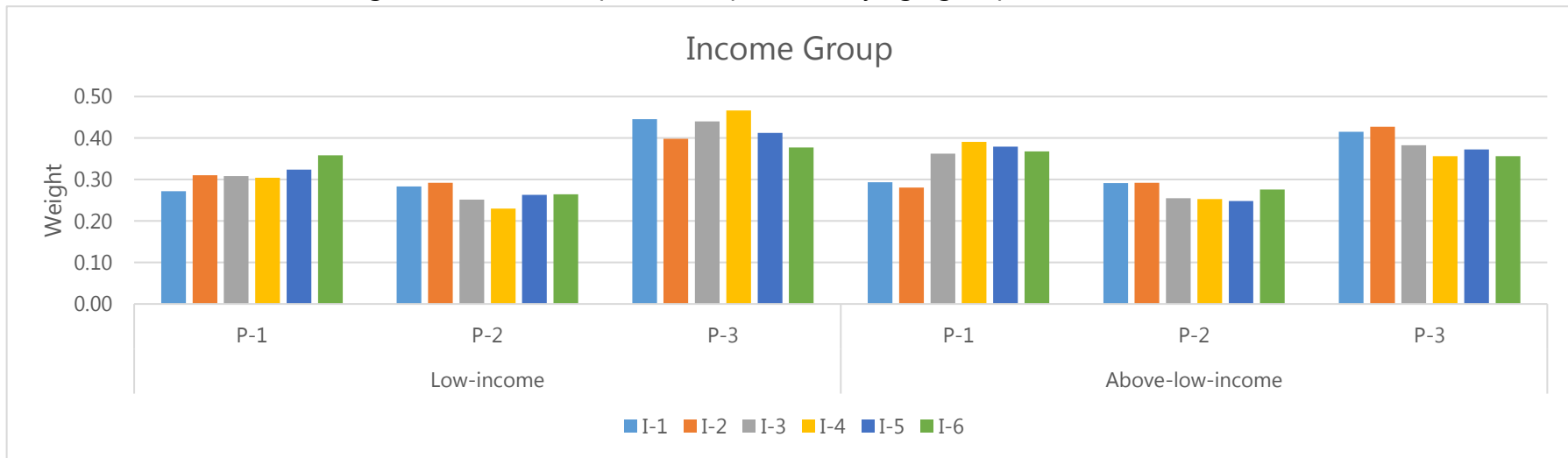


Fig. 17 Pairwise comparison of practices by income group (Source: Authors)

### 3.3 The perspective of local government

Fig. 19 to 21 shows the results of pairwise comparisons of criteria, indicators under each criterion, and practices under each indicator from the perspective of the Nachikatsuura town officials. The results had the highest consistency in the study with a CR of 0, which may be partly explained by some of the officials having participated in the design of the questionnaire survey (Triantaphyllou and Mann, 1995). Similar to the community responses, government officials preferred societal value (C-3) was a dominant criteria followed by relevance to DRR/CCA policy (C-2) and measurability and verifiability (C-1). Mental disease was ranked the most important indicator to assess the NELD effectiveness of practices, followed by local governance indicators such as less collaboration of local government with local communities (I-5) and health indicators such as chronic disease (I-2). The responses from town officials were similar to that of the community members except for the chronic diseases. The community and town officials also differed in their opinion on effective practice to address NELDs. Town officials identified DRR policy and planning (P-1) as the most important practice for addressing NELDs while communities preferred shelter policy. Fig. 18 presents the overall decision tree for town officials and depicts the relatively higher importance given to health indicators, which explains the higher perceived effectiveness of DRR policy and planning.

