Research on the Correlation between Disaster Preparedness and Ecosystem Conservation – Toward Building a Culture of Disaster Risk Reduction for Local Sustainability

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Abstract

In recent years, record-breaking extreme weather and climate-disaster events have dominated the headlines and drawn public attention to the anthropogenic climate change and its influences. Disasters liked to extreme hazard events such as floods, droughts, heat waves, tropical cyclones, volcanic eruptions, and earthquakes repeatedly undermine local and national development efforts to support livelihoods, promote economic growth and achieve human well-being. The importance of pursuing integrated solutions to disaster reduction and sustainable development is more critical than ever. Ecosystem management and the sound management of natural resources is a solution to sustainable development that is considered as a "no-regrets" demand to address rising disaster and climate change issues. Yet, when we think about this ecosystem-based adaptation together with our surviving and life-protection from natural hazards and disasters, the ultimate purpose of disaster risk reduction, it is vital to clarify how ecosystem-based disaster risk reduction can contribute to our survivability and promote our preparedness.

This thesis aims: 1) to understand the current status of disaster preparation, willingness in local ecosystem conservation, and experiences and knowledge of local disasters among residents in a local area, 2) to clarify the correlation between disaster preparation behavior/intention and willingness to conserve local ecosystems among citizens, then eventually, 3) to make recommendations for promoting disaster risk preparedness as self-help or mutual help, namely how to use and incorporate the local ecosystem conservation in disaster risk management as well as what is to be enhanced, altered, or added in ongoing local disaster management strategies.

Having selected two sites in Japan, this research conducted a workshop approach for youth in Shiga Prefecture and questionnaire surveys to citizens and small and medium-sized

enterprises in Sukagawa city, Fukushima Prefecture. Based on the Constructivist Theory of learning, in particular, Zone of Proximal Development, the workshop gave youth an opportunity to subjectively evaluate local natural resources using the concept of the ecosystem services by the Millennium Ecosystem Assessment. The results were analyzed qualitatively to clarify the differences in their subjective evaluation depending on their past environmental educational experiences. Regarding the questionnaire surveys to citizens and enterprises, the results were statistically analyzed, namely, with Multi Correspondence Analysis, Cramér's V, and logistic regression aiming to determine whether, and how, their disaster preparation behavior and willingness to conserve local ecosystem services are correlated. As for the municipality strategies and policies, this research reviewed official documents, historical records of disasters and place-names, and had interviews to city officials to examine whether, and how, they have a view to integrate their past disaster experiences and local natural environmental conservation.

The findings suggest that disaster preparedness and willingness for local ecosystem conservation are correlated. In case of youth, those who are interested in local natural items such as rivers showed interest in local past disaster experiences, and those who have cognitions to the connectivity to global environmental issues evaluated regulating services of local natural ecosystems such as mitigating floods and droughts. The questionnaire surveys to citizens and enterprises clarified the correlation between their interests in local ecosystem services and their disaster preparation behaviors. Citizens who are interested in cultural services showed the higher occurrence probability of disaster preparation behavior, whereas enterprises showed the strongest association with environmental actions and disaster preparation behavior, namely formulation of Business Continuity Plan. The document reviews and interviews revealed that the ecosystem-based approach for disaster risk reduction has not enough been considered yet as well as that local place-names can be

more used to include in local environmental education to show two sides (benefits and disaster risks) of nature for integrating ecosystem-based approach of disaster risk reduction.

This thesis concludes with answering the preceding three objectives based on the key findings given above as well as recommendations to integrate local disaster experiences and place-names in environmental education in local formal and non-formal settings.

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Acronyms & Abbreviations

BCP	Business Continuity Planning
BCM	Business Continuity Management
CCI	Chamber of Commerce and Industries, The
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
EE	Environmental Education
ESs	Ecosystem Services
GEJE	The Great East Japan Earthquake and Tsunami
HFA	Hyogo Framework for Action
IPCC	Intergovernmental Panel on Climate Change
ILEC	International Lake Environment Committee Foundation
MA	Millennium Ecosystem Assessment
MCA	Multi Correspondence Analysis
MoE	Ministry of the Environment, Japan
MLIT	Ministry of Land, Infrastructure, Transport, and Tourism, Japan
PEDRR	Partnership for Environment and Disaster Risk Reduction
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SMEs	Small and Medium-sized Enterprises
UN	United Nations, The
UNDRR	United Nations Office for Disaster Risk Reduction (formerly UNISDR)
ZPD	Zone of Proximal Development

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Contents

CHAPTER 1
Introduction

1.1 Background

In recent years, record-breaking extreme weather and climate-disaster events have dominated the headlines and drawn public attention to the anthropogenic climate change and its influences. Disasters liked to extreme hazard events such as floods, droughts heat waves, tropical cyclones volcanic eruptions and earthquakes repeatedly undermine local and national development efforts to support livelihoods, promote economic growth and achieve human well-being. The importance of pursuing integrated solutions to disaster reduction and sustainable development is more critical than ever. Ecosystem management and the sound management of natural resources is a solution to sustainable development that is considered as a “no-regrets” demand to address rising disaster and climate change issues (IPCC, 2012; UNDRR, 2009; UNDRR, 2011).

The degradation of ecosystems as risk factor is not necessarily addressed by relevant authorities in many regions of the world (UNDRR, 2011). Additionally, the role of ecosystems in the context of disasters is perhaps the most overlooked component in disaster risk reduction (DRR) and development planning. Whereas ecosystem management is still perceived by many as having conservation value only (for example, maintaining biodiversity), its role in the context of DRR in terms of providing hazard protection, livelihood recovery and sustainability, and resilient development is often ignored. Yet, in some cases, ecosystem-based solutions to DRR are in greater demand by various

stakeholders such as governments, tax payers and countries where there may be limited choice but to invest in ecosystems as the most readily available and effective solution to reducing underlying risk factors (Pihl et al., 2019). Even then, hard engineered solutions for risk reduction, such as the construction of dykes to protect against water hazards (e.g., flooding, sea walls in areas prone to tsunamis and storm surges) often remain the more favored intervention approach in DRR. In order to fill the gap in opportunities by ecosystems for DRR, there are several practices where ecosystem-based, ecosystem-inclusive, or hybrid-ecosystem-engineering solutions can be applied successfully as part of a more systematic approach to DRR (Renaud et al., 2016).

1.1.1 Linkages of Ecosystems, Humans, and Disasters

Ecosystem and its role in disaster risk reduction have been increasingly recognized not only as a means to attain ecosystem-based disaster risk reduction but also to contribute to sustainable development. A closer look at disasters revels that they are induced by a complex mix of drivers, such as people living in dangerous places, poor governance, environmental degradation, inadequate early warning, and lack of preparedness by the public and the authorities. These are all interlinked with challenges of socio-economic development. Discussions around the theme of ecosystem disaster risk reduction and related concepts are of increasing interest in the recent years (Peduzzi et al. 2010).

Millennium Ecosystem Assessment (MA) (2003; 2005) presented the concept of Ecosystem Services and their classification. The content of became crystallized in the 1990s since the original concept of ES was presented by Odum in 1959 (Vihervaara et al., 2010). MA (2003; 2005) produced the classification with four services, i.e., Provisioning service, Regulating service, Cultural service, and Supporting service, as well as to what extent those services are related to human well-being (Figure 1.1). MA define ecosystem services as “the

benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services, which directly affect people, and supporting services needed to maintain the other services (MA, 2003, p. 78)."

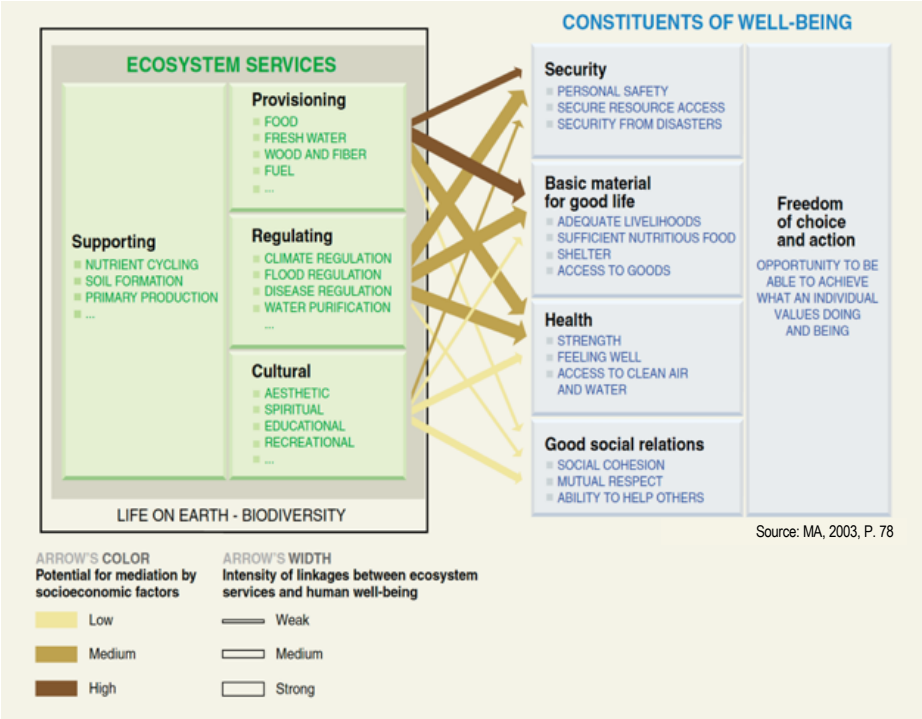

Figure 1.1 Linkages between Ecosystem Services and Human Well-being (MA, 2003, p.78; MA, 2005, p. 4)

As Figure 1.1 show, it is the regulating services (climate regulation, flood regulation, disease regulation, water purification etc.) that have the most intensity of linkages between ES and human well-being. It also has larger potential for mediation by socio-economic factors to the many of constituents of human well-being (security, basic material for good life, and health). It is reported that the regulating services may possess the largest portion of economic value of ecosystem services, though it is no more easy targets to measure than cultural services are (TEEB, 2010). MA (2005) warns that up to 70% of the regulating services have been degraded and/or depleted by unsustainable management.

Hyogo Framework for Action (HFA) also focuses ecosystem in its Priorities for Action, which promotes to encourages the sustainable management of ecosystem and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction (UNDRR, 2005). This has transferred to Sendai Framework for Disaster Risk Reduction (SFDRR) (UNDRR, 2015) as lessons learned, in which it was more precisely included to "promote the mainstreaming of disaster risk assessment, mapping and management into rural development planning and management…at the same time preserving ecosystem functions that help reduce risks (p. 15)" as a priority action to invest in disaster risk reduction for resilience.

Yet, although ecosystem conservation and disaster risk reduction are inter-related, the discussions on those topics have always been paralleled (Renaud et al., 2013). The integration of sustainable management of ecosystem and natural resource remains far from mainstream (UNDRR, 2011; UNDRR, 2013). In order to promote ecosystem management and policy interventions, it is necessary to employ not only natural scientific views such as ecosystem dynamics and structures but also humanity and social science and engineering perspectives on how people evaluate and are benefited from ecosystem, which enables us to capture it as a socio-ecological system within which natural system and social system are linked (Berkes and Folke, 1998; Berkes et al. 2003).

Figure 1.2 describes the conceptual relation and linkages between ecosystem, natural resources, and human activities based on Hagihara (2006) and Okada et al. (2006). Using a metaphor of a house for the relation system between environment and disaster risks, it forms three large layers: Geo, Eco, and Socio. Eco and Socio (a house) stands upon Geo (the ground). Eco (the first floor of a house) supports Socio (the second floor of a house). The layer of Socio further can be subdivided into culture, social structure, infrastructure, land-use, and human activities. In this system, any events at Geo or Eco influences Socio, ad vice

versa. Activities of nature and human (life, production, distribution, consumption, and dispose) are interlinked within Socio (the second floor). The cycle of nature activity circulates in a self-containment manner, on the other hand, human activity disposes as waste back into resources of Eco (the first floor). The lower the layer is located, the slower its speed of changes is. A number of studies have dealt with the relation between natural hazards, human activities or well-being (yellow-framed arrows and boxes in the Figure 1.2). That is, the relation between resources, human activities and well-being has not been rather overlooked. In the trend of acknowledging ecosystem services and their contribution to DRR, it should be worth to focus on the relation between the ecosystem services, natural resources, and human activities toward sustainable development (green-framed arrow and boxes in Figure 1.2).

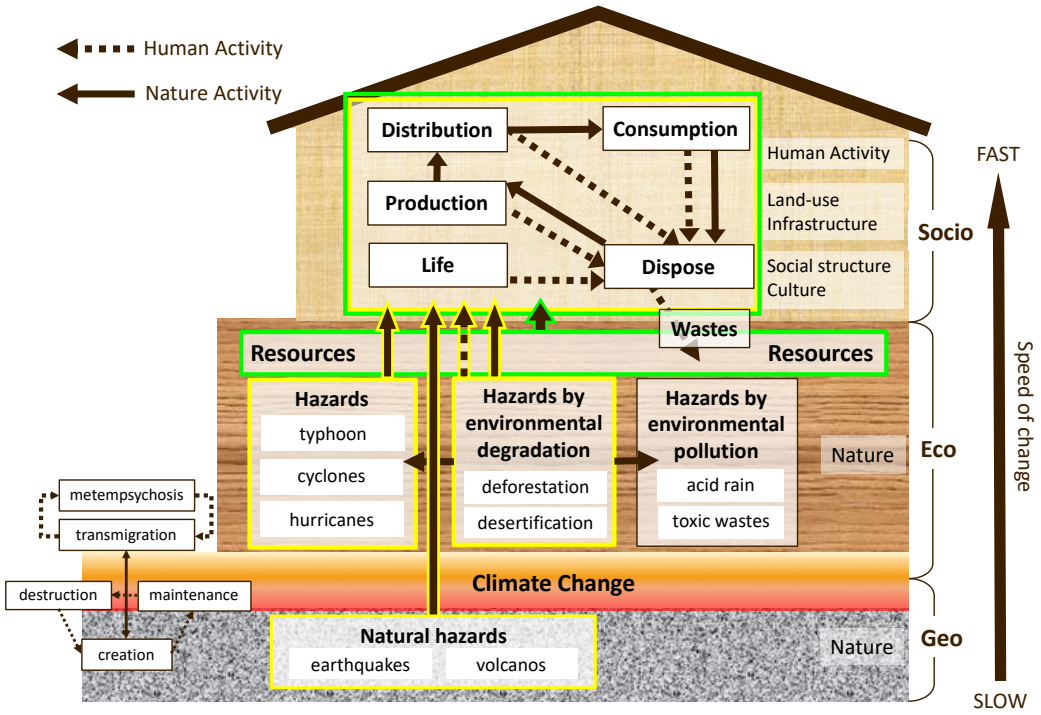

Figure 1.2 The conceptual relation between human activity, natural resources, and natural hazards. The green-framed arrow is the focus of this research (green-framed)
(Created by the author based on Hagihara, 2006; Okada et al., 2006)

1.1.2 Ecosystem-based Disaster Risk Reduction

To incorporate natural resources management approaches with disaster risk reduction methods, Ecosystem-based Disaster Risk Reduction (Eco-DRR) has been emerged. Eco-DRR is an approach that entails ecosystem services or the sustainable management of ecosystems with disaster risk reduction methods such as early warning systems and emergency planning in order to have more effective disaster prevention, reduce the impact of disasters on people and communities, and support disaster recovery (Sudmeier-Rieux et al., 2013).

Eco-DRR is defined as "the sustainable management, conservation and restoration of ecosystems to reduce disaster risks, with the aim to achieve sustainable and resilient development (Estrella and Saalisma, 2013, p.30)." Regarding the connection ecosystem, humans, and disaster, MA (2005) states "dynamic complex of plants, animals and other living communities and the non-living environment interacting as a functional unit, and humans are an integral part of ecosystems." Another expected characteristic of Eco-DRR is that it supports human well-being in both phases of pre-disasters and post-disasters when ecosystem is well-managed (Figure 1.4).

Eco-DRR, however, is not a panacea for DRR as the type of disasters and their causes are various. This brings arguments on both some strong expected contribution of Eco-DRR and some weakness or limitations of Eco-DRR.

The pro-characteristics of the approach are:

- Mitigate the disaster risks with their services/functions,
- Sustainable with lower cost,
- Local natural resources and environment oriented; and

- Helps build resilience, and resilience is not only a more positive term than focusing on vulnerability reduction but also more appropriate for understanding complex and dynamic systems and interactions between socio-ecological systems.

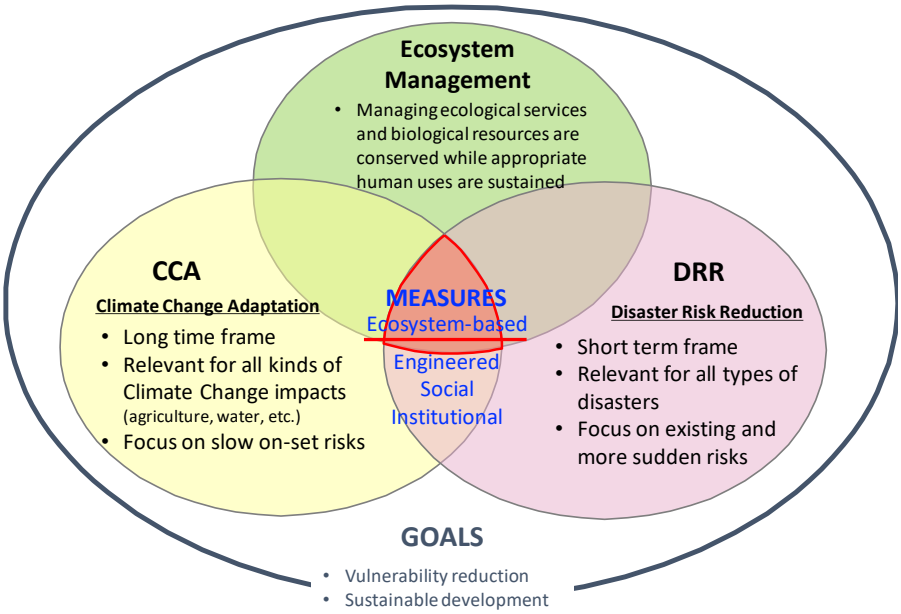

Figure 1.3 The conceptual of Ecosystem-based Disaster Risk Reduction (Eco-DRR) (Modified Renaud et al., 2013; Sudmeier-Rieux et al., 2017; UNDRR 2011; 2013)

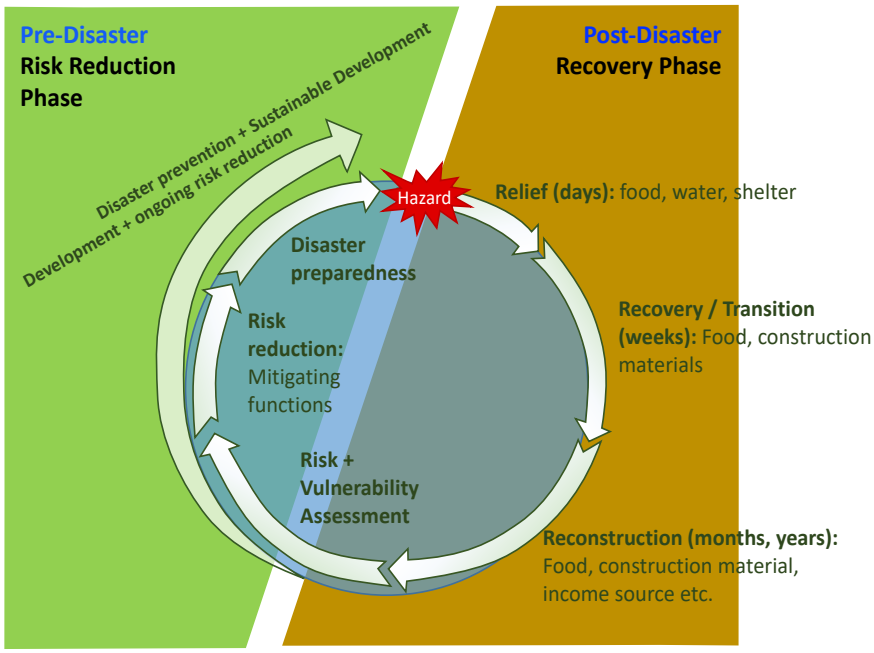

Figure 1.4 Functions of the ecosystems in a disaster cycle (Modified Sudmeier-Rieux, 2013; Lloyd-Jones, 2009)

On the other hand, the con-points of argument are:

- It may help build resilience, but:
- Resilience as defined as the ability to return to the pre-disaster state does not necessarily reduce risk or vulnerability; and
- Resilience is not an appropriate approach to DRR and CCA if it only focuses on increasing the capacity of populations to cope in the short term, rather than a long-term approach to reducing underlying risk factors (Sudmeier-Rieux et al., 2017)

1.1.3 Ecosystem-based Disaster Risk Reduction in Japan

Japan is one of the most disaster-prone countries. The country and its people have long been in tradition of utilizing ecosystems for mitigating disasters, e.g., planting pine trees along the coast to mitigate winds and blown sands, planting bamboo trees and/or *sakura*-cherry trees along the river banks to reinforce the strength to prevent the flooding, and storing storm waters in the rice paddies. However, since the late 1960s, rapid and nationwide development, social transformation, as well as population growth had changed the landscape of such using ecosystems for disaster mitigation. New residential areas were expanded even into the areas with high disaster risks, for which then-government had to hammer out the budget to construct, operate and maintain new social infrastructures as a disaster prevention measure (MoE, 2017).

These days, the situations of society in Japan have changed. Depopulation and aging have become serious in Japanese society, especially in rural areas and it is followed by falling birthrate and fewer labor for land-use management including increasing unused land in agriculture (Japan Policy Council, 2014; MLIT, 2012). The social infrastructures built

during the economic growth period have deteriorated and in need of maintenance or repair, which will most likely have to face the budget difficulties as shown in Figure 1.5 (MLIT, 2012). This infrastructure issues have had to be considered with more extreme climate and meteorological events that have become more unprecedentedly in frequency and extreme level. The most recent report by leading scientists calls this weather extreme "a new normal" (Pihl et al., 2019, p.17). Receiving such social situation changes, Eco-DRR is expected to as a "win-win" solution for DRR approach. It encourages to avoid living in disaster-prone areas and keep healthy buffers to protect people's lives and properties in aiming to reduce vulnerability and exposure by harnessing the multiple functions of ecosystems (Figure 1.6) (MoE, 2016).