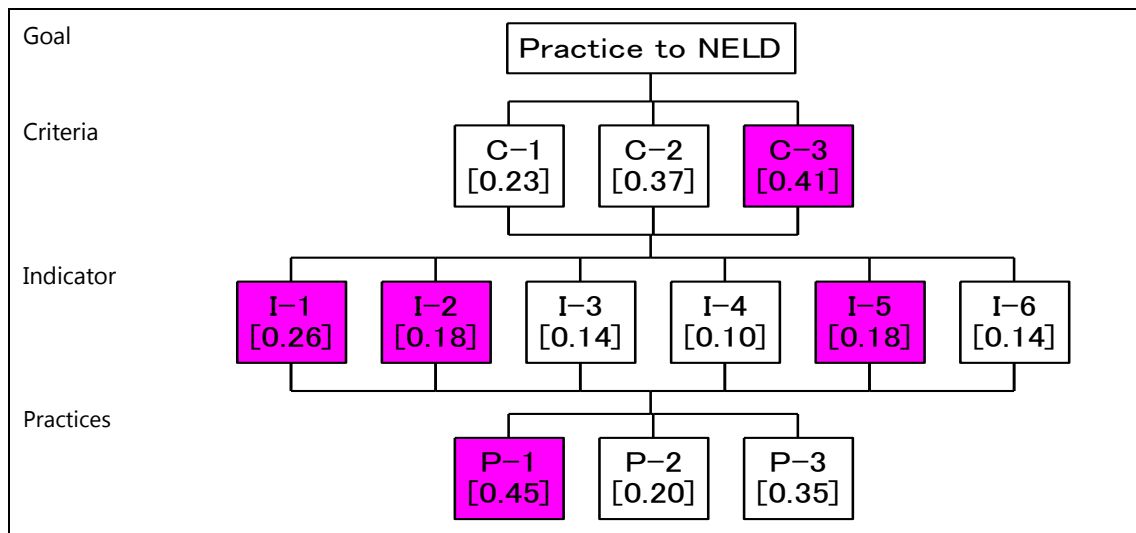


Fig. 18 Overall weights from the perspective of local government  
(Source: Authors)

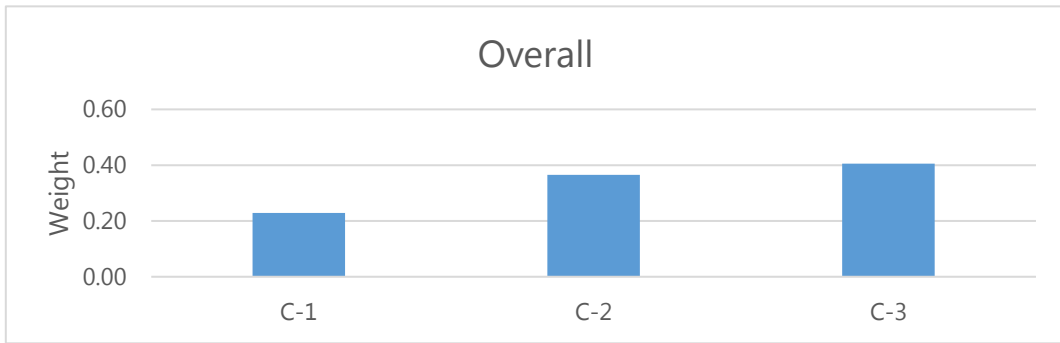


Fig. 19 Pairwise comparison of criteria (overall) (Source: Authors)  
 (C-1: Measurability and verifiability; C-2: Relevance to DRR/CCA policy; C-3: Societal value;  
 CR = 0.000)

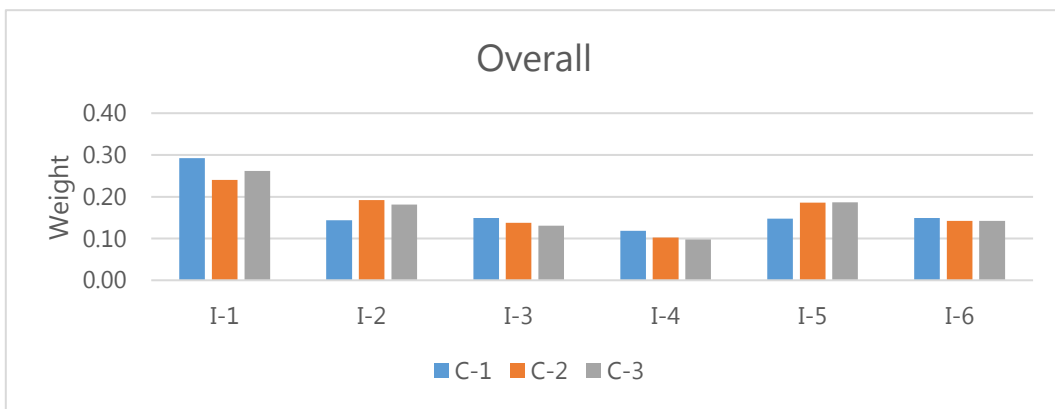


Fig. 20 Pairwise comparison of indicators (overall) (Source: Authors)  
 (I-1: Mental diseases; I-2: Chronic diseases; I-3: Period of school discontinuation; I-4: Number  
 of school discontinued; I-5: Less collaboration of local government; I-6: Less participation of  
 community; CR (C-1) = 0.009; CR (C-2) = 0.007; CR (C-3) = 0.008)