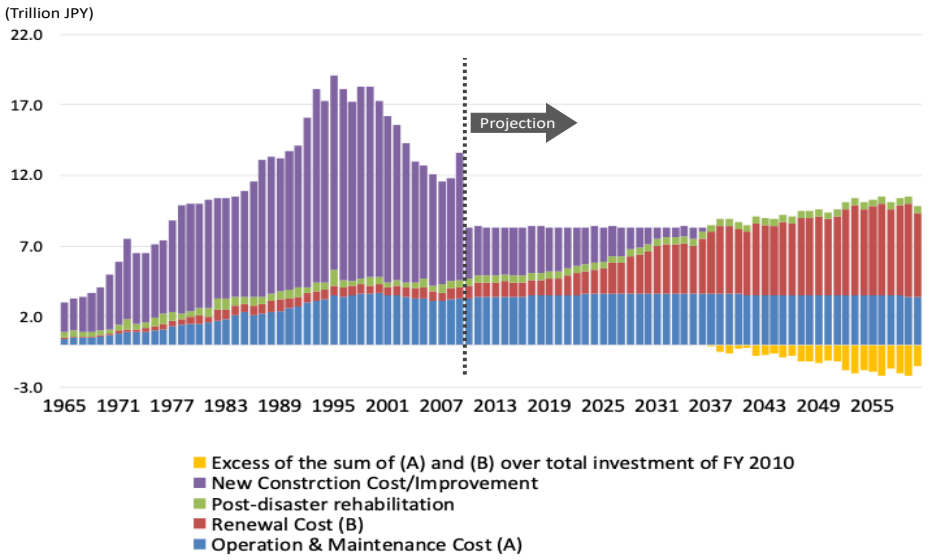

Figure 1.5 Projection of O&M cost in case the current status of budget use is kept
(Data source: MLIT, http://www.mlit.go.jp/hakusyo/mlit/h23/hakusho/h24/html/n1216000.html)

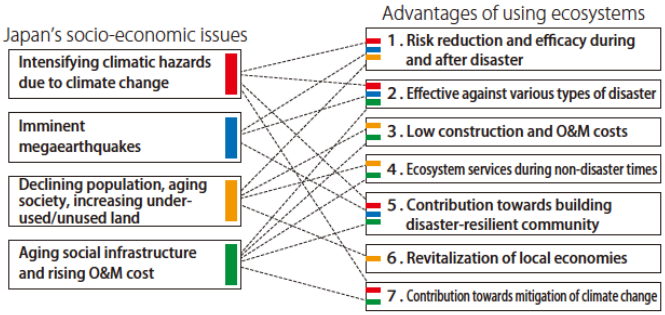

Figure 1.6 Solutions to topical Issues promised by Eco-DRR (MoE, Japan, 2016)

1.1.4 Institutions, Stakeholders, and Preparedness in Japan

In relation with the sound ecosystem management and DRR, Japan established some institutions in relation with disaster risk management and social capital, and they clearly mention the sound ecosystem management, for example:

- Basic Act for National Resilience Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of Citizenry (強くしなやかな国民生活の実現を図るための防災・減災等に資する国土強靭化基本法) (Article 9, Chapter 3),
- National Land Use Planning Act (国土利用計画法) (Chapter 3, Chapter 6 (1)),
- Act on Priority Plan for Social Infrastructure Development (社会資本整備重点計画法) (Chapter 1, section 2; Chapter 2, section 3)
- Biodiversity National Strategies (生物多様性国家戦略)2012-2020 (Chapter 2, section 6; Chapter 3, section 2; Chapter 4, section 2).

Japan experienced the GEJE, which was an opportunity to review the relation between human life and nature. Another important point reviewed was people's preparedness for disaster risks. The trend was reflected in the amendment of Basic Act on Disaster Management (災害対策基本法) in 2013 (Cabinet Office, 2015). Basic Act on Disaster Management is the fundamental law on disaster risk management in Japan and formulates basic principles, establishes a necessary system through the national and local governments and other public institutions, and clarify responsibilities regarding disaster risk management (Ministry of Justice, Japan, 2016). Under the Act, each local government is to establish Disaster Management Council for promoting implementations of Local Disaster Management Plan (地域防災計画). In the view of preparedness at district or community level,

When the Act was amended, District Disaster Management Plan (地区防災計画) was added (Article 42, para. 3) as a disaster management plan under the municipal level aiming to promote people's disaster preparedness (Figure 1.7).

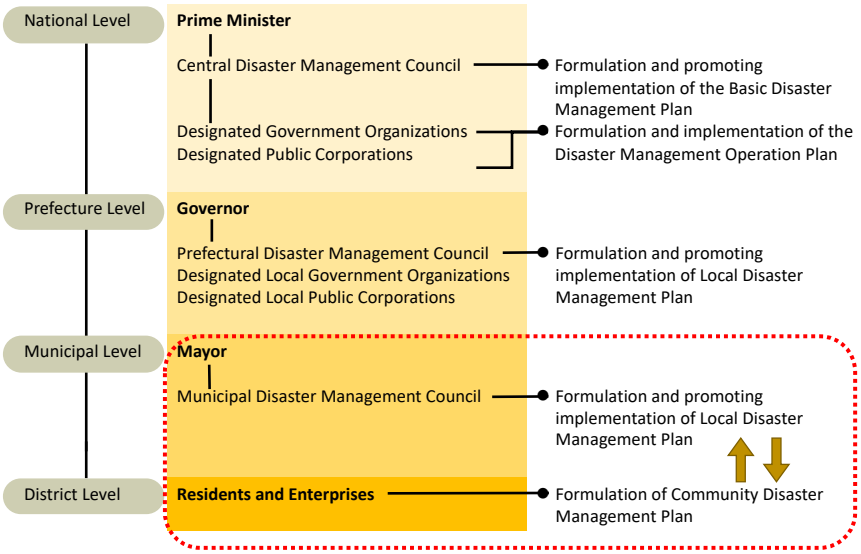

Figure 1.7 Stakeholders at each level of the disaster management system in Japan and the targeted group of this research (red dotted line) (modified Cabinet Office, 2015)

It highlights the preparedness by district residents and companies/enterprises beyond what is provided by the public, more precisely, they are expected to prepare storage of goods and materials required for disaster management activities, mutual support in the event of a disaster, and other disaster management activities in the area (Cabinet Office, 2015; Ministry of Justice, 2018).

1.2 Purposes and Rationale

As given above, Eco-DRR or Ecosystem-based approach has emerged and been drawn attention in the relation with disaster management in Japan. Though the concept has

been well-understood, quantitative assessment of Eco-DRR effects and mutual agreement toward social implementation have remained as issues to be tackled. Also, the amendment of Basic Act on Disaster Management adding self-help (disaster risk preparation by individual and/or each household) and mutual help (preparation and cooperation in neighbors) at district level is derived from insufficiency of preparedness as well as psychological distance to disaster risks (e.g., Burningham et al, 2008; Stoknes, 2015). In order to overcome it, story-telling is not enough to promote preparation behaviors (Burningham et al, 2008), some studies propose to use river landscapes for raising awareness and behaviors of disaster preparation (Katagiri, 2015; Nagoya University Library, 2005). However, which part of landscape to be effective to use has not been clarified yet.

Landscape includes local ecosystems. Using the concept of ecosystem services (provisioning service, regulating service, cultural service) and targeting local citizens, this research tries to clarify in which ecosystem service citizens with preparation behaviors show their interest, namely the correlation between disaster preparedness and willingness of local ecosystem conservation. By doing so, this research expects a possibility to find out new viewpoints to fill the mental gap to disasters as well as to promote disaster preparedness as self-help, thus it seeks to contribute to build a seamless culture of disaster risk reduction with a mind of ecosystem management at local level.

Thus, the purpose of this research are: 1) to understand the current status of disaster preparation, willingness in local ecosystem conservation, and experiences and knowledge of local disasters among residents in a local area, 2) to clarify the correlation between disaster preparation behavior/intention and willingness to conserve local ecosystems among citizens, then eventually, 3) to make recommendations for promoting disaster risk preparedness as self-help or mutual help, namely how to use and incorporate the local ecosystem

conservation in disaster risk management as well as what is to be enhanced, altered, or added in ongoing local disaster management strategies.

1.3 Structure of the Research

Figure 1.8 show the relation of each chapter and research items to engage the issues given in the preceding sections.

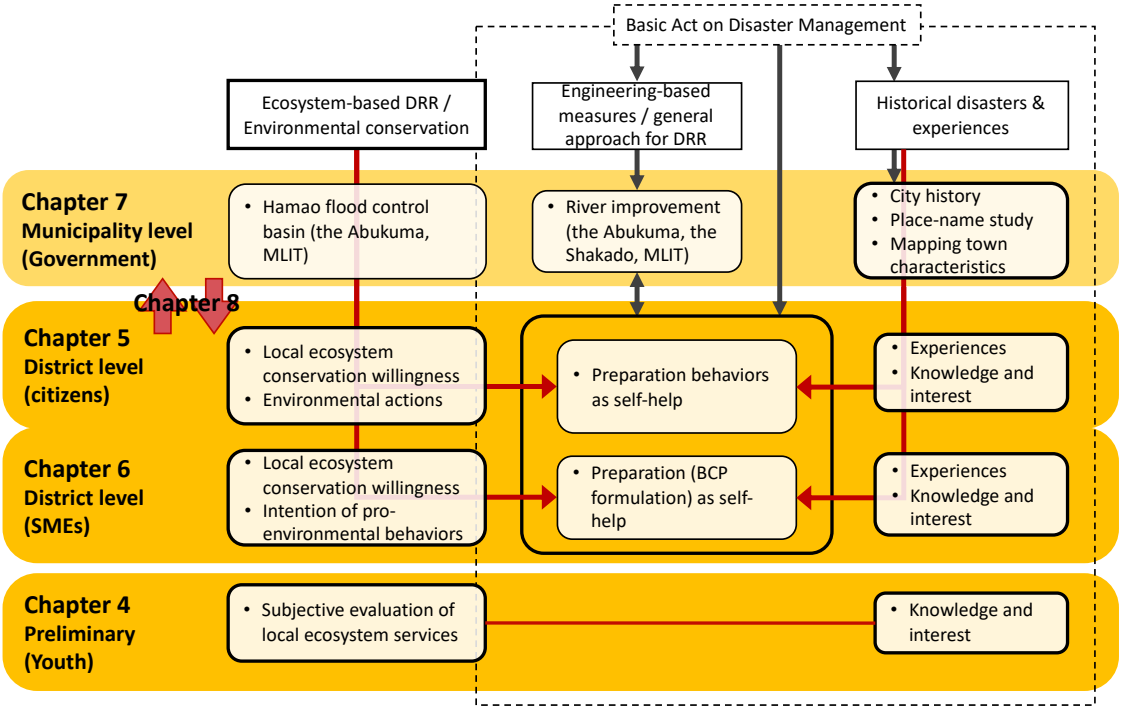

Figure 1.8 The targeted groups and topics dealt with in the chapters this research

Chapter 4 and Chapter 6 are based on the following articles:

Chapter 4:

Kimura, N., Hoshino, S., & Onitsuka, K. (2019) Subjective Evaluation of Local Natural Resources with the Concept of Ecosystem Services - Re-visiting Environmental Education as a method of local sustainability. *Journal of Rural Planning*. 38(3), 418-427.

Chapter 6:

Kimura, N., Hoshino, S., & Onitsuka, K. (2019) Analyzing the Association between Disaster Risk Preparedness and Environmental Consciousness of Small and Medium-Sized Enterprises: The Case of Sukagawa City, Fukushima Prefecture, Japan. *Journal of Disaster Research.* 14(8), 1047-1058.

Finally, the whole thesis structure is given in Figure 1.9.

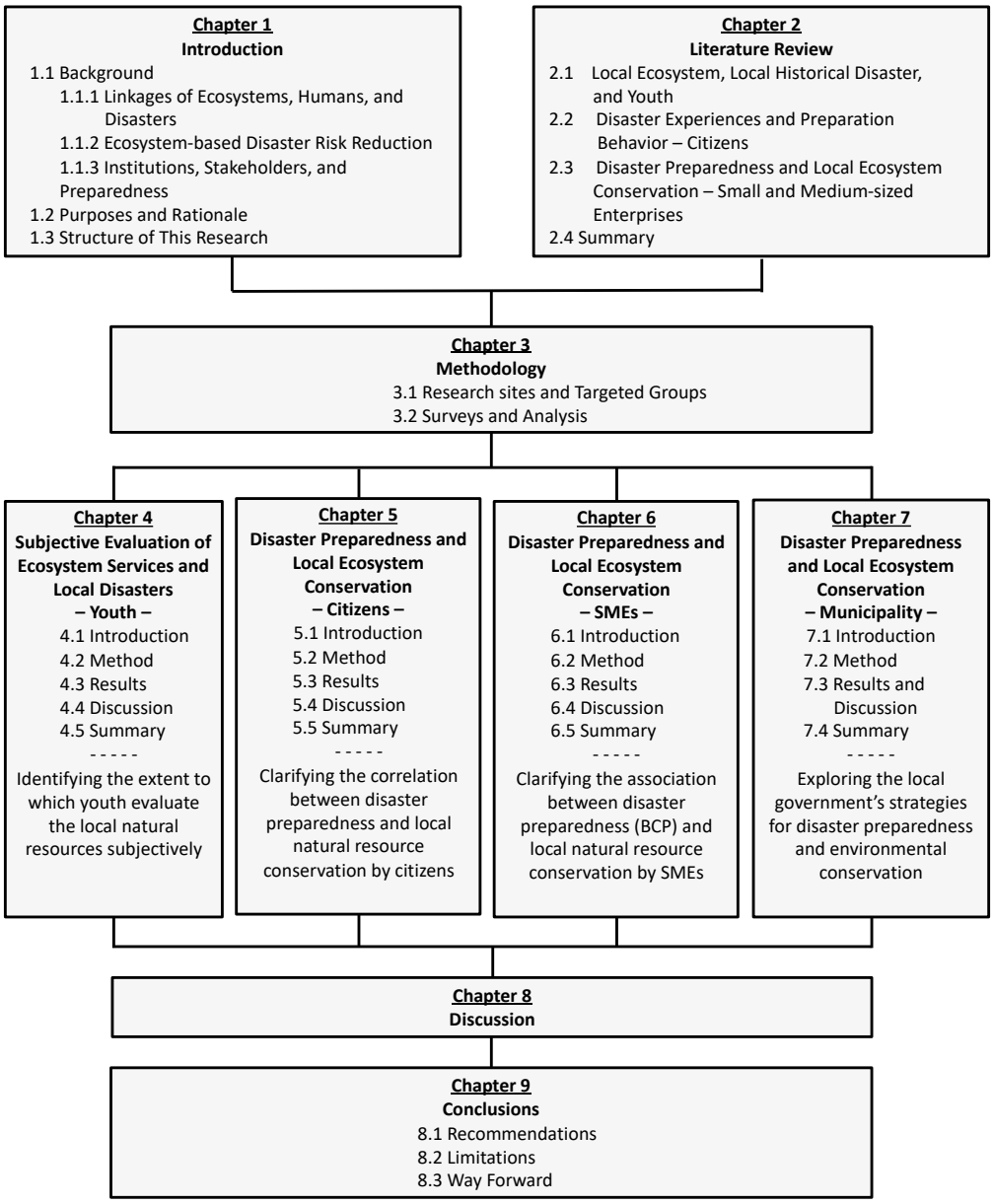

Figure 1.9 Structure of This Research

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CHAPTER 2
Literature Reviews

This chapter presents a literature review in relation with 1) subjective evaluation of local ecosystem by youth, 2) citizens' disaster awareness, preparedness and conventional disaster risk reduction approach, as well as historical disasters as local knowledge, and 3) small medium-sized enterprises' Business Continuity Plan formulation as a disaster risk reduction countermeasure and their local ecosystem conservation consciousness.

In light of emerging of Eco-DRR and wider social implementation in the future, this chapter attempts to organize 1) what issues still remained in the conventional DRR approaches in the relation with preparedness, and 2) in what way disaster preparation behavior is related with ecosystem or natural resource conservation. Through this, I expect to draw attention to the significance of the objective of this research.

2.1 Local Ecosystem, Local Historical Disaster, and Youth

2.1.1 Environmental Education and Disaster Risk Reduction for Youth

Environmental Education (EE) has long been playing an important role in many educational aspects. EE has been implemented not only in school curricula but also for the purpose of nature conservation as well as the sustainable development, and has become one of important method of community planning and development. Focusing on EE as a method of rural planning, Shigemura (2003) states that education through natural environment and agricultural experience plays a significant role as an indispensable concept in nurturing

independent individual actions such as daily-checking, evaluating, creating and managing local environment where both children and adults can have a new place of learning.

Regarding the relationship between the natural environment and human well-being, the concept of ecosystem services (ES) has been increasingly recognized as a means to contribute to sustainable development since the Millennium Ecosystem Assessment released its synthesis in 2003 (MA, 2003). Ecosystem services (ES) is defined as "the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits." In order to promote ecosystem management, it is necessary to employ not only natural scientific views such as ecosystem dynamics and structures but also perspectives of Social Science, Humanities, and engineering regarding how people evaluate and are benefited by their respective ecosystems. This allows us to identify the system as a socio-ecological one within which natural systems and social systems are linked (Berkes and Folke, 1998; Berkes et al., 2003).

Discussions around ecosystem-based approaches have been of growing interest in recent years. An example is Ecosystem-based Disaster Risk Reduction, a concept defined as "the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development (Estrella and Saalismaa, 2013, p. 30)." Implementing such a concept requires cross-cutting viewpoints on both sound management and conservation of ecosystem and disaster risk reduction with mutual understanding (Furuta and Seino, 2016; Furuta and Shimatani, 2018). The type of activities has become more diverse and targeted group has expanded from adults to children and youth in many communities. Although youth and/or children's participation is significantly important (Cuminskey et al., 2015) as youth are to be especially highly regarded as partners

for disseminating information and communicating knowledge (Fernandez and Shaw, 2014), their participation has been underestimated (Mitchell et al., 2008).

2.1.2 Environmental Education on Local Natural Resources

Regarding the linkage between human activities and natural resources, in the field of EE, Fujioka (2006; 2016; 2017) has emphasized the significance of including such linkages and interaction from a socio-economical perspective together with the other two items in EE: the two sides of nature "benefits and disaster," locality and local natural resources. The characteristics of the local area is a strong influential factor in selecting EE sites. Consolidation with the school curriculum is also needed to maximize the learning outcome of EE (Watanabe et al., 2010). EE on potent local natural items (e.g., oceans, rivers) inspired the children's willingness to learn more about their environment and increased their pride in local products as well as in the likelihood of their intention to remain as residents in their local area after growing up (Matsumoto et al., 2017). Based on their EE experiences and learnings, it is expected that they have an opportunity to see their local natural environmental background through the existing ecosystem of their local area and rethink how their ecosystem and human activities have interacted, as well as how humans benefited from the ecosystem.

As for EE for high school students, studies have found that they developed environmental consciousness and a deeper sense of understanding of natural resources through EE programs (Ohta, 2017) and that EE for the younger generation is very important to their building a reasonable base for local development through opportunities of facing actual problems in their subjective rural society and pondering solutions for such problems that have many different answers depending on the situation and/or position of the individual (Nishiura et al. 2005).

2.1.3 Ecosystem Services and Evaluation

Subjective value and knowledge are key to behavioral change (Redman and Redman, 2014; 2017). ES has been used to measure the outcome of EE, EE experiences in the past and how targeted individuals perceive their local natural resources. Out of their study on farmers' perception of local natural resources, Hartel et al. (2014) are concerned that the tendency to prioritize provisioning services for the purpose of economic value may hamper sustainability of local ecosystems. Imai et al. (2014) measured the general awareness of ecosystem conservation. Ito and Hayashi (2015), Ota et al. (2012), Hasegawa and Hayashi (2014) and Okada et al. (2015) used ES to measure the subjective value of cultural services of each targeted site of local natural resources. Yet, there have been few studies using ES in both learning and measuring consciousness with a viewpoint of disaster risk reduction.

In anticipation of integrating ES (provisioning, regulating, and cultural services) and learnings of EE, it is vital to provide young generations with education on those topics and to raise their awareness of the tangible natural environmental background of their local area. It is important for the young generation, namely early youth [1)] or high school students, to understand these lessons as they are soon to be the next leaders in their local societies.

2.2 Disaster Experiences and Preparation Behavior – Citizens

2.2.1 Local Historical Disasters and Disaster Education

Education can occur in different settings, and is often categorized into three:

- Formal education ("taught in institutions or schools by trained teachers within the framework of a fixed curriculum (Hamadache, 1991, p. 113)"),
- Non-formal education ("or out-of-school education encompasses all forms of

instruction or learning situation (Hamadache, 1991, p. 113)"), and

- Informal education ("by family, associations, prominent members of society, social communication, the mass media, museums, games and all other cultural institutions (Hamadache, 1991, p.112).").

In fact, a number of studies have analyzed the relation between formal education and disaster preparedness with various results. Many reports point out that higher educational attainment increases preparedness e.g., preparation behavior for earthquakes (Russell et al., 1995), hurricanes (Baker et al, 2011; Norris et al, 1999; Reininger et al., 2013), floods (Lave & Lave, 1991; Thieken et al, 2007), tsunami (Muttarak & Pothisiri, 2013), and preparation for general emergency (Al- Rousanet al., 2014; Smith and Notaro, 2009). On the other hand, there exist some studies reported education does not have association nor correlation between preparedness. Faupel et al. (1992) showed the significant effect of education to planning activities and adaptive response activities among targeted households, especially about hurricane, but not about earthquake. (Heller, Alexander, Gatz, Knight, & Rose, 2005; Jackson, 1981; Kim & Kang, 2010; Lee & Lemyre, 2009; Lindell & Hwang, 2008; Miceli, Sotgiu, & Settanni, 2008; Siegel et al., 2003; Spittal et al., 2008). The different educational contents, socio-cultural setting or social norms may cause such mixed results on relation between education and preparedness. Hausman et al. (2007), for example, they emphasize high social capital help set the stage for increasing awareness of the consequences of risk in terms of preparedness toward terrorism as risk.

Regarding disaster education in formal and non-formal settings, historical disaster experiences are often included as learning contents in various styles such as lecture, story-telling, or workshop. From some cases in Japan expect that historical disaster experience and local traditional methods for DRR should be used and learned more for raising

awareness of potential disaster risks (e.g., Shaw et al., 2005; Takeuchi and Shaw, 2008). On the other hand, Nagele and Trainor (2012) did not find any significant relation between past disaster experience or educational level and protective action decision making. As for story-telling or narrative approach, Kimura and Hayashi (2005) clarified the effect of story-telling about local historical disasters by senior people for school pupils, right after the opportunity and still even one year later through timeline survey. There are studies showed powerful encountering results that narrative manner is not enough for raising awareness of disaster risks as the listeners tend to fail to perceive that such disaster may happen to themselves and think 'it'll never happen to me' (Burningham et al., 2008). Non-formal setting, workshop is a widely used. Workshop could be effective, but more importantly, its effect must be disseminated to the whole wide targeted area (Honma et al. 2008; Kumagaya et al. 2008).

As for informal education, UNDRR provides a serious online game "STOP DISASTERS! (UNDRR)." This is a serious game in which a player design and plan the building constructions and land-use for disaster reduction of a virtual town as a city planner based on a provided scenario. The objective of the game is "to save lives. Choose a scenario and try to build upon an established community; providing defences and upgraded housing to prepare for the inevitable disaster (UNDRR)." The game provides five different types of hazard scenarios: natural hazards: tsunami, hurricane, wildfire, earthquake, and flood, and all of them in five different languages. They set levels (easy to advanced) to choose from to play. The game was developed not only for children or youth but also training or education for teachers (UNDRR). The game gives players evaluation of their planning performance. Some studies employed this STOP DISASTERS!" as a research topic. Felicio et al. (2014) found that the game is effective regarding flood risk awareness raising among players (children). Pereira et al. (2014) also clarified, about wildfire, the positive evidence of impact to awareness of prevention measures, and furthermore, they expect that serious educational

games impact to higher awareness in society and its messages to be transmitted to share widely in society.

2.2.2 Preparation Behavior, Conventional Disaster Risk Reduction and Natural Environment

As drawn in Chapter 1, it is understandable that ecosystem-based disaster risk reduction (Eco-DRR) or ecosystem-based adaptation (EbA) is effective approach for the future disaster risk reduction considering socio-economic and demographic changes that are to come. However, Eco-DRR and EbA expect the ecosystem capacity to reduce risks, it by no means guarantee safety "*anzen* (or objective standards of protection)" and confidence "*anshin* (or subjective feeling of reassurance)" (Yamakawa and Nakai, 2017, p. 9). As far as looking at the framework and institutions of Japanese disaster risk management (DRM), it has encouraged, more than ever, that citizens and enterprises are to be prepared for disaster risks.

Some previous studies clearly point out that hard infrastructure makes citizens less aware and/or less prepared for disaster risks. Citizens do neither accept flood inundation risks nor want any of such disaster to happen around their houses or offices. The psychological aspect "I do not want it" keeps people from preparing for potential flood risks (Terumoto et a al. 2004). Their discussion is associated with what Birningham et al. (2008) mentioned "I'll never happen to me" way of thinking among people as precedingly provided.

Some studies focus on landscape to incorporate with raising awareness and preparedness for flood or storm risks. Katagiri (2015) asserts that landscape with water can regenerate citizens' awareness of water in basin. From its abundant reference and records, Nagoya University Library Research Division (2005) re-organized local disaster experience and came up with a co-living viewpoint regarding people and nature environment. They

revisited that people in the area have long lived with the rich water environment chronologically, hence, they suggest to review such blessed and positive characteristic aspects together with local historical experiences for raising awareness and future DRR.

Another item that has become claimed to focus is, there are two major items being claimed to be used for raising awareness and promoting preparedness for disaster risk, especially flood risk, that are place-names and river landscape. Landscape for regenerating citizens' awareness of water in basin (Katagiri, 2015; Nagoya University Library, 2005).

These points are all connected with the experience in *Tohoku*, or North East part of Japan. After the huge tsunami hit the coastal zones in March 2011, the central government proposed to construct tall-long sea walls along the coast line. This proposal brought a total pros-and-cons in the local areas. The pro- side expected the sea wall to be built as they felt the tsunami was so scared that they do not hope to have any similar experience in the future, whereas the con-side augment was that such walls hide the ocean view that they have long been familiar with and grown up with in the area, besides, it would affect marine products they catch to live on and the food of those marine products. When the walls hide the sea from their eye, it causes problems in their daily lives and emergencies as they cannot check the tide or overall condition as quickly as they used to do. Eventually, the sea walls started to construct and completed in many parts. Changes in local people's mind was observed after a few years of completion of building the sea walls. People see the wall every single day, and even people who used to be pro-side for the wall started to have a question if their choice having such a wall was correct or right for us and for the future (Furuta and Seino, 2016). Tohoku case shows the relation between ecosystem conservation with "social - ecological systems" (Ostrom, 2008) together with DRR and disaster preparedness.

2.2.3 Place-names as a Local disaster Knowledge

In Japanese disaster management context, place-names are in the focus as a key to raise awareness and disaster preparedness. Place-names are precious record of the footage of cultural development (Kagami, 1964), and are not simply names to identify lands but a history of the place reflecting the natural environment and/or historical events the place-names were derived from (Kimata, 1991). However, after the amendment of a law (「住居表示に関する法律」) in 1962, new residential areas had been developed even in the disaster prone-area and their original place-names were changed to new names that are quite irrelevant from their original names so that the place's image looks and sounds better; thus, disaster occurrence has become more unprecedented, place-name have been in the light of research target (Kimata, 1991). These days, for the general public, books dealing with place-names and disaster risks are seen in the shelves of bookstores both online/offline (e.g., Endo, 2013; Tanigawa 2013). Some academic studies deal with place-names in Japan for educational contents and awareness raising (e.g., Kakimoto et al., 2009; Kawai et al., 2009) and research with geographical viewpoint aiming at the future use in disaster education or public education (e.g., Hanaoka, 2015; Kurata et al., 2008).

Mapping comes around as an effective way to meet the place-name and review the identity of the place, which maintains social capital in the local community (Toyoda and Kanegae, 2013). This point could consolidate with Hausmann et al. (2007) stating that high social capital help more favorable effects by education. We can find so many cases using mapping for awareness raising etc. both not only in Japan and overseas. Mapping or method using map would help participants understand chronological changes in a given area, especially, existence of leader in the community and inter-generational communication were given, and such activities encourage their understanding the local environment and disaster risks (Cadag et al., 2014).

2.2.4 Psychological Inconsistency in Risk Communication

In risk communication, Yamori (2011) insists that the following four actions are the key for disaster preparedness: personalizing, self-directing, visualizing, and making it daily. Especially, personalizing or taking the disaster risk and preparation for it as a matter to be dealt with yourself and/or at each household, namely to leave "I'll be alright" or "It'll never happen to me" thinking. Awareness of perception is not enough for it and to strengthen preparation actions. "Fear" to the risk is the key to reduce dependency to government/public services (Taniguchi 2013). However, Kasperson et al. (1988) emphasize the amplification of risk is possible to occur. How to disseminate the "fear" of feeling toward potential disaster risks is to be well-planned otherwise unnecessary amplification might distort the original message or may change the "fear" into "doom (Stoknes, 2015)" while transmitted. In the context of climate change, Stoknes (2015) raises five psychological walls (5Ds) as reasons that keep people from taking tangible behaviors, that are, Distance, Dissonance, Doom, Denial, iDentity. He proposes to change those 5Ds into 5Ss that are Social, Simple, Supportive, Story, and Signal in order to have people think and act.

2.3 Disaster Preparedness and Local Ecosystem Conservation – Small and Medium-sized Enterprises

2.3.1 Business Continuity Planning in Japan

Japan is prone to seismic and meteorological hazards because of its geographical location. These hazards often induce disasters, which can stagnate enterprise activities. The stagnation of business activities affects not only individual enterprises but also the overall economy of the area in which these enterprises are located. The economic damage can affect

businesses in other areas through commerce and/or the supply chain. In response to disaster, enterprises are required to secure the safety of their employees and customers regardless of their business size to continue their business activities by returning to a normal status as soon as possible.

In this context, it is vital for enterprises to promote the formulation and implementation of a Business Continuity Plan (BCP) stipulating management strategies in normal time. This would help small and medium-sized enterprises (SMEs) avoid disruption, resume and continue their crucial business activities in a specified goal period after a disaster event. Specifically, it is very important to encourage SMEs to develop BCP, as they play a central role in Japan's economy, comprising 99.7 % of all companies and employing 70.1 % of the total number of employees in Japan (Small and Medium Enterprise Agency of Japan, 2017).

2.3.2 Business Continuity Plan and Small and Medium-sized Enterprises

The BCP is a management strategy "a plan describing the policy, systems, procedures, etc. by which enterprises can avoid suspension of their critical business or can recover the critical business quickly if it is interrupted, even when contingencies arise, including natural disasters such as major earthquakes, communicable disease pandemics, terrorist acts, serious accidents, disruption of supply chains and abrupt changes in business environment, or they can recover business quickly if their business is interrupted (Cabinet Office of Japan, 2013, p 3; Maruya, 2007)." From 2007 to 2015, the BCP completion rate increased from 18.9% to 60.4% in large companies and from 13.4% to 29.9% in medium-sized companies (Cabinet Office of Japan, 2013). However, recognition of formulating a BCP must still be further promoted among companies, especially SMEs, to ensure they can keep operating their business while coping with unforeseen risks or emerging issues regardless of business size.

The BCP completion rate differs among areas because of the natural hazards in a given area, causing a gap in BCP formulation (Maruya, 2007). Maruya (2011) highlights the management of BCP formulation and securing alternatives for logistic infrastructure, the system of command, and earthquake-resistant reinforcement. Likewise, Koyama (2012) and Wang et al. (2013) (Wang et al., 2007) suggest an alternative office or stock-place to ensure a continuous supply chain as a risk hedge that enables companies to quickly transport the stock to another location in a disaster response period. Both emphasize building a network and collaboration with their system in relation to alternative strategies. Nishikawa et al. (2007) focus on collaboration in the local area in which they are located for the mutual helping and sharing of local resources from the viewpoint of district continuity. Some studies discuss BCP formulation from this collaboration perspective (e.g., Nishikawa et al., 2007; Isouchi eta al., 2014; Sashida et al., 2013), mostly targeting large-scale companies in a commercial district in urban areas.

Morikawa and Ikeda (2006) focused on SMEs, identifying impeding factors as knowledge, capital, and time, whereas Sullivan-Taylor and Branicki (2011) noted resourcefulness, technical, and organizational factors, for which limited evidence exists regarding SMEs' capabilities. In addition, for many SMEs, the cost for BCP formulation can be a trade-off from a short-term view. Thus, SMEs must be encouraged to consider BCP a necessary investment (Hatakeyama et al., 2013). However, technical and practical difficulties are constraints for the further promotion of BCP formulation in SMEs (Ono, 2015). Studies on BCP and SMEs including micro-size businesses are few compared to those on BCP in large or medium-size companies, especially in peri-urban or rural areas. The role of enterprises in the event of a disaster and preparation in normal time (ensuring the safety of employees, preventing secondary disasters, maintaining business continuity, contributing to and living in harmony with local communities) is important.

2.3.3 Business Continuity Plan and Co-living with Local Society

In Japan, considering local society in disaster risk reduction, the Community Disaster Management Plan (CDMP) was added as an amendment of the Basic Disaster Management Plan in 2015. CDMP regards residents and enterprises in a given area as the main actors and tries to promote proactive disaster management activities based on the spirit of self-help and mutual help in a bottom-up manner. It expects residents and enterprises to jointly propose a community disaster management plan so that the municipal disaster management council stipulate it in the municipal disaster management plan (Cabinet Office of Japan, 2015). With this trend of collaboration of enterprises and local society toward disaster risk reduction, cases on social responsibility may be referred to. In terms of business continuity and BCP, building a system beyond organizational boundaries based on a sense of co-living with local society, administrative organizations, and citizens is encouraged (Cabinet Office of Japan, 2015; Japan Business Foundation, 2013). Specifically, caring for local natural resources and implementing environment management initiatives from normal time are clearly mentioned in the Business Continuity Guideline by the Cabinet Office of Japan (Cabinet Office of Japan, 2015). Regarding the relationship between BCP and environmental management/actions, Natech (risk originating from conjoint natural and technological hazards) has been studied, in which the processing, handling, storage, and/or discharge of hazardous materials in normal time by enterprises are crucial (Cruz et al., 2015). Okano et al. (2007) address three possible models of integrating risk management and environmental actions within business management strategies, and discuss the correlation between the two in a study targeting corporate representatives in a seminar on environmental management. Thus, the relationship between enterprises' business continuity, environmental management, and environmental actions in normal time has been discussed, and attention paid to disaster risk reduction.

Contribution to local society and an environment management initiative are not necessarily the most prioritized actions for most enterprises. However, as mentioned, it seems important to pay attention to these aspects in relation to BCP. However, studies on the relation between private sectors' BCP formulation and cooperation for local natural resources are limited, especially in terms of a case of a given local area wherein SMEs comprise the majority.

This study aims 1) to analyze the association between BCP formulation status and perceptions/actions with the local natural environment by SMEs in normal time, and 2) clarify the strength of the associations to determine key points to further promote BCP formulation among SMEs as well as local sustainability.

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CHAPTER 3
Methodology

3.1 Research Site

This chapter provides the background information on the research sites of this study. I selected two sites in Japan: Shiga Prefecture for preliminary study and Sukagawa City, Fukushima Prefecture, for larger size of social survey.

3.1.1 Shiga Prefecture (Preliminary study)

The For the preliminary study, I targeted a public high school in Shiga Prefecture as the prefecture has a history of enthusiastic Environmental Education (EE). Shiga Prefecture is home to Lake Biwa, which is a source of fresh water for about 14 million people in the down-shed of its basin. Shiga Prefectural Government has been implementing education related to the lake's water, its varied ecosystems, and the greater water environment. In their "Guidance on School Education," they positioned "promotion of Environmental Education" as the priority for school education in 2012 in Shiga, and they aim to create citizens who can act independently to realize a sustainable society with interest in not only the natural environment of Shiga, the nearby environment such as Lake Biwa, the environment with a view to the entire Earth, but also understanding

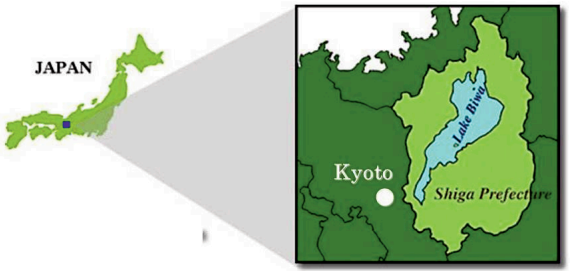

Figure 3.1 Location of Shiga Prefecture (Ichidate et al., 2016)

their responsibilities and roles as human beings in these environments. (Shiga Prefectural Board of Education, 2018).

3.1.1.1 Environmental Education in Shiga Prefecture

They also launched the Lake Biwa Floating School "*Uminoko (children of lake),*" in 1983. The "*Uminoko*" Floating School is an EE program administrated by the Prefectural Board of Education, and the program has been provided to all the pupils of the 5th grade at primary education level in Shiga Prefecture (10-11-year-old children). This provides pupils with opportunity for hands-on experience of water quality checking and observing aquatic animals etc. in easy scientific methods as well as the chance to appreciate the grand-scale of lake views and winds on the water (Shiga Prefecture Biwako Floating School, 2018). Given that, I expect that high school students would be ready to think received the EE about Lake Biwa and its surroundings during their primary school and junior-secondary school years, which share the same curriculum and same materials disseminated by the Board of Education of Shiga Prefecture. From these reasons, it is expected that high school students have a learning background of the nature ecosystem in the area through the past EE experiences.

3.1.1.2 Basin Flood Management in Shiga Prefecture

Another viewpoint of my selecting Shiga Prefecture is their "Integrated Flood Management Ordinance (流域治水条例)" in March 2014 as a risk-based floodplain regulation of the prefecture (Shiga Prefectural Government, 2014). It includes land use and building regulation measures to promote flood risk reduction on a newly developed risk evaluation method, which was the first in Japan (Ichidate et al, 2016). Since this research seeks the relation between the ecosystem conservation and disaster preparedness, I found that Shiga

Prefecture has the sufficient background to compare the two toward not only Eco-DRR but also EE for young generations with integrating a viewpoint of disaster education.

3.1.2 Sukagawa City (quantity social survey)

I selected Sukagawa city, Fukushima Prefecture, Japan for a case study on the correlation between disaster risk preparedness and local ecosystem conservation. Sukagawa city is located in the middle part of Fukushima Prefecture (Figure 3.2). The area size is 279.43km2 with the population of 76,141 (as of January 1, 2019). The city has two Class-A rivers (the Abukuma River, the Shakado River) and has experienced many floods since its old time. When the Great East Japan Earthquake (GEJE) happened in March 2011, large quakes (level 6 on the Japanese scale) hit the city and caused damages, e.g., 10 people loss, 1,5322 houses either total-collapsed or partly damaged, 748 buildings, 519 facilities and equipment, and 351 cases of product damages were reported (Sukagawa City, 2013a; 2013b).

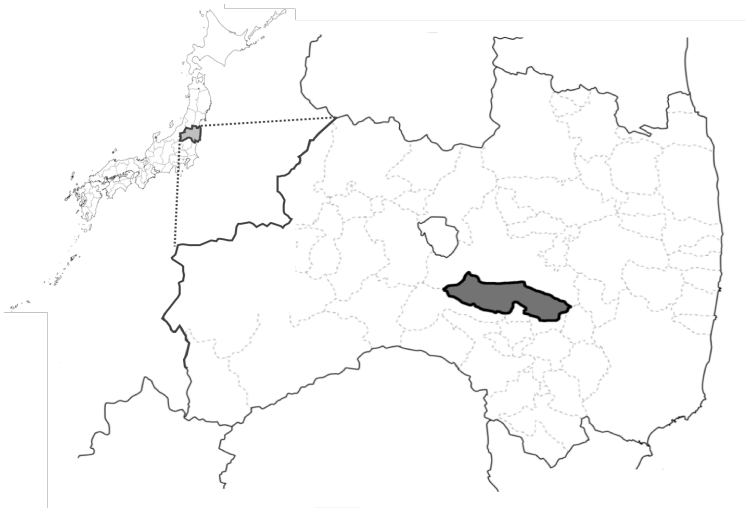

Figure 3.2 Location of Sukagawa city, Fukushima Prefecture
Source: Modified a base map from Freemap
(https://www.freemap.jp/item/fukushima/fukushima.html)

Table 3.1 General census of Sukagawa City, Fukushima Prefecture, Japan

Population	75,795	As of 1 November 2019
Households	27,385	
Area size	279.43 km^2	
Density of population	277.1 / km^2	
Labours in industries	Primary: 3,472 Secondary: 11,813 Tertiary: 21,717 Others: 1,608	
Farmers	2,811	(households)
Enterprises	3,203	(Private sector)
Industrial enterprises	163	
Product shipment	170.5 billion JPY	
Commerce enterprises	668	

Source: Sukagawa City (2019)

3.1.2.1 Nanohana (rapeseed flower) Project in Sukagawa City

Sukagawa city has been implementing Nanohana (rape blossoms) Project since 2007 for the recycle-based society. The outline of Nanohana Project is 1) rape blossoms are planted in crop-rotating agricultural fields, 2) cooking oil is manufactured from harvested rape blossoms, 3) used oil is collected for use as an ingredient for soap or fuel for fishing boats, farm tractors, automobiles, etc., and 4) the oil cakes are utilized as fertilizer or feed, and 5) the excrement from livestock is utilized as manure to agricultural field etc. (East Asia Summit, Energy Cooperation Task Force) (Figure3.3).

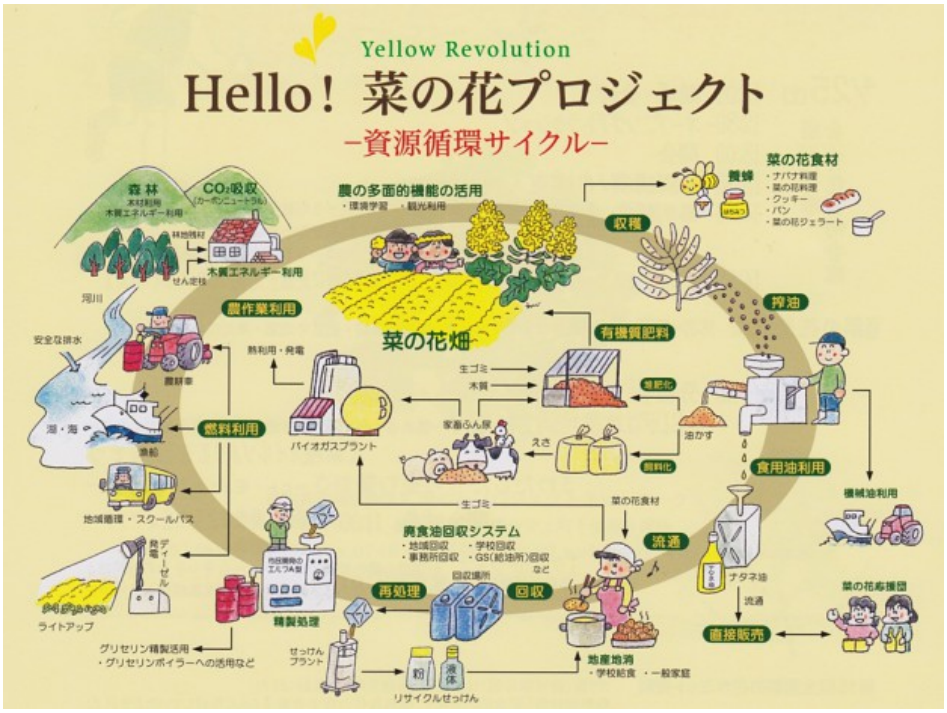

Figure 3.3 The concept of Nanohana (rape blossoms) Project cycle

The city had been using the bio-diesel fuel out of the Nanohana Project for the garbage collecting cars. On the occasion of gasoline shortage after GEJE, the city managed to drive all city garbage collecting cars with the bio-diesel fuel produced through the Project, hence the city did not have any garbage bag that long waited to be picked up and managed to keep rather cleaner conditions even in the devastating experience.

3.1.2.2 Historical Disasters in Sukagawa City

Sukagawa City has experienced many floods for many years. In old day (before the river improvement), the river coastal areas were quite flood prone (Figure 3.3). Houses and agricultural fields were frequently inundated.

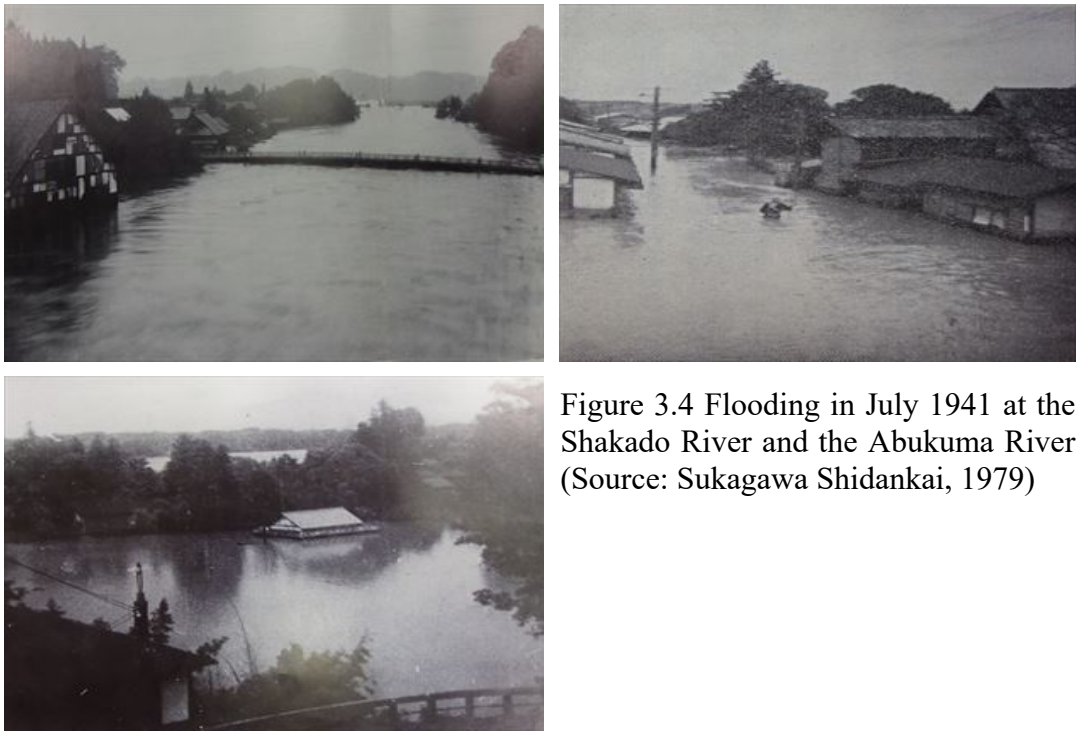

Figure 3.4 Flooding in July 1941 at the Shakado River and the Abukuma River (Source: Sukagawa Shidankai, 1979)

The river improvement project had been implemented along the Shakado River from 1971 to the late 1980s (Sukagawa Water Supply Department, 1988). Around the same period, the Abukuma River had bank improvement as well. The project went well, however, the meeting point of the two rivers remained flood-prone as large amount of storm water from the two rivers meet on the occasion of excessive precipitation.