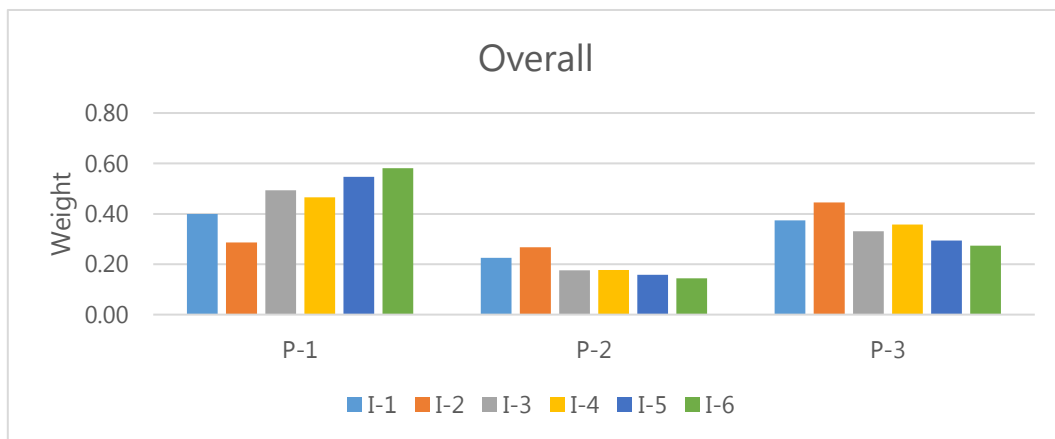


Fig. 21 Pairwise comparison of practices (overall) (Source: Authors)  
 (P-1: DRR policy and planning; P-2: Disaster compensation; P-3: Shelter policy; CR (I-1) =  
 0.003; CR (I-2) = 0.000; CR (I-3) = 0.001; CR (I-4) = 0.001; CR (I-5) = 0.000; CR (I-6) = 0.001)



### 3.4 Assessing the Current Status

This section discusses the current status of practices identified in the study in the Nachikatsuura town and provides recommendations for the town, prefecture and national governments wherever applicable, to address issues identified in the previous section. The results indicate that both communities and town officials agree on the importance of addressing mental diseases (I-1) and issues affecting the collaboration of local government with local communities (I-5). Communities have identified their limited participation in decision-making (I-6) as a challenge. In terms of health issues, in addition to mental diseases, town officials also recognized the importance of addressing chronic diseases (I-2), especially keeping in view the increasing number of elderly residents. The results also reveal that the shelter policy and DRR policy and planning will help address these issues, even though the relative effectiveness differs depending on the demographic characteristic of respondents.

In this section, an effort has been made to describe the current status of mainstreaming these NELD indicators and practices into Nachikatsuura's existing disaster management (DM) plan, a part of which covers the shelter policy. Disaster data collection formats are also discussed. The discussion reveals that the mere presence of these practices may not suffice and that the details in their planning and implementation also determine their effectiveness.

#### 3.4.1 Mental and chronic diseases

The town's DM plan clearly describes efforts to address mental diseases while chronic diseases were not specifically defined in the plan but may have been considered under 'illnesses' described in the DM plan. The DM plan includes the health and hygiene plan for windstorms and floods caused by typhoons, which lays down guidelines for public nurses on providing healthcare to individual households, and evacuation centers for addressing physical and mental illnesses in the aftermath of disasters (Nachikatsuura Town, 2016). The health and hygiene plan also contains the mental health and welfare policy plan to address long-term disaster impacts on mental health. The plan suggests mental-care counseling including visits to people living in temporary houses, formation of self-help groups among affected people, information gathering for identifying mental

problems, and research and development of policies to address the identified problems. The plan gives special attention for the mentally disabled, who are more likely to become mentally unstable, the elderly, who are more likely to suffer a sense of isolation due to relocation to temporary houses, alcoholism, which may occur after disasters, underdeveloped children and the bereaved.

The town office is generally required to collect loss and damage data after the disaster using specific data collection formats and report the data to the prefectural government, which then reports to the Fire and Disaster Management Agency (FDMA) and other concerned government ministries as appropriate (MIC, 2014). However, the data formats do not require the collection of information on the number of local communities affected by illness including mental and chronic diseases (FDMA, 2001). Moreover, methodologies that could be used to establish cause and effect relationships between mental and chronic diseases and the typhoon are lacking. It is complicated by the fact that many of these NELDs continue to occur after several months and years of the natural disaster making it difficult to attribute them to a specific event. Consequently, any changes in numbers of mental and chronic disease cases cannot be attributed to the typhoon (Nachikatsuura Town, 2013).