Figure 3.5a Flooding at the meeting point of the Abukuma and the Shakado in 1998 (Source: Sukagawa City website)

Figure 3.5b Flooding at the Abukuma in Sukagawa city in 1998 (Source: Kishii, 2011)

Figure 3.6 (left): Kagenuma *Ryujin* Shrine: a small shrine enshrined a cow head flowed down in the flood in 1890 (Source: by author)
Figure 3.7 (right): The Shakado River Course before/after the river improvement in 1971 (Source: Sukagawa Water Supply Department, 1988)

The city's official records keep historical flood disasters at their city library. In the town, they keep a small shrine in a residential area (Figure 3.6). The shrine enshrines the head of a cow that was flowed with flood water in 1890. However, as my preliminary field survey, it seems that such historical experience has not been used to raise awareness or promotion of today's disaster preparation. As given in the preceding chapter, the trend of revisiting historical disaster experiences and learn from our predecessors' experiences have become an important aspect. Likewise, in Japanese disaster management context, place-names has become another focus to review for wider population. Many place-names in Japan mean or imply the land's natural hazard experiences or geographical/geological characteristics.

In fact, there are unique place-names in Sukagawa city, and those place-names can be found in the flood-prone area or any other area of the city (Figure 3.7; Figure 3.8).

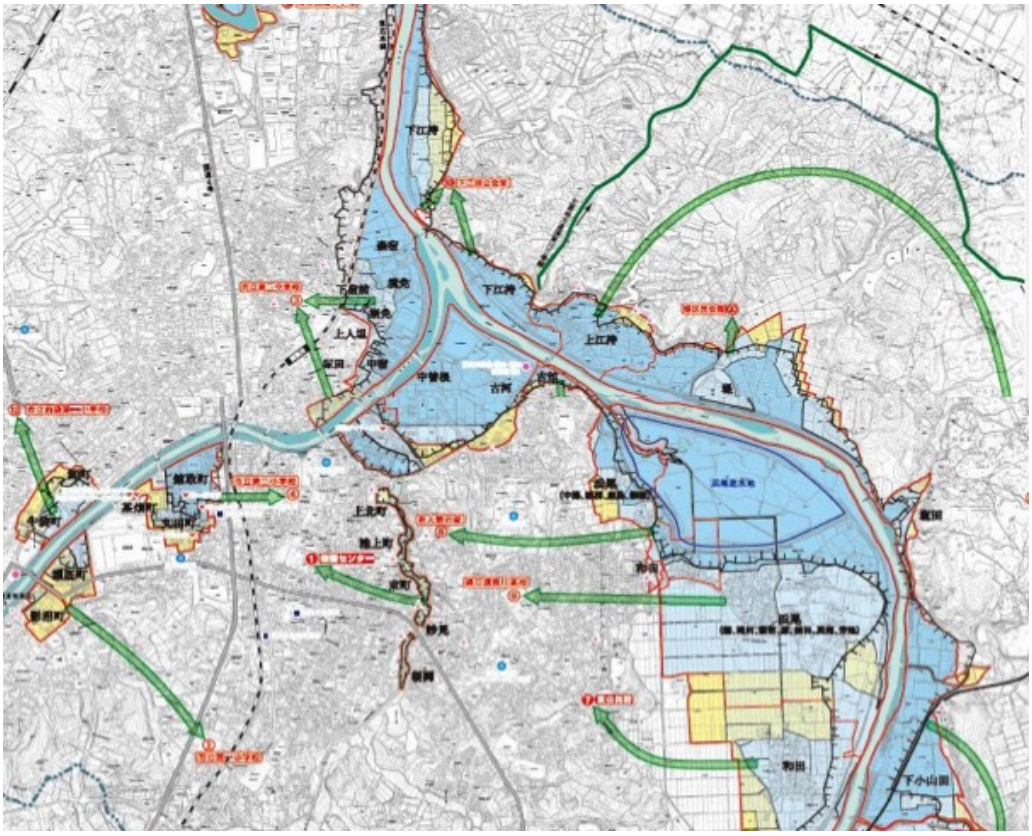

Figure 3.8 Hazard map of Sukagawa City (excerpt) (Sukagawa City, 2014)

Since this study seeks the association between the disaster risk preparedness and behaviors of local ecosystem conservation by citizens and small and medium-sized enterprises in a given local area, authors see Sukagawa as an appropriate site for the purpose.

3.2 Social Surveys and Analysis

3.2.1 Workshop (Preliminary)

This research used a workshop approach to understand the perceptions to ecosystem services of local natural resources and disaster experiences targeted youth in Shiga Prefecture. I applied the constructivist theory, Zone of Proximal Development by Vygotsky (Vygotsky, 1962; Fosnot and Perry, 2005) in structuring the workshop. ZPD emphasizes the learning is not a simple knowledge transfer but a process to recognize. It is a learning process with peers or individuals who are more skilled or adults (Fosnot and Perry, 2005) (For the

details of ZPD is given in Chapter 4, Section 4.2.2). As the concept of ecosystem services is new to targeted youth, I decided to structure group works and group discussions through which targeted workshop participants can learn exchanging their views. Regarding the individual views and perceptions, I used a hint of Significant Life Experience (SLE) for a short questionnaire survey at the end of the workshop. SLE focuses on the experiences that triggered a given person for pro-environmental activities and/or environmental conservation actions, that is, outdoor experiences, families, organizational activities, works, and negative experiences in the past (Chawla, 1998a). Although the criteria of questionnaire questions of SLE has still been in search (Chawla, 1998b), I included a question about past volunteer experiences in related with natural environment in order to grasp the relation between their perception to ecosystem services, especially functions for disaster risk reduction, of their local natural resources and local historical disasters.

3.2.2 Social Survey (Questionnaire)

I conducted two questionnaire surveys: one targeting to citizens in Sukagawa city whose age is from 15 to 70s. The counterpart of collaboration with the municipal government, especially with Department of Life and Environment, Environment Division. Further details are given in Chapter 5. The other targets to small and medium-sized enterprises (SMEs) in Sukagawa city with collaboration with the Chamber of Commerce and Industry of Sukagawa (CCI-Sukagawa). The further detail information on this survey is provided in Chapter 6.

3.2.3 Statistical Analysis

In order to examine the association between the disaster preparedness and local ecosystem conservation among citizens and SMEs, I employed statistical analyses: Multiple Correspondence Analysis (MCA), Cramér's V, and logistic regression.

MCA is a multivariate graphical technique designed to explore the relationships among categorical variables (Sourial et al., 2010). It is used in many areas such as marketing and ecology using the Statistical Package for the Social Sciences (SPSS) (Doey and Kurta, 2011). In market research, for example, we might categorize purchases of a range of products made at selected locations; or in medical testing (Yelland, 2010). I used MCA to explore the association between disaster preparation behavior and local ecosystem conservation using the observed variables through the questionnaire.

Cramér's V is a measure of association between two nominal variables, and it takes a value between 0 and +1 (inclusive), and the closer to +1 the value is, the stronger the association is. It is based on Pearson's chi-squared statistic (Cramér's, 1946; Suga, 2016). Obtaining the results of MCA, I calculated the Cramér's V to see the strength of association of the variables, and then discuss the results in order to seek some key aspects to promote disaster preparedness and realize a seamless culture of disaster risk reduction.

When the association was confirmed with Cramér's V, I used logistic regression analysis to examine the occurrence probability of willingness to conserve local ecosystem services as independent variables (polychotomous) with disaster risk preparation behaviors as dependent variables (dichotomous). Logistic regression allows the evaluation of multiple independent variables by extension of the basic principles (Haebara, 2016; Hosmer et al., 1989). I used SPSS (IBM) version 25 for these analyses. This step using logistic regression analysis is included to acquire evidence that can support pursuing the third purpose of this research: to make recommendations on how and what to incorporate the local ecosystem conservation into disaster risk management.

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CHAPTER 4

Subjective Evaluation of Ecosystem Services and Local Disasters – Youth

4.1 About This Chapter

In light of these points above, this report introduces a method using the concept of ES for a subjective evaluation of local natural resources (benefiting the side of nature) among youth. It aims to identify differences made in their evaluations of local natural resources based on their EE/conservation experiences and their interest in local disaster risks as another perspective of nature. This method expects to encourage youth to share various ideas, have constructive discussions and a mutual understanding of conservation of local natural resources among people with various ideas.

4.2 Methods

4.2.1 Selected Site and Targeted People

As mentioned in Chapter 3, the research site for this study was conducted in Shiga Prefecture. A workshop approach was employed. The participants were 19 high school students in the 1st and 2nd grades, and their ages were 15 to 17 years old. I selected only students who had received EE on Lake Biwa during their elementary school and junior high school years through consulting with their high school teachers beforehand. Though ES was a new concept to them, they had gained enough basic knowledge to comprehend ES as well as personal interaction with ecosystems and academic experience in subjects such as biology, geography, geology, and social sciences. I did not specify the gender balance in the

consultation with high school teachers, and most of the participating students were female eventually. I accepted it as this workshop looks at the difference in the subjective evaluations and whether or not they show interest in local disaster risk issues. I held the workshop on two separate days in August 2015 and November 2015 due to the school's schedules and students' club activities. The workshop was held from 13:00 to 16:00 with the same contents on both days.

4.2.2 Workshop – Theory and Structure

4.2.2.1 Theory

The workshop was based on the Constructivist Theory of learning, in particular, social constructionism. The general idea of the social constructionism is that learners obtain and develop their new ideas and concepts using their current or past knowledge and learning is not a simple knowledge transfer but a process to produce meaning, and such meaning-making activities take place in the dialectic between the individual and society (Bruner and Postman, 1949; Bruner, 1960; Vygotsky, 1962; Fosnot and Perry, 2005). Vygotsky elaborated on the concept, referring to it as the Zone of Proximal Development (ZPD), a learning process of children/youth. ZPD is a learning process of children/youth and is described as a "range of tasks that are too difficult for an individual to master but can be mastered with the assistance or guidance of adults or more skilled-peers (Fosnot and Perry, 2005)." ZPD consists of "scientific" concepts (structured activities, e.g., classroom instruction) and "spontaneous" concepts (pseudo-concepts "emerging from the learner's own reflection on everyday experiences (Kozulin, 1986)." Scientific and spontaneous concepts develop in reverse directions. While scientific concepts work their way down imposing their logic on the learner, spontaneous concepts work their way up, meeting the scientific concept and allowing the learner to understand its logic (Vygotsky, 1986). Based

on these theoretical arguments, I designed the workshop as follows: 1) Lecture (scientific concepts), 2) Group work (matrix-making), 3) Discussion (exchanging opinions, peer-learning), and 4) Questionnaire (past/everyday experiences) (Figure 4.1). The details of each activity are given in the following subsections.

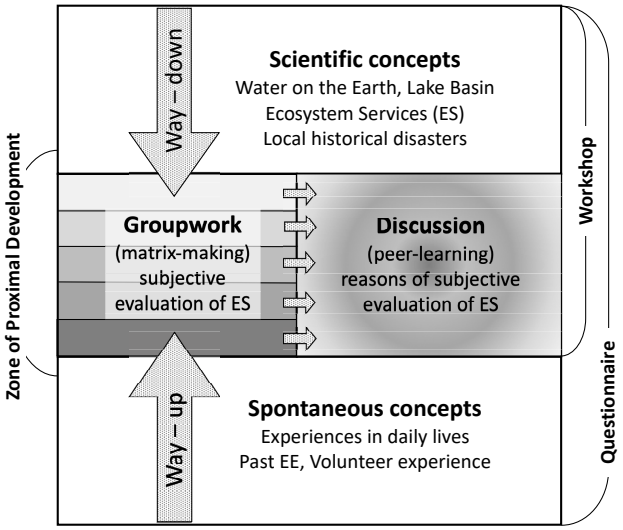

Figure 4.1 Theoretical framework of the workshop (created by author based on Fosnot and Perry (2005), Kozulin (1986) and Vygotsky (1986))

4.2.2.2 Grouping

Before starting the workshop, I opened with an icebreaking session to form groups for the group work activity. Students were divided into several groups based on their answers to "When you hear a word 'water,' what comes to your mind first?" This step was implemented to facilitate forming groups with members who shared similar opinions of water because good working relationships with other group members is important in social constructionism. I aimed to see if there were any differences in their matrix-making due to their different intuitive ideas regarding 'water' that they might have had in their past EE or other conservation experiences.

4.2.2.3 Lecture

The lecture focused on freshwater environments, as they all had received environmental education related to Lake Biwa. Lectures on general information regarding water and the Lake Biwa Basin were given, and then a lecture on ecosystem services followed. As none of the students had heard the phrase 'ecosystem service' before, the functions of ecosystem services of freshwater environment ecosystem (Figure 4.2) were outlined. Each function (numbered from 1 to 21 in Figure 4.2) were explained. As they had received EE on Lake Biwa prior to these activities, I gave some representative items of Lake Biwa for each function in ES so that they could understand the functions by associating them with familiar items they had previously learned. For example, I showed the cases of dams (for water supply (No.1), irrigation crops (No.5), hydropower potential (No.6)), mountains (for wood/fibre (No.3), fuel (No.4), sound water quality (No.13), health provisions (No.14)), marshland with reeds (for flood/drought mitigation (No.7), aquatic habitats (No.11), diverse food-chain (No.12), and ecotone buffer capacity (No.15)) to explain regulating services. Also, I provided different climates in Shiga Prefecture (with a large lake, surrounded by mountains) compared with another prefecture (without large bodies of water, yet surrounded with mountains), etc.

Table 4.1 Contents of the workshop

Contents	Details
Icebreaking	Items come up to mind when they hear "water" and grouping
Lecture	· Water on the Earth, Water Cycle · Lake Biwa: History, Basin and Human activities · Ecosystem services of freshwater environment · Local historical disaster (floods)
Group work (Matrix making)	· Matrix-making: To evaluate freshwater ecosystem services based on the following two axes (qualitative and subjective evaluation) · Functions that are "feel close to us" and "not close to us" · Functions that are "the most important/prioritized" and "less important/prioritized
Presentations and Discussion	· Each group to present the result of their matrix · Q&A and exchanging opinions
Questionnaire	· Topics that found interested, topics to share with other people, volunteer experiences

4.2.2.4 Matrix-making (Group Work)

Following the lectures on water environment and freshwater ecosystem services, each group of students worked on matrix-making. The students were to rate each function of Provisioning, Regulating, and Cultural services of their respective ecosystem (numbered 1 to 21 in Figure 4.2) on a matrix based with two axes (Figure 4.3). The horizontal axis was for "functions that are felt close" and "functions that are not felt close." The vertical axis was for "functions that are more important" and "functions that can be less important."

These axes are also based in social constructionism. This supports the point that one's past experience influences their evaluation as shown in previous studies given above. Taking this matrix-making as a part of the learning process for students, this matrix-making aims to provide the students with an opportunity to review their local natural environment and rethink how those functions are related to themselves in their past or in their everyday experience. Such an approach based on social constructionism encourages learners to use active techniques to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. It can even help learners to continuously assess their learning activities by themselves in the future.

4.2.2.5 Group Discussion and Questionnaire

Once the groups completed their matrix-making task, I provided time for group presentations and discussions among all groups. All the groups were to give the reasons why they placed each ES function in each quadrant, in order to give them a chance to compare their choices of placement and reasoning through peer-learning.

At the end of the workshop, I conducted a small paper-based questionnaire to ask in which topics the participant students were interested, as well as about their background in volunteer experience. The questionnaire included 1) general questions about whether the

workshop contents were easy to comprehend, 2) in which topics they were interested, 3) one topic out of the workshop that they found interesting enough to tell other people, and 4) volunteer experiences. The responses were collected on site.

Provisioning Services			
1	Water supply	**4**	Fuel
2	Fish	**5**	Irrigation crops
3	Wood and fiber	**6**	Hydropower potential
Regulating Services			
7	Flood/drought mitigation	**12**	Diverse food-chain
8	Self-purification capacity	**13**	Sound water quality
9	Navigation route	**14**	Health provisions
10	Climate mediation	**15**	Ecotone buffer capacity
11	Aquatic habitats	**16**	Fertile lands
Cultural Services			
17	Aesthetic and scenic values	**20**	Spiritual values
18	Recreational values	**21**	Educational resources
19	Religious sites		
Supporting Services			
Heat Energy, Geological Formation, Physical Structure, Nutrient Cycling, Primary Production			

Figure 4.2 Ecosystem services of lakes (ILEC, 2007, p. 2)

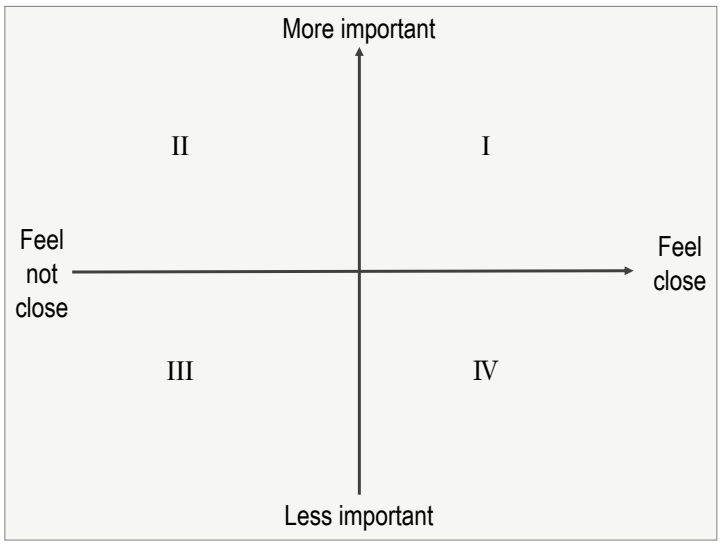

Figure 4.3 Matrix axes for subjective evaluation of ES (created by author)

4.3 Results

4.3.1 Grouping

Participants were divided into five groups according to their responses to the question in the icebreaking session, “What’s the first thing that comes to mind when you hear the word, ‘water’?” Based on their answers, I had 5 groups: group ‘CLIMATE’ (5 students), group ‘FISH’ (4 students), group ‘LIFE’ (3 students), group ‘RIVER’ (4 students), and group ‘FEELING’ (3 students).

Group CLIMATE had participants who thought of ideas relating to weather, climate or other meteorological phenomena. Group FISH had participants who answered with common names of fish. Group LIFE had participants whose answers were related to practical activities in their daily lives. Group RIVER consisted of participants who gave answers relating to rivers, lakes, or oceans. Finally, participants who responded with visual aspects or colors were in a group dubbed FEELING. In these groups, the students worked together on locating each function of ecosystem services on a matrix.

4.3.2 Matrix of Subjective Evaluation –by Group

Fig.4a to Fig.4e show all the resulting matrices produced by the five groups. By and large, their evaluations and their reasons reflected a modern lifestyle. The following section gives the characteristic evaluations by each group.

4.3.2.1 Group CLIMATE

This group evaluated most of the ES functions as important and placed them in either quadrant I or II. They evaluated all the functions of provisioning services except hydropower potential (No.6), as “important” and “feel close”, hence placing them in quadrant I. They placed many regulating services (flood and drought mitigation (No.7), self-purification

(No.8), climate mediation (No.10), aquatic habitats (No.11), ecotone buffer capacity (No.15), and fertile lands (No.16)) in quadrant II, i.e., identifying it as “important” but it “feel not close” to them subjectively. As for cultural services, they evaluated recreation value (No.18) and educational resources (No.21) as important. Fig.4a showed their evaluation and the placement of each ES function.

4.3.2.2 Group FISH

They placed many of the functions/capacities of ES in quadrant II, “important” but “feel not close” to it. As for regulating services, this group placed only sound water quality (No.13) and health promotion (No.14) as “important” and “feel close” subjectively (I), while the rest were placed in quadrants II and III, that is, they felt “not close” to these functions. They evaluated educational resources (No.21) of cultural services as highly “important”. They evaluated the remaining three cultural services, aesthetic and scenic values (No.17), recreational values (No.18), and spiritual values (No.20), as “less important”, although they “felt subjectively close”. Fig.4b shows their evaluation and placement details.

4.3.2.3 Group LIFE

Their placement of ES functions showed the reflection of practicality in their own daily lives. They evaluated water supply (No.1), fish (No.2), diverse food-chains (No.12) as “important”. Wood/fibre (No.3), fuel (No.4), and hydropower potential (No.6) were evaluated as “less important” and/or “felt not close” (III/IV). No cultural services were evaluated as “important” by this group. Their evaluations are given in Fig.4c.

4.3.2.4 Group RIVER

Their evaluation for provisioning services was similar to that of group LIFE. This was the only group which evaluated navigation routes (No.9) as "important". They evaluated flood and drought mitigation function (No.7) and climate mediation (No.10) as "less important" and "feel not close" to the students subjectively (III). They placed aesthetic and scenic values (No.17) and educational resources (No.21) in quadrant I, acknowledging it as "more important" and "feel close" to the students personally. Their evaluations are shown in Fig.4d.

4.3.2.5 Group FEELING

This group placed the most functions of ES in either quadrant I or III. This is the only group that evaluated fish (No.2) as "less important" and "feel not close" (III), while the other groups placed it in quadrant I. Also, they evaluated fertile lands (No.16) as rather more "important" and "feel close" (I), whereas the other groups placed it in quadrant II. Like group RIVER, group FEELING evaluated climate mediation (No.10) as "less important" (IV) and regarded educational resources of cultural services as "important" (I). More details are given in Fig.4e.

4.3.3 Group Discussion – Reasons and Peer-Learning

Each group presented their evaluation matrix and the reasons for it. This section gives some characteristic differences found in their reasons of evaluation.

For provisioning services, their expression and wording were simple and direct, but they were reflections of socio-economic trends of their own lives. Especially regarding water supply (No.1), fish (No.2), and crop irrigation (No.5), all of the groups gave the same reason that they simply need them for drinking and eating, thus evaluating them as "highly

important" and "feel close". For wood/fibre (No.3), fuel (No.4) and hydropower potential (No.6), group LIFE evaluated them as "less important" and "feel not close" (III) because they do not have physical access to these resources in their everyday lives. On the other hand, group CLIMATE evaluated wood/fibre (No.3) and fuel (No.4) as "important" and "feel close" (I), citing reasons that they use books, notebooks and stationery tools made from wood/oil, they use transport that require fuel, as well as their need for kerosene for heating in winter. This shows that the students in group LIFE made evaluations based on 'their own' daily activities, while the students in group CLIMATE gave evaluations with wider viewpoints and attention not only to the production process but also to their lives throughout the year.