Reports indicate that 125 mental health experts and several school counselors were dispatched to the affected areas in Nachikatsuura and other municipalities in Wakayama for providing physical and mental healthcare to local communities during and in the aftermath of the typhoon in September 2011 (Nachikatsuura Town, 2013). In addition, a telephone counseling hotline for mental-care was established (Wakayama Prefecture, 2011b).

Despite these efforts, the survey showed an ongoing need for enhanced mental and physical healthcare at evacuation centers and homes. Prolonged stay and poor amenities such as bedding at evacuation centers, loss of family members, insomnia, alcoholism, and anxiousness about securing a livelihood, employment and income in the future were found to be causes of mental stress among the affected. Interviews with the affected community members also indicated refusal to attend school for more than a year due to mental stress caused by environmental changes after the disaster. The mental diseases were not limited to the affected communities as the town officials were also affected due to work

pressure. As a result, the prefectural and central governments were requested to support the town by providing additional manpower. Chronic diseases such as asthma, sciatica, hypertension and Alzheimer's dementia, and fatigue were also reported. These diseases were exacerbated by a lack of medicines and limited access to health facilities.

These observations supports the earlier health needs identified in the study. It is necessary for the town office to improve the shelter policy and the DM plan to address mental stress caused by disasters (Table 6). Increasing the number of mental health experts and providing long-term mental care would be positive steps. There is also a need for the town's DM plan to recognize chronic diseases as a major NELD. The shelter policy should be strengthened to improve medical preparedness at evacuation centers and ensure periodic and sufficient dispatch of medical experts as long as necessary after the disasters. It was also observed that the measurement and reporting frameworks for mental and chronic diseases need to be strengthened to collect sufficient information to aid decision-making.

### 3.4.2 Less collaboration and participation

Collaboration between the town office and communities is an important aspect of disaster risk management planning and such a need was well recognized by the town's DM plan. Community associations and voluntary organizations for disaster prevention played a crucial role in the aftermath of the disaster in terms of the operation of evacuation centers, provision of food, post-disaster damage assessment and removal of disaster waste. Building consensus between the town office and local communities while carrying out these tasks is of paramount importance for effective recovery. Data related to local governance on government collaboration with communities for recovery and the number of interactive sessions for consensus-building between the town office and communities had not been included by the town office in the data collection formats (FDMA, 2001).

The survey results demonstrated challenges facing collaboration between the town office and communities especially in organizing evacuation centers. For instance, food was only provided in evacuation centers, due to insufficient collaboration with community associations. Those who were not evacuated faced

difficulties in accessing food. In addition, lack of engagement of communities by the town office meant that the needs of the disabled and elderly were not adequately met and lack of collaboration with communities also posed problems in identifying disposal sites for disaster waste. As a result, some communities, as in the case of Iseki District, carried out debris removal without any help from the town office. Lack of dialogue between the town office and communities was reported to have negatively affected the recovery plans after the disaster. It should be understood that several of these issues emanated from a manpower shortage within the town office, which meant limited time for collaboration and lack of experience in responding to large-scale disasters.

Based on this experience, the prefectural and central governments need to have made provisions to support town offices to avoid manpower shortages (Table 6). They should also invest in strengthening the human resources and technical capacity of the town office to prepare for, cope with and recover from disasters. This evidence and experience suggests the need to strengthen the shelter policy and related components of the DM plan to enhance collaboration between the town office and communities in matters related to organization of evacuation centers, removal of debris and recovery planning.

In addition, it is vital for the town office to revise the DM plan to enable periodic opportunities for community consultations and dialogues, to obtain community opinions and for consensus-building. Relevant experts and facilitators familiar with the local socio-economic contexts should participate in these interactions to provide independent opinions as a way of avoiding conflicts between the communities and the town office.

### 3.4.3 School discontinuation

Both communities and the town officials gave lower priority to addressing prolonged school discontinuation and number of school discontinued than health and local governance issues. The data collection formats required information to be collected on the number of schools discontinued, but not on the period of school discontinuation (FDMA, 2001). Nevertheless, the town office has reported the period of school discontinuation and this can provide useful information for measuring the education loss faced by children.

The survey results showed that in particular female and youth households and low-income groups recognized the need to improve the shelter policy for addressing the inaccessibility of educational opportunities for children. Some schools such as the Ichinono Elementary School and Iseki Kindergarten directly suffered physical damages caused by debris flows and many schools were temporarily used as evacuation centers (Nachikatsuura Town, 2013). As a result, some schools were temporarily closed and children were forced to discontinue school or go to other schools under high mental stress from the disaster and worry about an uncertain future.