With respect to regulating services, discussion was focused on the functions related to disaster risk reduction, namely, flood/drought control (No.7), climate mediation (No.10), and buffer zone capacity (No.15). It was agreed by all the groups to conserve the natural environment with such functions. However, they said that they were not sure about exactly which natural resources in their area they should conserve for those functions. Also, they gave a reason that the scale of those functions is too large for them to realize whether such functions are really happening. For example, group RIVER evaluated climate mediation (No.10) as "less important" and "feel not close" (III) because they thought that it was a global- level issue and there may not be much they can do about it at local level. Other groups responded that it is a global issue, but that Japan as well as Shiga are a part of this world, hence, our actions do make a difference. Exchanging these opinions, the participants came up with an idea that they need to know which natural environments in their local area have regulating service functions. Reeds (Yoshi), a commonly studied in EE in Shiga Prefecture, was given as an example of having a buffer zone capacity (No.15). However, students claimed they do not feel close to the role reeds play in their respective ecosystems because the students, again, do not frequently use nor have physical access to reeds/reed

products in their daily lives. Regarding aquatic habitats (No.11), group FEELING placed it in quadrant I, labelling it as “important” and “feel close”, but fish (No.2) in quadrant III, was “less important” and students did not feel that fish were subjectively close to them as a resource. One of the students in the group asked, “What problem would occur in our today’s lives if an endemic species became extinct? Why do I have to protect those fish and plants? Is extinction not a part of natural selection?” Other students looked a little puzzled, but gave several answers from their learnings and understanding through their past EE experiences, i.e., as “the endemic species exist only in Lake Biwa, and they have lived there for hundreds of years, they are an important part of the local culture. Besides, our way of living influences their survival, so I should protect them.” This indicates that there was a good level of peer-learning and dialectic occurring in this workshop. This helped students to recognize and comprehend the relationship between human society and natural resources, thus, realizing that scientific concepts and the spontaneous concepts of students are indeed met. This exercise helped students to develop a deeper understanding and appreciation for their natural environment.

Reasons for evaluation of cultural services were similar among all the groups. Only groups RIVER and FEELING evaluated aesthetic/scenic and recreational values (No.17) (No.18) as well as educational resources (No.21) as “rather important” as they provide students with a relaxing environment and learning targets. Religious sites (No.19) and spiritual values (No.20) were evaluated as neither “important” nor “feel close” (III) by all groups because they do not have such practices at all.

By and large, differences in evaluation seemed to have derived from the range of their viewpoints, more precisely, the extent of their recognition of the linkages between their daily activities, society, and ecosystems. Figure 4.5 displays the overall subjective evaluation as “More important/Less important” and “Feel close / Feel not close.”

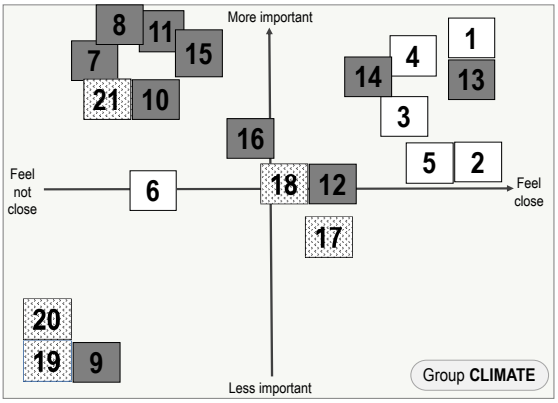

Figure 4.4a Matrix by Group CLIMATE

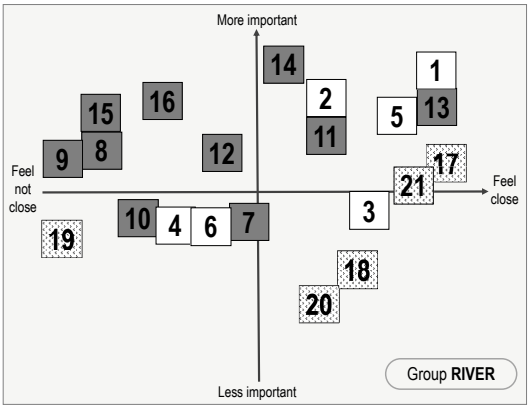

Figure 4.4d Matrix by Group RIVER

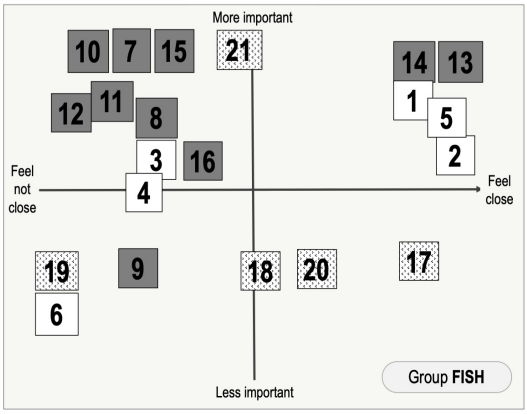

Figure 4.4b Matrix by Group FISH

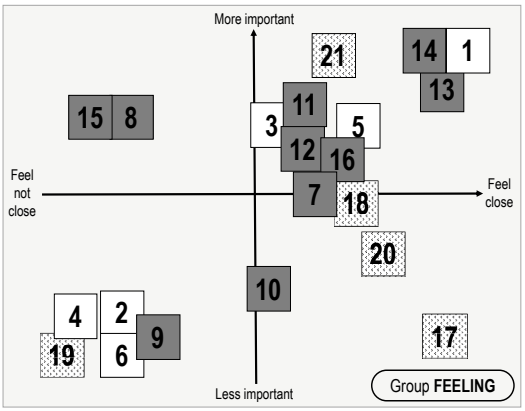

Figure 4.4e Matrix by Group FEELING

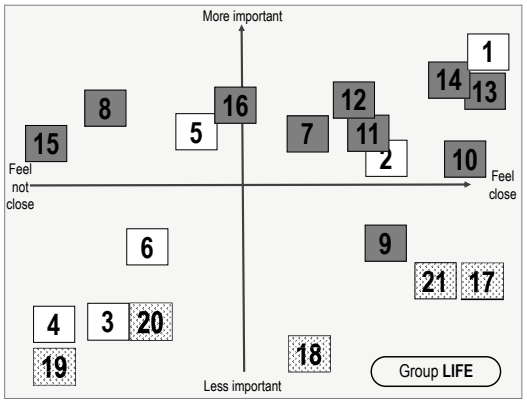

Figure 4.4c Matrix by Group LIFE

Legend

Provisioning service

1 Water supplies
2 Fish
3 Wood and fibre
4 Fuel
5 Irrigation crops
6 Hydropower potential

Cultural service

17 Aesthetic and scenic values
18 Recreational values
19 Religious sites
20 Spiritual values
21 Educational resources

Regulating service

7 Flood and drought mitigation capacity
8 Self-purification capacity
9 Navigation routes
10 Climate mediation
11 Aquatic habitats
12 Diverse food-chains
13 Sound water quality
14 Health provisions
15 Ecotone buffer capacity
16 Fertile lands

Legend

II	I
"More important" + "Feel not close"	"More important" + "Feel close"
III	IV
"Less important" + "Feel not close"	"Less important" + "Feel close"

Table 4.2 Overall placement of subjective evaluation by five groups

Ecosystem Services \ Groups		CLIMATE	FISH	LIFE	RIVER	FEELING
Provisioning Services	1. Water supply					
	2. Fish					
	3. Wood and Fibre					
	4. Fuel					
	5. Irrigation crops					
	6. Hydropower potential					
Regulating Services	7. Flood/drought mitigation					
	8. Self-purification capacity					
	9 Navigation route					
	10. Climate mediation					
	11. Aquatic habitats					
	12. Diverse food-chain					
	13. Sound water quality					
	14. Health provisions					
	15. Ecotone buffer zone					
	16. Fertile lands					
Cultural Services	17. Aesthetic and scenic values					
	18. Recreational values					
	19. Religious site					
	20. Spiritual values					
	21. Educational resources					

4.3.4 The Most Interested Topics

Six participants selected ES as an interesting topic in the workshop. 2 students in group RIVER found local historical disasters (LHD) interesting. 6 students felt they were likely to share ES topics with other people outside the workshop. There were no students who selected ES and LHD for both interesting topics and topics to share with other people (Table 4.2).

I took a look at a cross-examination of their volunteer experience with the topics that they found interesting in this workshop and want to share with other people. This is to grasp if their interested topics differ depending on their volunteer experience, namely social

interaction. Overall, more students without volunteer experience found the topic of Ecosystem Service more interesting (33%) than the students with volunteer experience (12%). Students who had volunteer experience showed a modest interest in discussion (28%) and group work (matrix-making) (26%) (Fig.5). I also examined the relation between their volunteer experience and the topics that they want to share with other people outside of the workshop with a chi- square test. As a result, I found both factors to be significantly related at χ^2=12.390, df=5, p=.03 (p<.05). On the other hand, concerning the relation between their volunteer experience and the topics that they found most, second-most, and third-most interesting did not show any significant difference.

4.4 Discussion

It was found in the group matrix-making activity that students' perceptions of functions of provisioning services shared a similarity to highly regarded economic values and their own daily activities. This may refer to what Hartel et al. (2014) pointed out; that is, focusing too much on provisioning services may cause a risk in which short-term socioeconomic interests may harm other important ecosystem services. It was found that the students' viewed regulating services, especially functions related to disaster risk mitigation, as "more important" but did "not feel close". It suggests that they prioritize functions that protect their safety from the disaster risks, but they actually do not consider such disaster risks as risks to their own personal well-being. Rather, such functions are thought of as irrelevant to them, hence, they do not "feel close" with such functions. Two students in group RIVER showed their interest in local historical disaster topics. This can be interpreted as they recognized both the benefits and risks of rivers, as the given local disasters in the workshop were floods. Cultural services tended to be evaluated as "less important." This also means that the students' viewpoints were rather weighted in favor of socio-economic

interests as individual or daily practices. Though they understand their way of living influences the survival of other living things, their practical understanding of both socio-economic and socio-ecological linkages may need to be reinforced.

ES was selected more as an interesting topic in the workshop and the topic to share with other people outside the workshop by students without volunteer experience. These results tell us that the workshop gave them an opportunity to meet a variety of opinions on local natural resources. I interpret these that this workshop played a role as social interaction through discussing with their peers. Meeting a variety of opinions and views on ES should be connected to a willingness to have more social interaction. The chi-square test also showed a significant relation between topics that students were willing to share and students' volunteer experience.

The workshop led the students to recognize long-term functions, relationships and interactions of human activities and ecosystems, as well as benefits they gain from natural resources and risks (disasters) through co-working, dialogue, and diverse learning topics. In this way, it might be possible to develop EE methods for learning about the two sides of nature (benefits and risks) in a given area in order to work towards local sustainability. This would support points made by previous studies (e.g., Fujioka 2006; 2016).

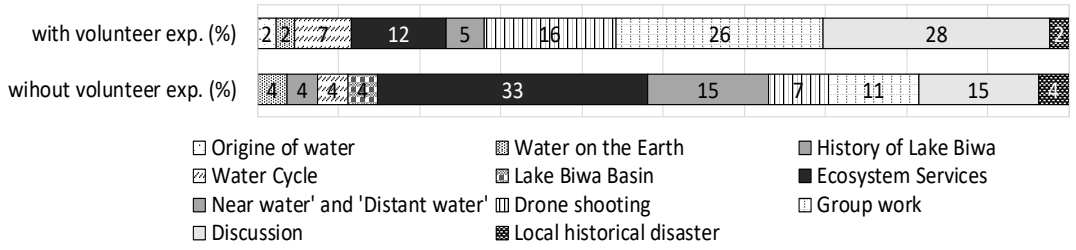

Figure 4.5 Interested topics and volunteer experience

Table 4.3 Participating students' answers to the icebreaking question (general idea of water), interested topics, and volunteer experience

Group	Student	Answer to icebreaking	Most interested topic	2nd most interested topic	3rd most interested topic	Volunteer experience
CLIMATE	S1 (f)	Rain	WC	OW	DS	Cleaning the river
	S2 (f)	Ice	G	WE	DS	Reed conservation, water quality survey
	S3 (f)	Rain	G	DS	D	Eco Club
	S4 (f)	Snow	D	DS	ES	Cleaning activities
	S5 (f)	Water droplet	DS	D	ES	No
FISH	S6 (m)	Gori fish	BB	WC	D	J21 proposal to the prefectural Assembly (aquatic plants)
	S7 (f)	Ayu sweet fish	ES	ND	WE	No
	S8 (m)	Shijimi clam	ES	D	G	No
	S9 (f)	Water birds	G	D	ES	No
LIFE	S10 (f)	Tap water	ND	G	D	Water quality survey, the Red Cross seminar for youth
	S11 (f)	Drinking water	ND	ES	G	No
	S12 (f)	Washing	D	HL	DS	No
RIVER	S13 (f)	Lake Biwa	G	D	ES	Water quality survey
	S14 (f)	River, ocean	G	D	LHD	Attended a water environment summit
	S15 (f)	The Yodo River	D	G	WC	Water quality survey, Conservation of aquatic plants
	S16 (f)	The Yasu River	WC	BB	LHD	No
FEELING	S17 (m)	Cold, refreshing	G	ES	D	Events to remove invasive plants
	S18 (f)	Blue	G	D	ND	Events to remove invasive plants
	S19 (f)	Clear/Transparent	n/a	n/a	n/a	n/a

Legend: S=student, (m)=male, (f)=female; OW = Origin of Water, WC = Water Cycle, G = Group Work, LHD = Local Historical Disaster, WE = Water on the Earth, BB = Lake Biwa Basin, D = Discussion, HL = history of Lake Biwa, ES = Ecosystem Services, DS = Drone Shooting, ND = "Near water" and "Distant water

In this time of required paradigm shift, an ecosystem-based approach or ecosystem-thinking, "in which all components of the ecosystem (including humans and human activities) and all known factors affecting them are considered and evaluated (Likens and Franklin, 2009, p. 512)," is going to be the most important. Utilizing the holistic characteristics that ecosystem approaches possess will enable us to find new environmental problems or re-structure the existing issues as well as to create a stronger framework to cope with those complexities (Currie, 2011). The method using ES may be a good entrance point for educating the young generation, such as high school students, before facing new problems or such paradigm shifts in their local areas, so that they can learn to share their views. Their learnings from EE methods like this workshop in their early years will help them to learn to think about how to make the most of resources, for the sound sustainable development of their local areas.

4.5 Summary

This chapter analyzed the results of the workshop on ecosystem services targeting high school students in Shiga Prefecture, where EE related to Lake Biwa has been promoted for many years. I summarize it as follows:

- Ecosystem services can be an effective topic to review and develop concepts of socio-economic as well as socio-ecological connections as individuals.
- A workshop with matrix-making and extensive discussions can play an important role of building social interaction skills through peer-learning.
- Further study using quantitative analysis is needed to measure the relation and to what extent subjective evaluation of ecosystem services, personal experiences, and awareness of disaster risk reduction are related.

Such a method of employing a “workshop” approach on ES for youth and outcomes could possibly be applied in consensus building processes in local natural resource conservation and sustainable development planning with a hint of disaster risk reduction viewpoints of other local areas in the future.

Notes

1) The United Nations World Youth Report defines ‘youth’ as persons aged between 15 and 24 (UN, 2018).

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CHAPTER 5

Disaster Preparedness and Local Ecosystem Conservation – Citizens

5.1 Introduction

This chapter deals with the association between disaster risk preparedness, willingness to take pro-environmental actions and to conserve local ecosystem among citizens. In light with the objective of this research, I attempt to clarify the strength of the association between disaster risk preparation behaviors, willingness to take pro-environmental actions and local ecosystem conservation by citizens.

5.2 Method

5.2.1 Questionnaire Survey and Analysis

A questionnaire survey was conducted from August 28, to September 17, 2017 under collaboration with the Sukagawa Municipality, Department of Life and Environment, Division of Environment. The targeted group is citizens aged 15 to 70s. I used the equation (1) (Haebara, 2016; Thetheorier.com) for calculating the necessary sample number. "*N"* is population (76,651), "*p"* is response rate (0.5), "*k"* is confidence coefficient, and "*L"* is sampling error.

$$n = \frac{N}{\left(\frac{L}{2k}\right)^2 \times \frac{N-1}{p(1-p)} + 1} \quad \text{.....(1)}$$

The necessary sample number was calculated as 383. The questionnaires were distributed by post to 1,358 citizens selected by stratified sampling method, and I collected 445 responses by post eventually (response ratee 32.6%). I structured the questions referring to some literature reviews. Table 5.1 shows the question groups, the number of questions, alternatives, and the existing studies referring to structure the questions.

5.2.2 Hypothesis and Analysis Framework

As mentioned in preceding chapters, ecosystem-based disaster risk reduction (Eco-DRR) has been paid attention as an option for the future disaster risk management in the time of hard discussion around uncertainty and unprecedented damages due to extreme weather events. Yet, Eco-DRR is an approach that expects the sustainable solution that the ecosystem can offer to mitigate disaster risks and the severity of their impacts, while adapting to global changes. For the ecosystem to exerts such functions, a sound ecosystem management is needed with stakeholders' participation, namely local actors in a given area. It is important to build confident relationship between stakeholders/actors of environment management within the local community for a better initiative of Eco-DRR (Dalimunthe, 2018). Also, it is vital to understand human-environmental connections that involves diverse values and ecosystem services provided by the natural environment in order to reduce risk against uncertainties, (Dhyani et al., 2018). The participation of local stakeholder including buy-in or cooperation within land management to achieve sufficient level, is critical for the successful implementation of Eco-DRR measures and rolling out of nature-based solutions to tackle climate change and natural hazards (McVittie et al., 2018). When we consider these points made by previous studies, it is required that stakeholders have both views on sound ecosystem management and how the local ecosystem functions to mitigate disaster risks. Furthermore, considering the viewpoint of disaster risk management as raised in Chapter 1, the preparedness

or preparation on human-side is to be paid attention, namely disaster preparation behaviors by local citizens as self-help or mutual help. Eco-DRR cannot be a panacea and has the limitation in mitigating the natural hazard impacts that could be unprecedented these days. It has been reported that people tend to depend on the grey infrastructure and become less prepared themselves for future disaster risks by some studies (e.g., Terumoto et al., 2003; Homma et al., 2006; Kumagaya et al., 2008; Taniguchi, 2013). Would ordinary citizens, a part of stakeholders of Eco-DRR, take behaviors of disaster preparation themselves as they have the views on ecosystem conservation and management?

Regarding preparedness and awareness-raising of disaster risks, in Japanese context, there have been many reports focusing on local characteristics, especially local disasters in the past and place-names, to be included in the strategy of raising awareness and promoting preparedness among the wide population (e.g., Shaw et al, 2005: Nagoya University Library Research Development Unit, 2005; Takeuchi et al., 2008). Kagami (1964) emphasized the place-names as the precious records delivering the trajectories of local cultural development in the past. Place-names are not simple signs or names to identify the place but reflecting the geographical conditions as well as the origins of the place-name (Kimata, 1991). Due to the amendment of legal institution in 1962, the old place-names has been changed to new names that have nothing to do with the original names that shows the characteristics of the place (Kimata, 1991). Place-names and historical disasters have been taken as a research topic, they have been studies with geographical approach (e.g., Abe, 2013; Hanaoka, 2005; Kawai et al. 2009; Sakamoto & Itoigawa, 2005), engineering approach (Ogasawara et al., 2014; Natume et al., 2015; Kori & Sugiyama, 2012; Koarai et al. 2011; Kurata et al., 2008), and social scientific and humanities approach (e.g., Kakimoto et al., 2009; Kimura & Hayashi, 2009; Sekido, 1989). The number of general books dealing with place-names and disasters has increased and alert the detaching place-names and their background (e.g., Endo, 2013; Tanigawa, 2013).

As this research aims to seek elements to promote citizens' preparedness for disaster risks through analyzing the correlation with their disaster experiences, natural environmental consciousness or willingness to participate to local ecosystem conservation, I set the following nine hypotheses based on the previous studies prior to analysis:

Hypothesis 1 (H1): Association is observed between willingness to take pro-environmental actions and disaster preparation behavior.

Hypothesis 2 (H2): Association is observed between consciousness to Climate Change influence in their local area and disaster preparation behavior.

Hypothesis 3 (H3): Association is observed between willingness to participate to local ecosystem conservation, especially regulating service related conservation, and disaster preparation behavior.

Hypothesis 4 (H4): Association is observed between local historical disaster knowledge and disaster preparation behavior.

Hypothesis 5 (H5): Association is observed between knowledge about place-name and disaster preparation behavior.

Hypothesis 6 (H6): Association is observed between past disaster experience and disaster preparation behavior.

Hypothesis 7 (H7): Association is observed between emphasizing self-help and disaster preparation behavior.

Hypothesis 8 (H8): Association is observed between subjective resources (money, stamina, knowledge) and disaster preparation behavior.

Hypothesis 9 (H9): Association is observed between attributes (age, occupation, years of resident) and disaster preparation behavior.

Table. 5.1 Question items and question groups A–N

Groups	Questions	# of Qs	Alternatives	References
A	General disaster risk preparation behaviors (anti-seismic reinforcement, contact lists, drills, hazard map, etc.)	12	1. Yes 2. No	Sukagawa City, 2013 (Sukagawa City DRR guide "*Bosai* Guide")
B	Disaster experiences (actual experience, observation on site, watched on media)	6	5. Strongly Agree (SA) 4. Agree (A) 3. Neutral (N) 2. Disagree (DA) 1. Strongly Disagree (SD)	Endo, 2013 Hanaoka, 2015 Kimura and Hayashi, 2009 Tanigawa, 2013
C	About the area you live in (knowledge on the background of the area)	3		
D	Self-help / Mutual help / Public help	3	pairwise comparison	Cabinet Office, Japan, 2015
E	Customizing preparation for disaster risks	2	5. Strongly Agree (SA) 4. Agree (A) 3. Neutral (N) 2. Disagree (DA) 1. Strongly Disagree (SD)	Ohtomo & Hirose, 2007b
F	Preparation: Individual level and public service	2		Ohtomo & Hirose, 2007b Endo, 2013 Tanigawa, 2013
G	Information on preparation for disaster risks around you	2		Ohtomo & Hirose, 2007b
H	Natural environment in Sukagawa and your area	2		Sukagawa, 2013 ("*machizukuri* vision")
I	Awareness of climate change	2		Stoknes, 2015
J	Pro-environmental actions	2		Ohtomo and Hirose, 2007a
K	Information on environment conservation around you	2		
L	Future participation of natural environment conservation	10		ILEC, 2007 MA, 2003; 2005
M	Subjective resources for disaster risk preparation and natural environment conservation	5		
N	Attributes (gender, age, occupation, residence, years of resident, number of children, district)	7	Multiple	

*Indices in the colored columns were used for analysis

I conducted the MCA and Cramér's V based on the analysis framework shown in Figure 5.2. It comprises three analyses (1), (2), and (3) as follows:

Analysis (1): This is to examine H1, H2, and H3, that are the association between environmental consciousness and disaster preparation behavior. I used the indices of disaster preparation behaviors (Group A (12 variables)) and the environment related indices (The environment related (Group I (1 variable), Group J (1 variable), and Group L (9 variables)) for Multiple Correspondence Analysis (MCA) and Cramér's V.

Analysis (2): This is to examine H4, H5, H6, and H7, that are the association between disaster preparation behaviors, past disaster experiences, knowledge of local historical disaster and local place-names, and type of help to emphasize. disaster preparation behavior. I used the indices of disaster preparation behaviors (Group A (12 variables)), past disaster experiences (Group B (4 variables), knowledge of local historical disasters and local place-names (Group C (2 variables), and type of help to emphasize (Group D (1 variable).