Hence, it is important for the town office to carefully consider the continuity of education for children when schools are closed due to physical damage or their use as evacuation centers (Table 6). The official data collection formats should be also improved to collect information about the period of school discontinuation which can be an indicator for measuring the loss of educational opportunity for children.

Table 6. Summary of recommendations to address NELDs

NELDs	Recommendations
Mental and chronic diseases	<ul style="list-style-type: none"> <li>▪ Improve the town's shelter policy and DM plan to address mental stress through mobilizing more mental health experts and providing long-term mental care.</li> <li>▪ Recognize chronic diseases as a major NELD and enhance the shelter policy for medical preparedness at evacuation centers.</li> <li>▪ Strengthen the measurement and reporting frameworks for mental and chronic diseases to aid decision-making.</li> </ul>
Less collaboration and participation	<ul style="list-style-type: none"> <li>▪ The prefectural and central governments should invest in improving the human resources and technical capacity of the town office for disaster recovery.</li> <li>▪ Strengthen the town's shelter policy and DM plan to enhance collaboration between the</li> </ul>

NELDs	Recommendations
	<p>town office and communities especially for adequate management of evacuation centers.</p> <ul style="list-style-type: none"> <li>▪ Improve the town’s DM plan to establish communication channels to obtain community opinions and for consensus-building.</li> <li>▪ Seek participation of relevant experts and facilitators with independent opinions that can assist in avoiding conflicts between the communities and the town office.</li> </ul>
School discontinuation	<ul style="list-style-type: none"> <li>▪ Give careful attention to the continuity of education for children when schools are closed.</li> <li>▪ Improve official data collection formats for the period of school discontinuation.</li> </ul>

Source: Authors

## 4. Conclusions

The NELDs caused by climate-related disasters are important challenges in Japan as the existing countermeasures are more focused on addressing physical damages. However, the NELDs, including loss of health, education, social capital and local governance, can be substantial. This study aimed at identifying and prioritizing key NELDs caused by the 2011 Typhoon No.12 and practices to address these NELDs for effective DRR and CCA. The study applied the AHP analysis to prioritize key NELD-related elements (i.e., criteria, indicators and practices), which were identified, evaluated and narrowed down through three sequential steps: 1) comprehensive literature review; 2) expert consultation; and 3) focus group discussion in the affected community. Questionnaire surveys were conducted to prioritize the key NELD-related elements targeting the affected communities and the town officials.

The study identified several similarities and differences between the preferences of the affected communities and town officials. The affected communities identified social value as an important criteria, collaboration of local government with local communities as an important indicator and shelter policy as an important practice to address NELDs. The results were similar to those of the town officials, except on practice, where DRR policy and planning was prioritized instead of shelter policy. It was found that mental diseases and shelter management are closely related, as improper and insufficient post-disaster relief and rehabilitation were found to be causes of mental diseases. This indicates a need to support vulnerable people amongst the affected households by mobilizing more mental health experts and providing long-term mental care. In addition, providing mental-care to the town officials is necessary as they face significant mental pressure in the aftermath of the disaster. There is also a need to recognize and address chronic diseases as a major NELD in the town's DM plan and strengthen the shelter policy in terms of medical preparedness at evacuation centers and periodic dispatch of medical experts.

It is crucial for the town office to improve the shelter policy and related DM plan in ways that strengthen collaboration between the town office and local communities. In particular, attention should be given to the appropriate management of evacuation centers through close coordination and

communication with community associations, voluntary organizations and volunteer groups. It is imperative for the town office to improve the DM plan by establishing communication channels to seek opinions and for consensus-building with communities. Participation of relevant experts and facilitators in these communications would strengthen the DM plan in terms of providing independent opinions that can assist in avoiding conflicts between communities and the town office. The prefectural and central governments should make provisions for supporting town offices to avoid manpower shortages and strengthen their human resources and technical capacity to prepare for, cope with and recover from disasters. Furthermore, it is also necessary for the town office to enhance the shelter policy to ensure educational opportunities for children when schools are discontinued due to their use as evacuation centers.

Another concern is that the disaster data collection formats of the town office do not collect information on some important NELD indicators identified by this study, such as number of local communities affected by mental and chronic diseases, collaboration for recovery and dialogue for consensus-building between the town office and communities, and period of school discontinuation. These indicators should be included in the data formats to ensure loss and damages are fully reported.



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