Analysis (3): To examine H8 and H9, the association between individual subjective capacity and attributes and disaster preparation behavior (individual (8 variables) × disaster preparation behaviors (A: 12 variables)).

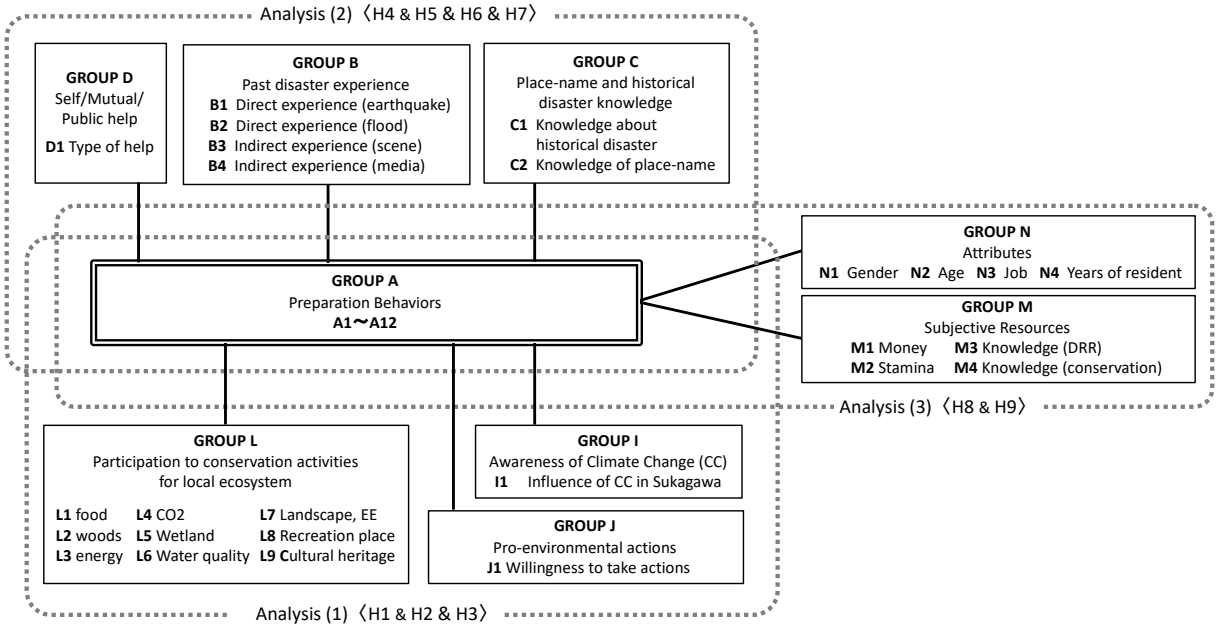

Figure 5.1 Analysis framework (source: created by the author)

I overviewed respondents' answers with simple tabulation and cross-tabulation prior to examining the association between attributes, disaster preparation behavior, the type of help (self-help/mutual help/public help) to emphasize, past disaster experiences, willingness to take pro-environmental actions and to participate in local ecosystem conservation. I used a Multiple Correspondence Analysis (MCA) to explore the relationships between the given sets of variables as well as to visualize them, followed by Cramér's coefficient of association (Cramér's V) to check the strength of the association.

$$V = \sqrt{\frac{\chi^2}{N(min(r,l)-1)}} \quad \text{.....(2)}$$

Equation (2) (Haebara, 2016) was used to calculate Cramér's V. "*N*" is the number of samples, "*r*" and "*l*" represent the number of rows and columns of the given cross-tabulation, and "χ^2" is the chi-square statistic. I used IBM SPSS Statistics 25 for the analysis and Microsoft

Excel 2016 for the figures. As given in the Chapter 3, I conducted a questionnaire survey to citizens in September 2017 from which I collected 445 responses (collection rate 32.8%).

5.3 Results

The majority of respondents were the citizens who are in their 50s or above (66.2%). 26% of the respondents are 'office workers,' the biggest group of attributes, and 'unemployed' (21.7%) follows. As for the years of resident, nearly 80% have lived in the city for more than 10 years, which means we can assume that the majority of respondents

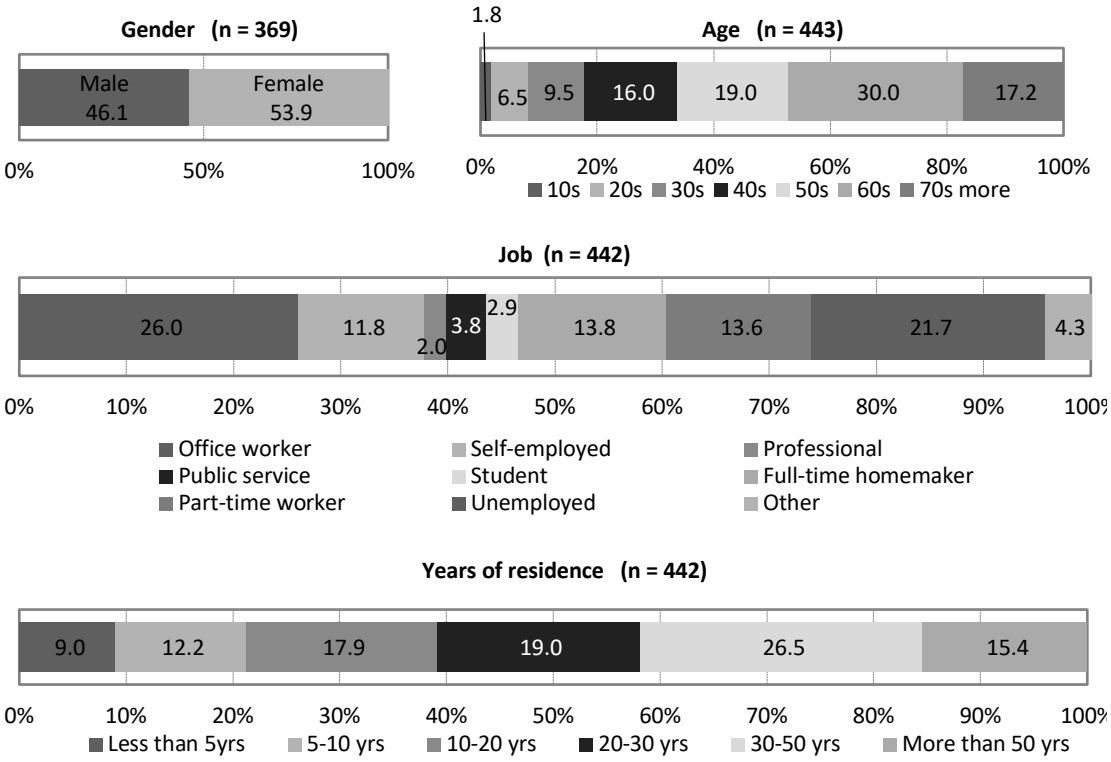

Figure 5.2 Attributes of respondents

have experienced the Great East Japan Earthquake (GEJE) disaster occurred in 2011.

Regarding the preparation behaviors (Group A), the ratio of respondents who have taken any action was not many (Figure 5.4). Regarding the nearest shelter and the routs to reach there, most respondents rather well checked ([A9] location 73.7%, [A10] routes 69.9%). As for [A4] confirming the means of contact and plural information sources (57.3%), [A5] talking

with family about contact in an emergency case (53.3%), [A6] keeping stock of water and food for 3 days (59.3%) and [A7] stock of life goods (53.3%), [A3] knowing the ground of resident place (52.0%) were taken actions by more than half of respondents. However, the rest of the general disaster risk preparation recommended by the municipality ([A1] Anti-seismic reinforcement, [A2] fixing furniture, [A8] keeping *bosai* guide including hazard map, [A11] evacuation drills and seminars, [12] first aid or how to use AED) showed rather lower rate of

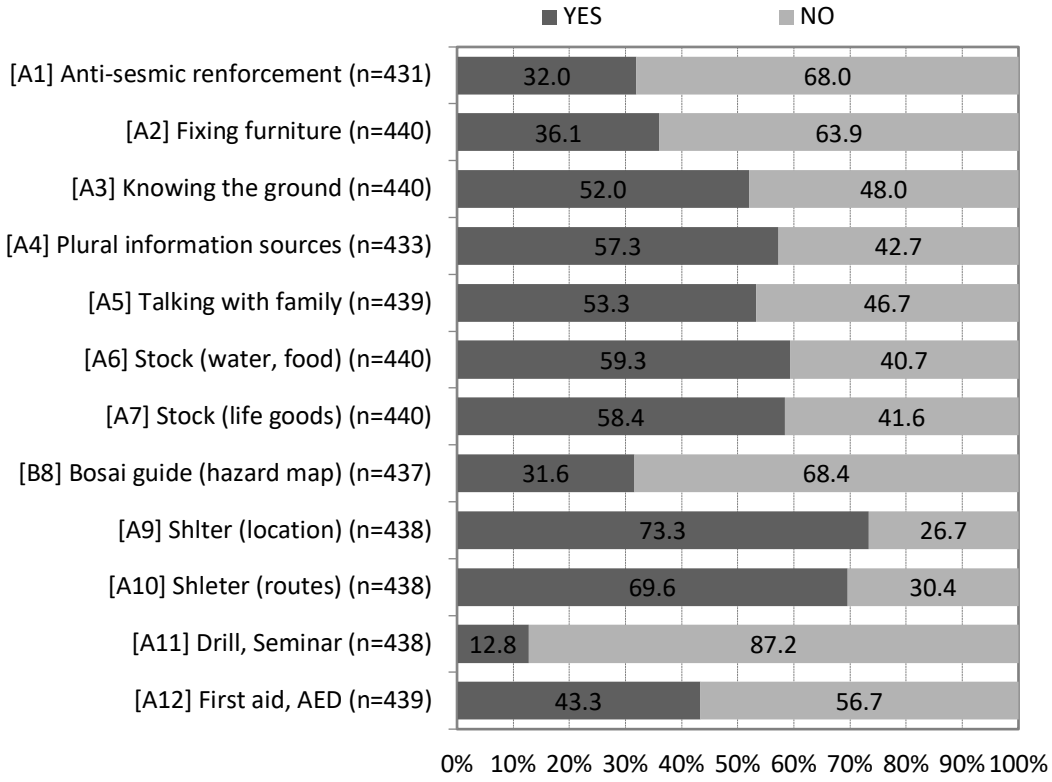

Figure 5.3 Simple tabulation of disaster preparation behaviors by citizens

action. Especially, *bosai* guide by the municipality was not kept handy by many of them, and only 31.6% managed to do so. Bosai guide includes not only hazard map but also important information from the municipality and what to do and not to do in emergency cases. Those who answered NO to this question [A8] gave the reason as they do not know when it was distributed or do not remember where they put it.

Regarding the environmental related questions about influence of Climate Change (CC) in the city [I1] and willingness to take pro-environmental actions [J1], more than half of respondents answered 'Agree' or 'Strongly agree' (Figure 5.9, 5.10). In the questionnaire, we defined 'pro-environmental actions' as separating garbage by type, saving electricity and water, using soap or biodegradable detergents, voluntary recycling papers and cooking oil, etc.

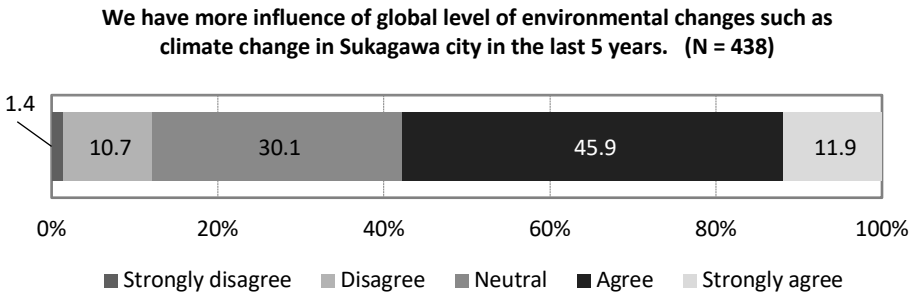

Figure 5.4 Influence of Climate Change in Sukagawa city

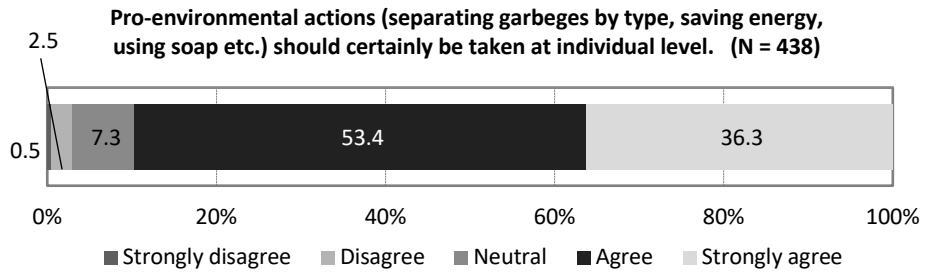

Figure 5.5 Willingness to take pro-environmental actions

When it comes to conservation activities, the ratio of respondents who are willing to participate became lower compared with the positive answers to influence of CC [I1] and willingness to take pro-environmental actions [J1]. Focusing on the clear positive answers as 'Strongly agree' and 'Agree' to participation to local ecosystem conservation, the most selected as participation target were food-related activities (provisioning service) and maintaining recreation place activities (cultural service). On the other hand, conservation targets that are

related to regulating services were selected by less than 25% of respondents, just except water quality which was selected by about 30% of respondents.

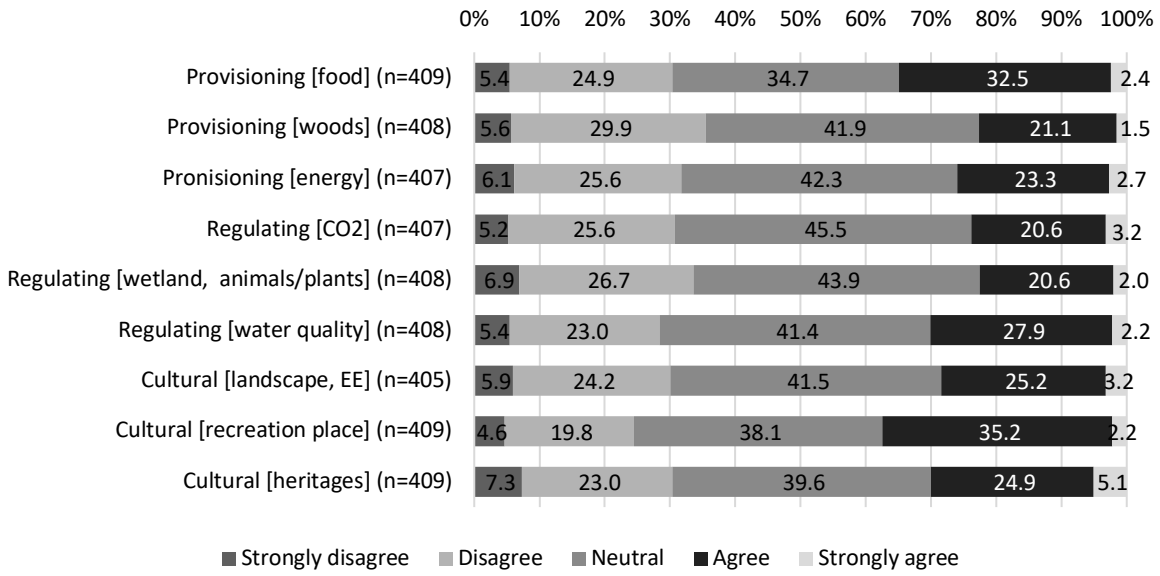

Figure 5.6 Ratio of willingness to participate to local ecosystem conservation activities

As for the past disaster experiences, a clear difference was observed. More than 90% of respondents answered that they thought disaster preparation is important from direct experience of earthquakes and indirect experiences by seeing the site and watched it throughthe media. Direct experience of flood did not lead to their thought of disaster preparation as much as that of earthquake and indirect experiences (Figure 5.5 ~ 5.8).

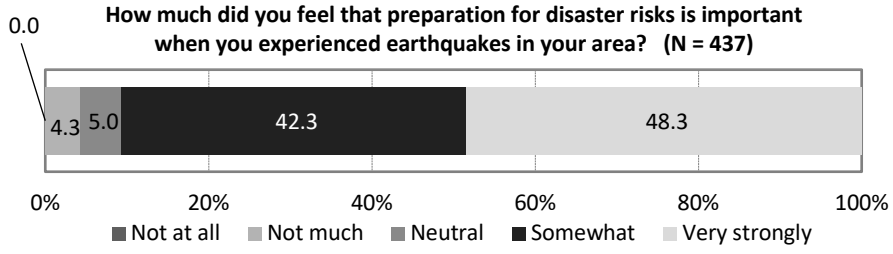

Figure 5.7 Direct disaster experience (earthquake)

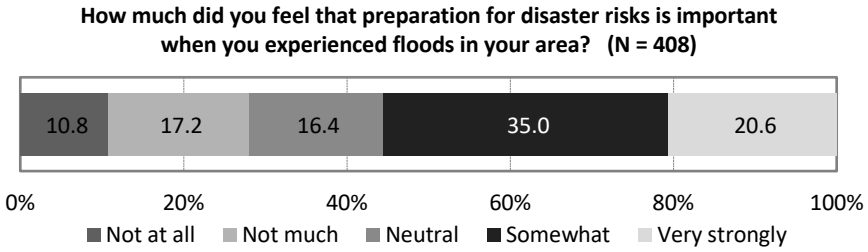

Figure 5.8 Direct disaster experience (flood)

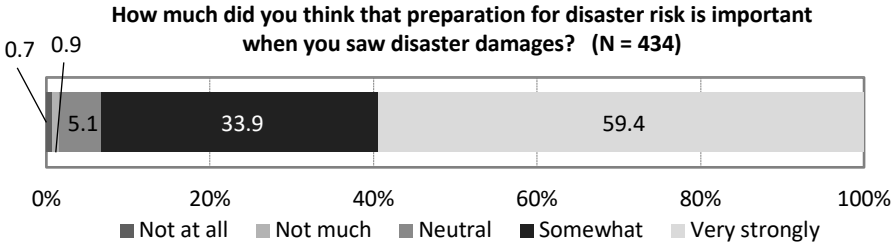

Figure 5.9 Indirect disaster experience (saw it)

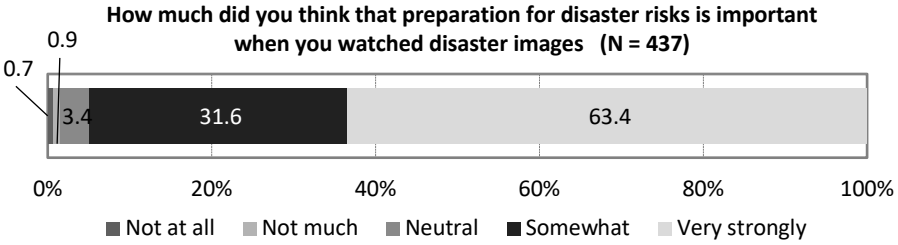

Figure 5.10 Indirect disaster experience (media)

5.3.1. Analysis (1) – Environmental consciousness and Preparation Behaviors

5.3.1.1 MCA

For Analysis (1), I used 11 environmental variables: influence of CC in Sukagawa city [I1], willingness to take pro-environmental action (J1) s, and target activities of local ecosystem conservation (L1 food (provisioning service), L2 woods (provisioning service), L3 energy (provisioning service), L4 reducing CO_2 emission (regulating service), L5 wetland and

aquatic animals/plants (regulating service), L6 river water quality (provisioning service), L7 landscape and Environmental Education (cultural service), L8 maintaining recreation places (cultural service), L9 cultural/folk heritages (cultural service)) and the 12 preparation behaviors (A1~A12). Each of A1~A12 has two variables of 'YES/NO,' while each of the 11 environmental indices has five variables: 'Strongly agree (SA)/Agree (A)/Neutral (N)/Disagree (D)/Strongly disagree (SD).' Using MCA, I examined the association between these indices.

The results of MCA of between the indices of local ecosystem conservation (L1~L9) and disaster preparation behaviors (A1~A12) showed a clear distribution. The group of respondents who answered 'SD' or 'D' were far apart from the group of 'SA' 'A' and 'N.' Figure 5.12 shows the results of MCA between "A8 (*bosai* guide (hazard map)) and all indices group L (L1~L9)." The A8 both 'YES/NO' and 'SA' 'A' and 'N' are gathered all closer, which means that some respondents who are willing to participate in local ecosystem conservation have not taken the action of keeping *bosai* guide (hazard map) handy (A8). One clear thing is that the respondents who answered 'D' or 'SD,' that is, not interested in local ecosystem conservation, have not yet paid attention to keep *bosai* guide (hazard map) handy at all. I examined the all indices of A1~A12 and L1~L9 with MCA, and the results of them all showed the very similar distribution. I provide the rest of the results of MCA in Appendix.

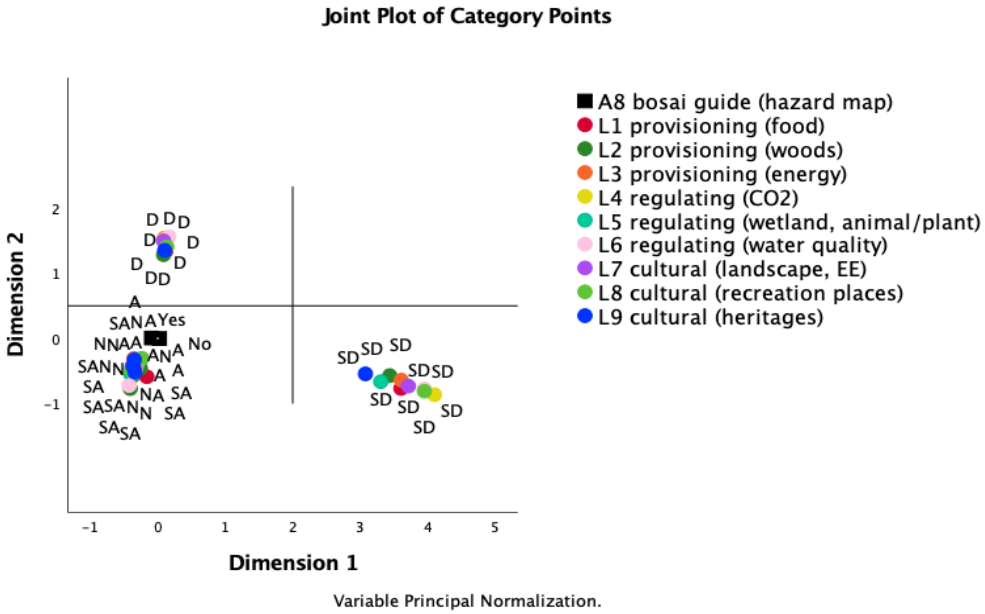

Figure 5.11 Results of MCA between keeping bosai guide handy (A8) and local ecosystem conservation (L1~L9)

5.3.1.2 Cramér's V

Following the distribution of the indices of disaster preparation behaviors (A1~A12) and environmental related indices (I1, J1, and L1~L9) by MCA, I tested the strength of each association with Cramér's V.

Significant association was observed between A12 (first aid, AED) and L7 (landscape and EE) (.249***), between A11 (drills, seminars) and L8 (maintaining recreation places) (.237***), and between A4 (plural information sources in emergency cases) and L9 (cultural/ folk heritages) (.281***). Some others showed weak association, for example, A4 (plural information sources in emergency cases) and L5 (talking with family about emergency responses) had weak associations with J1 (pro-environmental actions) or L1 (food), L5 (wetland etc.), L6 (water quality), and L8 (recreation places) as well (Table 5.2).

Table 5.2 Cramér's V coefficient of Analysis (1)

Natural Environment indices \ Preparation Behaviors	A1 Anti-seismic reinforcement	A2 Fixing furniture	A3 The ground	A4 Plural info sources in emergency	A5 Talk with family	A6 Stock (water, food)	A7 Stok (life goods)	A8 Bosai Guide (hazard map)	A9 Shelter (location)	A10 Shelter (routes)	A11 Drills, Seminars	A12 First Aid AED
I1 Influence of Climate Change	.106	.143					.130	.141			.145	
J1 Pro-environmental actions	.148	.135	.168*	.198**	.139	.173*	.173*	.116	.147	.128	.105	.186**
L1 Provisioning (food)	.146	.178*		.131	.159*	.121			.150		.129	
L2 Provisioning (woods)	.109	.102		.145	.109				.113	.101	.125	.150
L3 Provisioning (energy)	.172**	.153		.153	.119				.117		.115	.153
L4 Regulating (CO_2)	.138	.129		.125	.103		.103		.119	.148		
L5 Regulating (wetland)	.166**	.133		.166*	.214**		.135		.150	.148		.152
L6 Regulating (water quality)	.129	.121		.218**	.155*	.127		.126		.110	.113	.135
L7 Cultural (Landscape, EE)	.149	.200**		.150	.155*	.134			.118			**.249***
L8 Cultural (Recreation places)		.154*	.118	.218**	.217**	.120	.150		.137	.135	**.237***	.138
L9 Cultural (folk heritages)	.129	.136	.138	**.281***	.200**	.135	.120	.128	.143	.166*	.148	.184**

Association V ≥ .250
Weak Association .250 > V ≥ .100
Blank = no association
*** p < .001
** p < .01
* p < .05

Based on the above, the results of hypotheses examination were:

H1: Association is observed between willingness to take pro-environmental actions and disaster preparation behavior. → Adopted.

H2: Association is observed between consciousness to Climate Change influence in their local area and disaster preparation behavior. → Rejected.

H3: Association is observed between willingness to participate to local ecosystem conservation, especially regulating service related conservation, and disaster preparation behavior. → Partly adopted, but not with regulating services but with cultural services.

5.3.2. Analysis (2) – Past Disaster Experiences and Preparation Behaviors

5.3.2.1 MCA

The results of MCA of between the indices of past disaster experience (B1~B4), type of help (D1) and disaster preparation behaviors (A1~A12) showed interesting results.

Whereas the distribution between disaster preparation behaviors (A1~A12) and direct disaster experiences (B1, B2) were rather dispersed (Figure 5.13), that of distribution between indirect disaster experiences (seeing B3, through the media B4) showed clear grouping. The group of respondents who answered 'SD' or 'D' were apart from the group of 'YES/NO' and 'SA,' 'A,' 'N.' (Figure 5.14). Although the A8 both 'YES/NO' and 'SA' 'A' and 'N' are gathered all closer, it tells that the respondents who did not feel the importance of disaster preparation from the scenes and/or images on the media have not taken preparation behaviors. I examined the distribution regarding all the indices of A1~A12 and B1~B4, C1 and C2, D1. Their MCA results are provided in Appendix.

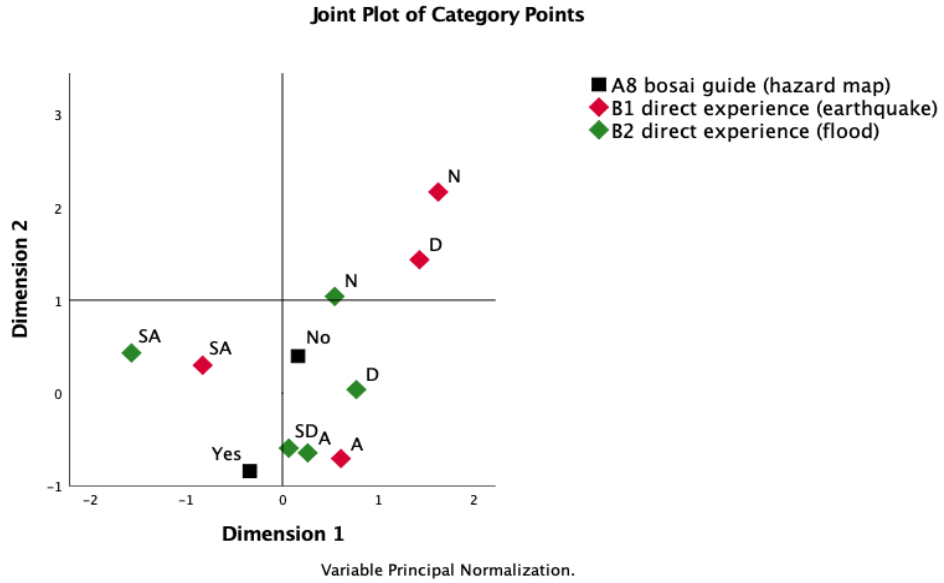

Figure 5.12 Results of MCA between keeping bosai guide handy (A8) and direct disaster experience (B1, B2)

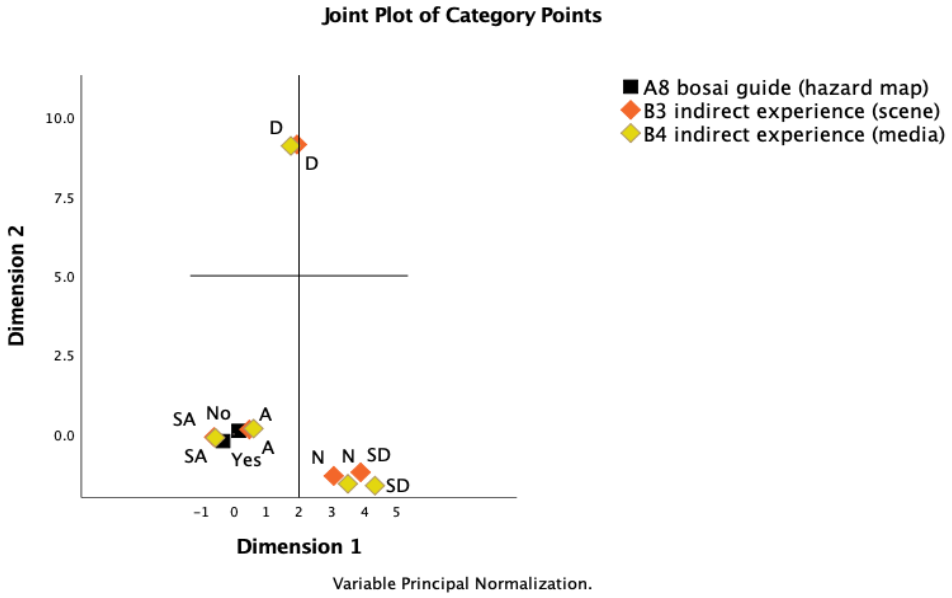

Figure 5.13 Results of MCA between keeping bosai guide handy (A8) and direct disaster experience (B3, B4)

5.3.2.2 Cramér's V

Following MCA, I conducted the Cramér's V to examine the strength of association between each pair of indices: disaster preparation behaviors (A1~A12) and past disaster

experience (B1~B4), in addition, knowledge of local historical disasters (C1) and place-name origins (C2), as well as type of help to emphasize among the three: self-help/mutual help/public help (D1). For D1, I set up a question in the pairwise comparison in the questionnaire. I weighed the responses so that the one type of help to emphasize is returned, thus I obtained one variable for D1.

Significant associations were observed between A3 (knowing the ground) and C2 (place-names) (.280***), between A4 (plural information sources for emergency) and C2 (place-names) (.271***), and between A5 (talking with family about emergency responses) and B3 (indirect disaster experience (by seeing the site)) (.258***). Some others showed weak association (Table 5.2). Based on the above, the results of hypotheses examination were:

H4: Association is observed between local historical disaster knowledge and disaster preparation behavior. → Adopted.

H5: Association is observed between knowledge about place-name and disaster preparation behavior. → Adopted.

H6: Association is observed between past disaster experience and disaster preparation behavior. → Partly adopted. Only with indirect experience.

H7: Association is observed between emphasizing self-help and disaster preparation behavior. → Rejected.

5.3.3. Analysis (3) – Subjective Resources, Attributes, and Preparation Behaviors

5.3.3.1 MCA

This section presents the distribution through MCA between the indices of subjective resources (M1~M4), attributes (N1~N4) and disaster preparation behaviors (A1~A12).

Table 5.3 Cramér's V coefficient of Analysis (2)

Natural Environment indices \ Preparation Behaviors	A1 Anti-seismic reinforcement	A2 Fixing furniture	A3 The ground	A4 Plural info sources	A5 Talk with family	A6 Stock (water, food)	A7 Stok (life goods)	A8 Bosai Guide (hazard map)	A9 Shelter (location)	A10 Shelter (routes)	A11 Drills, Seminars	A12 First Aid AED
B1 Direct experience (earthquake)	.129	.241***	.125	.140*	.163**	.202***	.201**	.135	.152*	.165**	.123	
B2 Direct experience (flood)	.175*	.117	.141	.125	.168*	.119		.102	.157*	.106		
B3 Indirect experience (scene)	.101	.192**		.148	.258***	.183**	.204**	.135	.188**	.182**		
B4 Indirect experience (watched)		.148*			.247***	.158*	.144	.118	.179**	.153*	.113	
C1 Historical disaster	.107	.130	.229***	.244	.155*	.162*		.167	.155*	.170*	.243***	
C2 Place-names	.143		.280***	.271***	.132	.136		.143	.199**	.226***	.173*	
D1 Type of help		.107	.107								.145*	

Association $V \geq .250$
Weak Association $.250 > V \geq .100$

Blank = no association

*** $p < .001$
** $p < .01$
* $p < .05$

The distributions between the subjective resources (M1~M4) and disaster preparation behaviors (A1~A12) were all similar, but all distribution formed two groups: one is YES for A1~A12 and 'SA,' 'A,' and 'N,' the other is NO for A1~A12 and 'D,' 'SD' in a linear-shape. Figure 5.15 show the result between A8 *bosai* guide and subjective resources (M1~M4). YES and 'SA,' 'A,' and 'N' are distributed in the left side of dimension 1 while NO and 'D' 'SD' were located in the right half. Both groups are forming a linear-shape. As for the attributes (N1~N4) and preparation behaviors (A1~A12), a very obvious result was isolating distribution of young generation and student, which was far apart from the big crowd of the most indices (Figure 5.16). The rest MCA results for analysis (3) are also provided in Appendix.

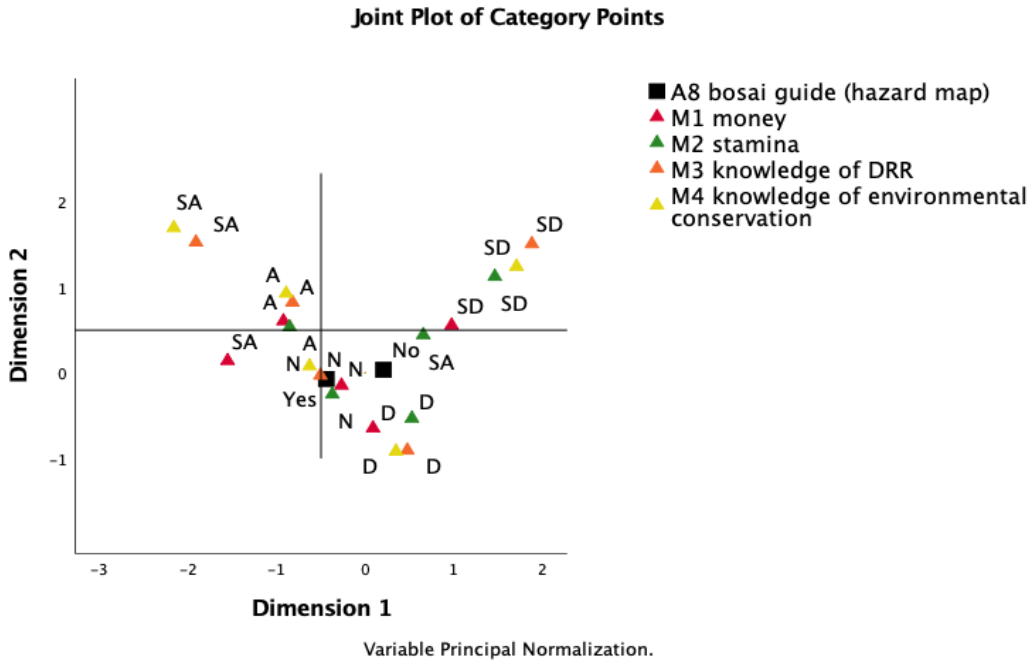

Figure 5.14 Results of MCA between keeping bosai guide handy (A8) and subjective resources (M1~M4)

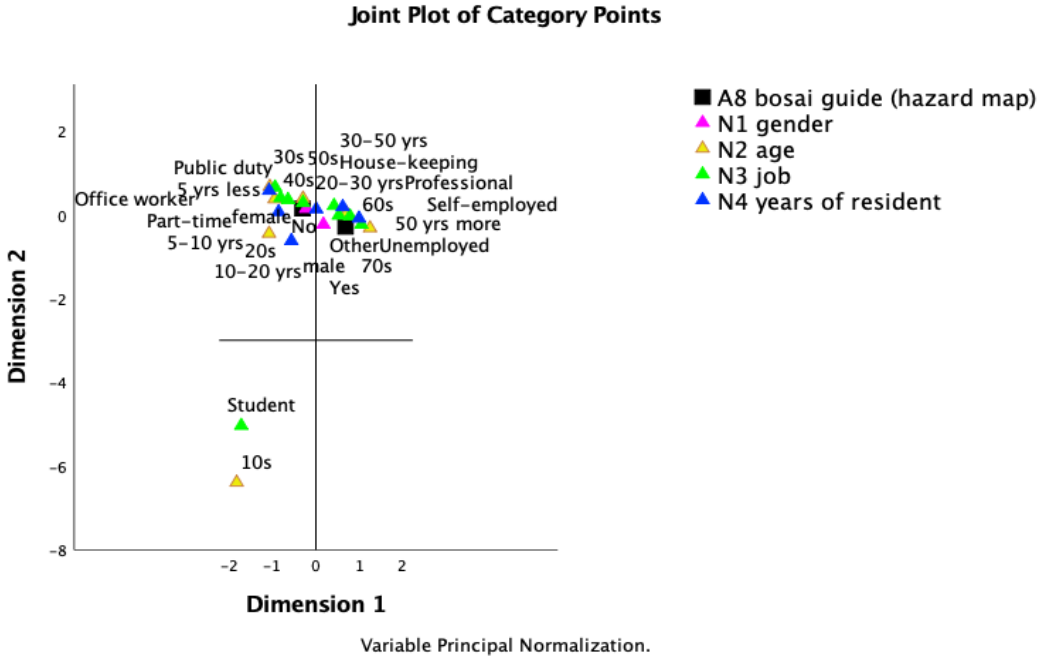

Figure 5.15 Results of MCA between keeping bosai guide handy (A8) and attributes (N1~N4)

5.3.3.2 Cramér's V

I examined the association between disaster preparation behaviors (A1~A12) and subjective resources (M1~M4), attributes (N1~N4).

Knowledge of DRR (M3), knowledge of environmental conservation (M4), age (N2), and job (N3) showed significant associations between disaster preparation behaviors. M3 and knowing the ground (A3) (.318***) (p<.001), M4 sand A3 (.278***), M3 and A4 (plural information sources for emergency case) (.362***), M4 and A4 (.352***). Age (N2) showed significant associations with *bosai* guide (A8) (.328***), and A12 (first aid, AED) (.303***). Job (M3) had a significant association with A12 (345***) (Table 5.4).

Thus, the hypotheses both H8 and H9 were adopted.

Table 5.4 Cramér's V coefficient of Analysis (3)

Natural Environment indices \ Preparation Behaviors	A1 Anti-seismic reinforcement	A2 Fixing furniture	A3 The ground	A4 Plural info sources	A5 Talk with family	A6 Stock (water, food)	A7 Stok (life goods)	A8 Bosai Guide (hazard map)	A9 Shelter (location)	A10 Shelter (routes)	A11 Drills, Seminars	A12 First Aid AED
M1 Money	.197**	.187**	.201**	.163*	.159*	.170*	.154*	.195**			.166*	
M2 Stamina		.163*	.235***	.230***		.130	.111	.112		.117		.164*
M3 Knowledge on DRR	.151*	.226***	**.318*****	**.362*****	.186**	.234***	.177**	.143	.117	.146	.228***	.217***
M4 Knowledge on envi. conservation	.176*	.186**	**.278*****	**.352*****	.169*	.189**	.188**	.163*	.113	.160*	.166*	.194*
N1 Gender					.123*						.124*	
N2 Age			.165		.133	.202**	.171*	**.328*****	.173*	.232**	.220**	**.303*****
N3 Job	.183		.192*		.140	.171	.167	.217**	.110	.123	.187	**.345*****
N4 Years of resident	.164*	.116	.142	.107		.187**	.119	.192**	.168*	.178*	.144	.141

Association $V \geq .250$
Weak Association $.250 > V \geq .100$

Blank = no association

*** $p < .001$
** $p < .01$
* $p < .05$

5.3.4. Occurrence Probability

Finally, selecting the indices showed significant association with A1~1A12, I analyzed the occurrence probability using logistic regression with a method of Forward Likelihood Ratio. The results by Hosmer-Lemeshow Test indicates each model rather good fitness. Some show rather lower fitness, but they all can be acceptable. Table 5.5 gives all the indices with significant expectation of occurrence regarding disaster preparation behaviors.

For anti-seismic reinforcement (A1), knowledge of environmental conservation (M4) showed an expectation of occurrence though it was not very high. M4 also had significant expectation with stock of life goods (A7), keeping *bosai* guide handy (A8), and first aid, AED (A12). It was returned that knowledge of DRR (M3) shows significant expectation to fixing furniture (A2), knowing the ground (A3), plural information sources (A4), and stock of water and food (A6). Knowledge of local historical disasters (C1) also had a significant expectation to (A3) and routes to the nearest shelter (A10). As for disaster experience, only indirect experience by seeing the site (B3) returned the significant expectation, though not very much high, to fixing furniture (A2), talking with family (A5), stock of water and food (A6), keeping bosai guide handy A8), and location of shelter (A9).

On the other hand, job (N3) and age (N2) had a negative wise of expectation to A1 and A12, hence it is expected that job and age have probability to reduce the occurrence of some of the disaster risk preparation behaviors.

Table 5.5 Occurrence probability by logistic regression analysis (Forward Likelihood Ratio)

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
A1 **Anti-seismic reinforcement** Hosmer and Lemeshow Test Chi-square (0.819), df (7) Sig. (.997)	M4 knowledge of environmental conservation	0.491	0.131	14.113	1	.000	1.634	1.265	2.110
	N3 job	-0.101	0.040	6.366	1	.012	0.904	0.835	0.978
	Constant	-1.501	0.392	14.673	1	.000	0.223		
A2 **Fixing furniture** Hosmer-Lemeshow Test Chi-square (4.084), df (5) Sig. (.537)	B3 indirect experience (scene)	0.683	0.199	11.791	1	.001	1.980	1.341	2.924
	M3 knowledge of DRR	0.517	0.129	16.085	1	.000	1.677	1.302	2.158
	Constant	-5.052	0.979	26.633	1	.000	0.006		
A3 **Knowing the ground** Hosmer-Lemeshow Test Chi-square (6.504), df (7) Sig. (.482)	C1 historical disasters	0.316	0.091	11.926	1	.001	1.371	1.146	1.640
	M3 knowledge of DRR	0.554	0.132	17.635	1	.000	1.740	1.343	2.252
	Constant	-2.171	0.389	31.126	1	.000	0.114		
A4 **Plural info sources for emergency** Hosmer-Lemeshow Test Chi-square (3.745), df (7) Sig. (.809)	L9 cultural (heritages)	0.685	0.134	26.103	1	.000	1.985	1.526	2.582
	M3 knowledge of DRR	0.780	0.141	30.722	1	.000	2.181	1.655	2.873
	Constant	-3.797	0.574	43.788	1	.000	0.022		
A5 **Talk with family about** Hosmer-Lemeshow Test Chi-square (0.528), df (1) Sig. (.467)	B3 indirect experience (scene)	0.849	0.185	21.030	1	.000	2.337	1.626	3.358
	Constant	-3.792	0.853	19.757	1	.000	0.023		
A6 **Stock (water, food)** Hosmer-Lemeshow Test Chi-square (0.514), df (2) Sig. (.770)	M3 knowledge of DRR	0.506	0.124	16.721	1	.000	1.659	1.301	2.114
	Constant	-0.985	0.340	8.392	1	.004	0.373		

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
A7 **Stock (life goods)** Hosmer-Lemeshow Test Chi-square (0.958), df (2) Sig. (.620)	M4 knowledge of environmental conservation	0.379	0.123	9.520	1	.002	1.460	1.148	1.857
	Constant	-0.637	0.324	3.868	1	.049	0.529		
A8 **Bosai Guide (hazard map)** Hosmer-Lemeshow Test Chi-square (7.364), df (8) Sig. (.498)	B3 indirect experience (scene)	0.564	0.210	7.214	1	.007	1.758	1.165	2.653
	M4 knowledge of environmental conservation	0.379	0.136	7.819	1	.005	1.461	1.120	1.906
	N2 age	0.336	0.088	14.662	1	.000	1.399	1.178	1.661
	Constant	-6.102	1.127	29.332	1	.000	0.002		
A9 **Shelter (location)** Hosmer-Lemeshow Test Chi-square (0.001), df (1) Sig. (.975)	B3 indirect experience (scene)	0.566	0.168	11.336	1	.001	1.761	1.267	2.448
	Constant	-1.407	0.752	3.501	1	.061	0.245		
A10 **Shelter (routes)** Hosmer-Lemeshow Test Chi-square (1.076), df (3) Sig. (.783)	C1 historical disasters	0.369	0.100	13.688	1	.000	1.447	1.190	1.760
	Constant	0.071	0.241	0.086	1	.769	1.073		
A11 **Drills, Seminars** Hosmer-Lemeshow Test Chi-square (0.448), df (2) Sig. (.799)	M3 knowledge of DRR	0.659	0.176	13.935	1	.000	1.932	1.367	2.730
	Constant	-3.783	0.568	44.391	1	.000	0.023		
A12 **Frist aid, AED** Hosmer-Lemeshow Test Chi-square (2.968), df (8) Sig (.936)	M4 knowledge of environmental conservation	0.595	0.142	17.686	1	.000	1.813	1.374	2.393
	N2 age	-0.420	0.089	22.213	1	.000	0.657	0.552	0.783
	N3 job	-0.219	0.044	24.526	1	.000	0.803	0.736	0.876
	Constant	1.351	0.505	7.168	1	.007	3.863		

5.4 Discussion and Summary

The key findings of this study are: 1) local ecosystem conservation, especially willingness to participate to cultural/folk heritages conservation (cultural services), is correlated to disaster risk preparation behavior with occurrence probability with significant expectation, 2) willingness to take pro-environmental actions showed the most associations with five preparation behaviors though they were not strong enough to lead to correlation and occurrence probability, 3) whereas past direct disaster experiences did not have very clear correlation with preparation behaviors, indirect disaster experience (seeing the disaster site) rather returned significant expectation of preparation behavior occurrence, and 4) knowledge of DRR as a subjective resource gained the most expectations with preparation behaviors eventually, knowledge of environmental conservation as subjective resource followed and showed the second most occurrence probability.

By and large, these findings indicate that people who pays attention to the local area and consciousness of voluntary involvement and interest in their local area also have taken preparation behaviors themselves as self-help. In other words, people who cares the local characteristics, natural environment and local ecosystem in this study, have done disaster risk preparation behaviors themselves, namely as self-help.

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CHAPTER 6

Disaster Preparedness and Local Ecosystem Conservation – Small and Medium Enterprises

6.1 Introduction

This chapter presents the association between disaster preparedness, pro-environmental actions and willingness of local ecosystem conservation by small and medium-sized enterprises. In light with the objective of this research, I attempt to clarify the strength of association between disaster preparedness, pro-environmental actions and consciousness of local ecosystem conservation by small and medium-sized enterprises.

6.2 Method

6.2.1 Questionnaire Survey and Analysis

A questionnaire survey was conducted from February 24 to March 10, 2017 under collaboration with the Chamber of Commerce and Industry of Sukagawa (hereinafter CCI). The targeted group comprised 1,156-member enterprises of the CCI. The questionnaires were distributed and collected by post, and 240 valid responses were received (response rate 20.8%). I structured the questions based on the survey by the Cabinet Office (Cabinet Office of Japan, 2016). Table 1 shows the details of the questions.

Table. 6.1 Question items and groups A–G

Question Groups and Questions	Alternatives
A1 Capital A2 Number of employees A3 Industry type	Multiple alternatives
B1 Formulation status of BCP	1. Completed 2. Formulating now 3. Will formulate 4. I know BCP, but, will not formulate 5. Do not know BCP
C1 Past disaster experiences C2 Support and helping action after GEJE	1. Yes 2. No
D1 The level of emphasis between self-help, mutual help, and public help	Three pairwise comparisons
E1 Pro-Environmental actions/behaviors	1. Yes 2. No
E2 Environmental management system	1. Installed ISO14001 2. Installed another system 3. I know ISO14001, but not installed 4. Do not know ISO14001
F1 Participation and Contribution to local society in the business principle F2 Experience of conservation of local natural resources	1. Yes 2. No
F3 Participation to local natural resource conservation in the future	1. Provisioning services 2. Regulating services 3. Cultural services

6.2.2 Hypothesis and Analysis Framework

As this study aimed to seek elements to promote BCP formulation by SMEs in a given area through analyzing the association between their BCP formulation status, environmental management and actions, and local natural resource conservation, the following six hypotheses were set prior to analysis:

Hypothesis 1 (H1): A strong association is observed between BCP formulation status and implementing the environmental management system and environmental actions.

Hypothesis 2 (H2): A strong association is observed between BCP formulation status and participation in local natural resource conservation.

Hypothesis 3 (H3): A strong association is observed between business size (capital, number of employees) and BCP formulation status.

Hypothesis 4 (H4): A strong association is observed between business size (capital, employees) and implementation status of an environmental management system.

Hypothesis 5 (H5): A strong association is observed between BCP formulation status and past disaster experience, especially the amount of direct damage.

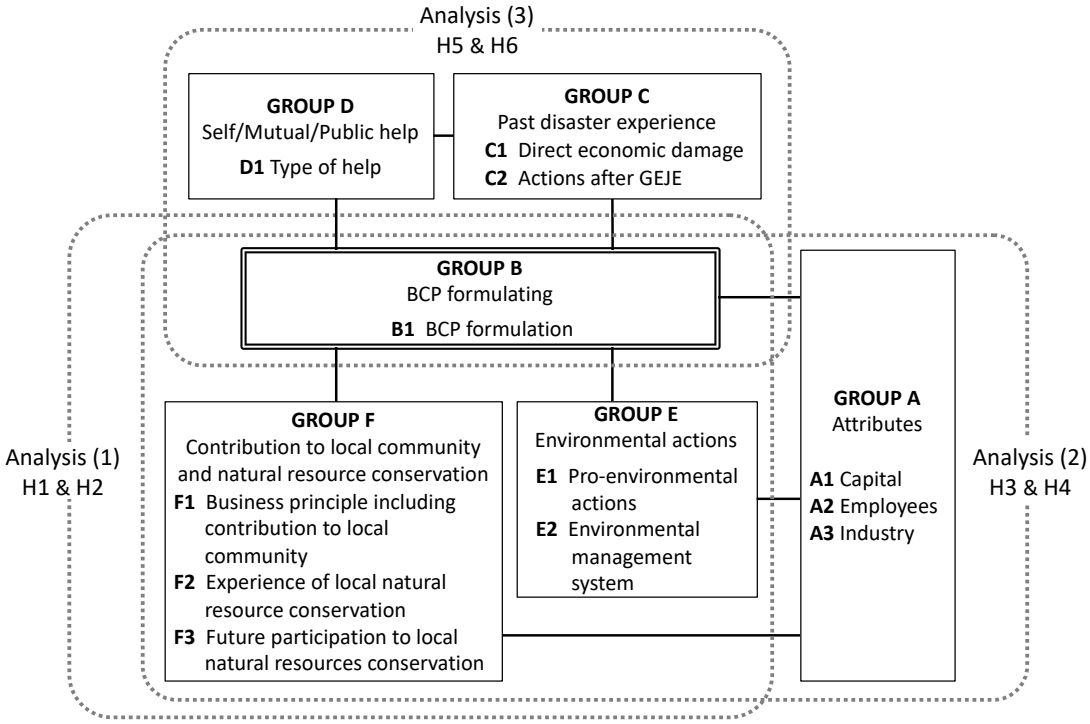
Hypothesis 6 (H6): A strong association is observed between BCP formulation status and emphasizing self-help.

I set up H1 and H2 to determine the relation between BCP formulation status and environmental actions with local natural resource conservation to find key points to promote BCP formulation among SMEs. As noted in section 1.2, enterprises/companies are now required to co-live and collaborate with local society beyond organizational borders in risk management, and to care for local natural resources and implement environment management initiatives from normal time. Regarding SMEs' local natural resource conservation, I employed the concept of ecosystem services by the Millennium Ecosystem Assessment (MA) (Millennium Ecosystem Assessment, 2003) to see which part of local natural resources respondent SMEs were interested in conserving. MA (2003) states that "ecosystem services are the benefits people obtain from ecosystems." I used three ecosystem services, namely provisioning services (e.g., food and water), regulating services (e.g., mitigation of floods, drought, land degradation, and disease), and cultural services (e.g., recreational, educational, cultural, and other non-material benefits).

In addition, I set up H3, H4, H5, and H6. H3 and H4 were to determine whether the association strength differs from that of H1 and H2 and whether the SMEs targeted in this study share the similar tendency of the relation between business size (capital and/or number

of employees), environmental actions and/or natural resource conservation, and BCP formulation status, as noted in previous studies (e.g., Morikawa & Ikeda, 2007; Cruz et al., 2015; Katori, 2014; Tonozaki, 2014). By comparing the results of H3 and H4 with those of H1 and H2, I attempted to ascertain which relation is stronger, because I expected to find key points to promote BCP formulation among SMEs with a small business size. H5 and H6 were set considering the CDMP, BCP, and collaboration in the local community, which previous studies addressed (e.g., Cabinet Office of Japan, 2015; Nishikawa et al., 2007; Isouchi et al., 2014; Sashida et al. 2013). Sukagawa, the study site, has experienced many floods and the GEJE; therefore, it is vital to determine the relationship with the BCP formulation status among SMEs in the area. For the emphasized type of help, I used a pairwise comparison of self-help, mutual help, and public help. Self-help was defined as "support and preparation done by each enterprise"; mutual help as "support and preparation with neighbors"; and public help as "support, preparation, and emergency rescue by public services such as municipality governments, the police, and the fire department."

To examine these hypotheses, the study employed the analysis framework shown in Fig. 6.1. Analysis (1) is for H1 and H2, which consider the relationship between BCP formulation status (B1) and environmental actions with local natural resource conservation (5 variables: E1, E2 and F1, F2, F3). Analysis (2) is for H3 and H4, which consider the relationship between attributes (3 variables: A1, A2, and A3) and BCP formulation (1 variable: B1), as well as the relationship between attributes (A1, A2, A3) and environmental actions and local natural resource conservation (5 variables: E1, E2 and F1, F2, F3). Finally, Analysis (3) is for H5 and H6 to check the relationship between BCP formulation status (B1) and past disaster experiences (2 variables: C1, C2) with the level of emphasis on help type (1 variable: D1).



Source: Created by the authors

Figure 6.1 Analysis framework

First, I overviewed respondents' answers using simple tabulation and cross-tabulation to determine the relation between attributes, status of BCP formulation, help type, pro-environmental behaviors, and participation in local society, especially natural resource conservation. Next, I conducted a Multiple Correspondence Analysis (MCA) to explore the interrelationships between the given sets of variables and to visualize them. I used Cramér 's coefficient of association (Cramér's V) to check the strength of the association.

$$V = \sqrt{\frac{\chi^2}{N(min(r,l)-1)}} \quad \text{.....(6.1)}$$

Equation (6.1) was used to calculate Cramér's V. "*N*" is the number of samples, "*r*" and "*l*" represent the number of rows and columns of the given cross-tabulation, and "χ^2" is

the chi-square statistic. I used IBM SPSS Statistics 25 for the analysis and Microsoft Excel 2016 for the figures.

6.3 Results

I received 240 responses. Regarding business size (capital and the number of employees), 59% had capital of less than 10 million yen and 24% had 11–50 million yen. Furthermore, 70% had fewer than 20 employees (Figure 6.2). Manufacturing industries comprised 19.2% and non-manufacturing 80.8%.

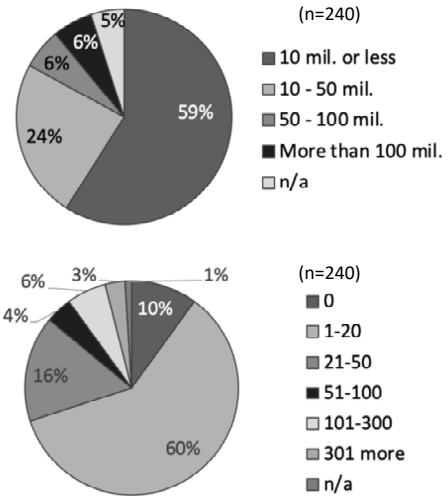


Figure 6.2 Capital (top) and number of employees (bottom) of respondent SMEs

For BCP formulation, only 8.1% had completed a BCP and 3.4% were in the process of formulating one. Including positive responses (will formulate BCP in the near future), 25.1% of SMEs were positive regarding BCP formulation (Figure 6.3).

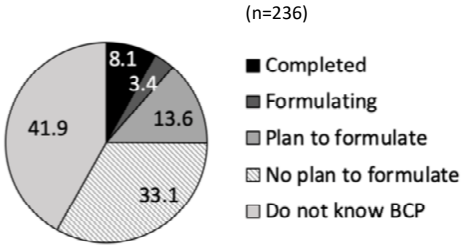


Figure 6.3 BCP formulation status

6.3.1. Analysis (1): BCP Formulation and Consciousness with Local Natural Resources

In general, relatively clear relations were observed between the status of BCP formulation and environmental consciousness and actions by respondent SMEs.

ISO14001 (the international standard that specifies requirements for an effective environmental management system and actions) has been implemented by 23 respondent SMEs, and 7 respondents implemented other systems (e.g., Eco-Action 21, Eco-Stage). As Fig. 5 shows, ISO14001 implementation and BCP formulation were clearly associated. BCP formulation was the highest in the group of respondent SMEs that implemented ISO14001 (34.8%). Including respondents with BCP formulation in progress (26.1%), 60.9% of respondent enterprises with ISO14001 implemented have been tangibly taking actions for BCP. SMEs with other environmental management systems followed at 42.9% (completed (28.6%) and formulation in progress (14.3%). More than half the SMEs that did not know ISO14001 answered that they also do not know about a BCP (55.1%) and have no plan to formulate one, even if they do know about it (31.9%).

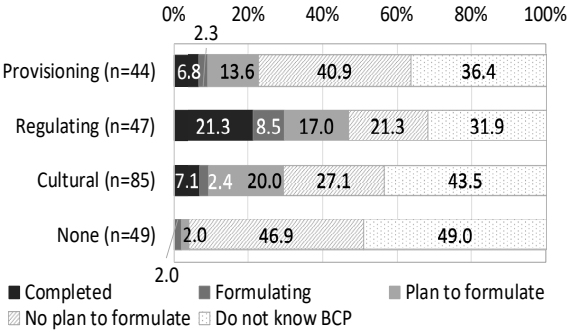


Figure 6.4 BCP formulation and future participation in conservation

Regardless of business size (corporation organization or single proprietor), 66.8% of respondent SMEs included the contribution to local society in their business principles. As a part of their contribution to local society, 40.7% of respondents had participated in conservation activities for local natural resources. The most selected were activities for resources related to cultural services: namely, maintaining recreational places, environmental

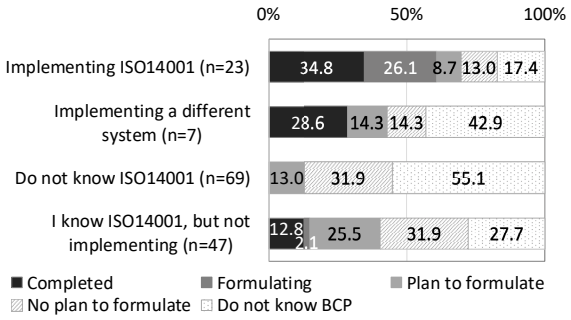


Figure 6.5 BCP formulation and ISO14001

education, landscape, or folk/cultural heritage. Figure 6.4 shows the relation between participation in local natural resource conservation and BCP formulation. The most selected conservation activities (n=85) were those for cultural services. For the relation with BCP formulation, positive answers for BCP formulation ("completed," "formulating," and "plan to formulate") were highest for the group of respondents that selected conserving resources related to regulating services for their future participation. Resources included in regulating services are reducing CO_2 emission and conserving river water quality and aquatic plants/animals. The reasons many respondents gave for this include recognition as a member of local society or using such resources (water, air) to sustain their business. Thus, they feel responsible for treating them appropriately. On the other hand, some responses indicated no interest in participating in local natural conservation in the future. Of this group, 95% responded that they either had "no plan to formulate" or "do not know BCP." This tells us that respondent enterprises that acknowledge and care about local society and natural resources are also aware of disaster risk preparedness.

6.3.2. Analysis (2): Attributes, BCP and Consciousness with Local Natural Resources

The cross-tabulation between attributes (capital, number of employees) and BCP formulation status indicated a very clear relation. The greater the capital of SMEs, the higher was their BCP formulation rate. More than 70% of respondents with more than 101 million

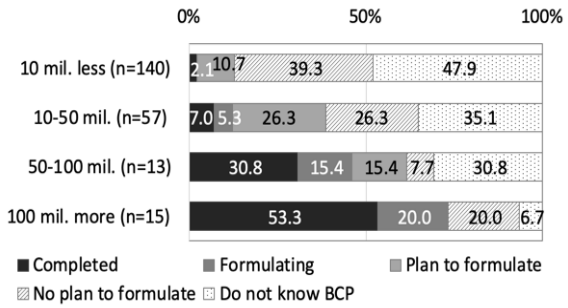


Figure 6.6 BCP formulation and capital

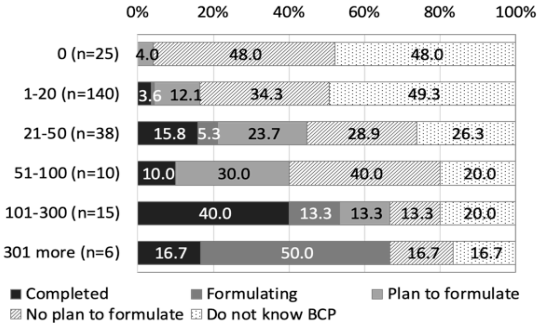


Figure 6.7 BCP formulation and employees

yen of capital had already worked on formulating a BCP (Fig. 6.6). Regarding the number of employees and BCP formulation, the formulation rate at respondent SMEs with more than 100 employees was higher than that of the others. Nearly 70% of these indicated "completed," "formulating in progress," or "will formulate in the near future." However, the BCP formulation rate was only around 10% among small enterprises with less than 50 million yen of capital or fewer than 50 employees. More than 80% of these respondents responded "will not formulate BCP" and "Do not know BCP" (Fig. 6.7).

Furthermore, 70% of respondent enterprises were very small with less than 20 employees, and of these 10% had no employees or were a single proprietorship. The cross-tabulation between corporation organizations and single proprietorships showed a clear gap in BCP formulation. No single proprietorship indicated having "completed BCP" or that they were "formulating a BCP." Manufacturing industries had a relatively higher ratio of BCP formulation status, especially those in electric appliances ("completed" 42.9%, "formulating" 14.3%), oil/rubber/ceramics ("completed" 20.2%, "formulating" 0%), and iron/steel ("completed" 16.7%, "formulating" 16.7%). Actually, financing and insurance had the highest ratio of having "completed" the BCP (50%), although one had not been formulated in other non-manufacturing industries.

As mentioned (Section 2.3.), I categorized local natural resources based on the Ecosystem Services (MEA) as follows: provisioning services (e.g., food and water), regulating services (e.g., mitigation of floods, drought, land degradation, and disease), and cultural services (e.g., recreational, educational, spiritual, and other non-material benefits). The survey asked respondents which category of conservation activities they were interested in being involved in in the near future. The most selected activities were cultural services (maintaining recreational places, environmental education, or folk/cultural heritage). The cross-tabulation between capital size and conservation preference showed that the ratio of

selecting provisioning services (food, drinking water, woods, and energy) was higher among small enterprises with capital of less than 50 million yen. Regulating services (river water quality, conserving aquatic plants/animals) were selected by larger enterprises with capital of more than 51 million yen. The ratio of enterprises with no interest in the conservation of local natural resources was higher (28.8%) among the group of the smallest enterprises (Figure 6.8).

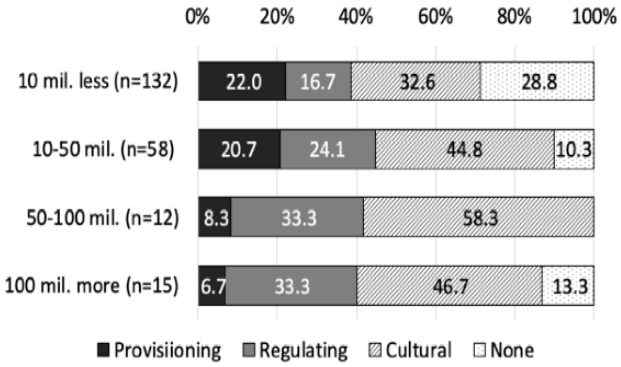


Figure 6.8 Capital and local natural resource conservation (ecosystem services)

6.3.3. Analysis (3): BCP Formulation, Past Disaster Experiences, and Types of Help

Past disasters caused by natural hazards experienced by respondent SMEs were earthquakes (197 enterprises); floods (30); storms (21); and landslides (1), drought (1), and others (1) (multiple choices). Among them, GEJE was the latest and largest disaster that negatively impacted their business: 27.8% received direct damage of up to 500,000 yen and 12.1% responded that they had more than 30 million yen of direct damage. The cross-tabulation with BCP formulation revealed that the answers "completed" and "formulating" were almost equally provided in each direct damage group (Figure 6.9).

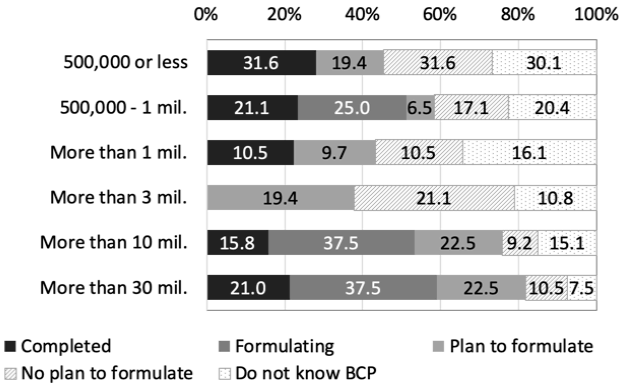


Figure 6.9 BCP formulation and direct damage by GEJE (in Japanese yen)

The BCP is a primary set of instructions to be prepared by each enterprise or organization regarding actions to take and responsibilities and roles to perform in an emergency. The authors expected that compared to others, enterprises emphasizing self-help would have completed or be formulating a BCP. In total, 73% (162 respondent SMEs) emphasize self-help over other types of help; however, the cross-tabulation with BCP formulation status showed that the group emphasizing mutual help had the highest ratio of BCP formulation ("completed" 11.8%, "formulating" 5.9%). The ratio of "no plan to formulate" was the lowest in the group emphasizing mutual help as well (Figure 6.10). In addition, approximately half of the respondent SMEs answered that they were committed to supporting neighbors or volunteer work in the city regardless of the size of capital, number of employees, or type of industry.

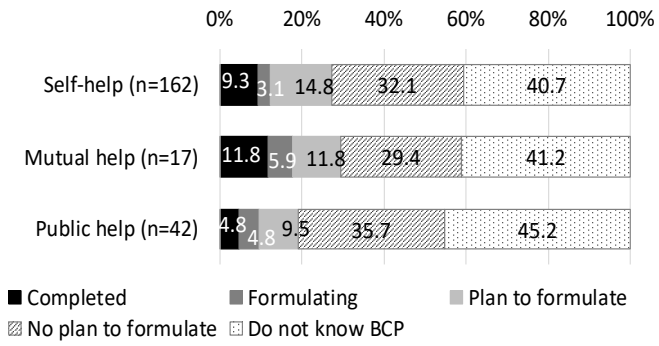


Figure 6.10 BCP formulation and type of help

6.3.4. Strength of Associations

I analyzed the results of the cross-tabulation using an MCA and Cramér's V to determine the strength of their association. I used the following variables in the MCA: BCP formulation status, type of help emphasized, ISO14001 implementation status, and participation in local natural resource conservation in the past and future.

Figure 6.11 shows the results of the MCA. Three groups can be observed: group A (broken line), group B (dotted line), and group C (chain line).

Group A is respondents that completed or were in the process of formulating the BCP, already implemented ISO14001, and are interested in participating in conserving the local natural resources of regulating services. Based on the results of the cross-tabulation (Fig. 7, 8, and 9), likely, the size of the business of respondents in group A is bigger than the other targeted enterprises. The respondents in Group B have not formulated a BCP yet, but are planning to do so. They have implemented environmental management systems other than ISO14001 or have some knowledge about ISO14001 despite not implementing it yet. They also have experience participating in conservation activities for local natural resources in the past and will do so in the future, preferably for resources related to cultural services. Mutual help is located closest to this group. Group C comprises respondents that are either negative or without knowledge/information on BCP and environmental management systems. They tend to be reluctant (or indicate no interest) in participating in the conservation of local natural resources.

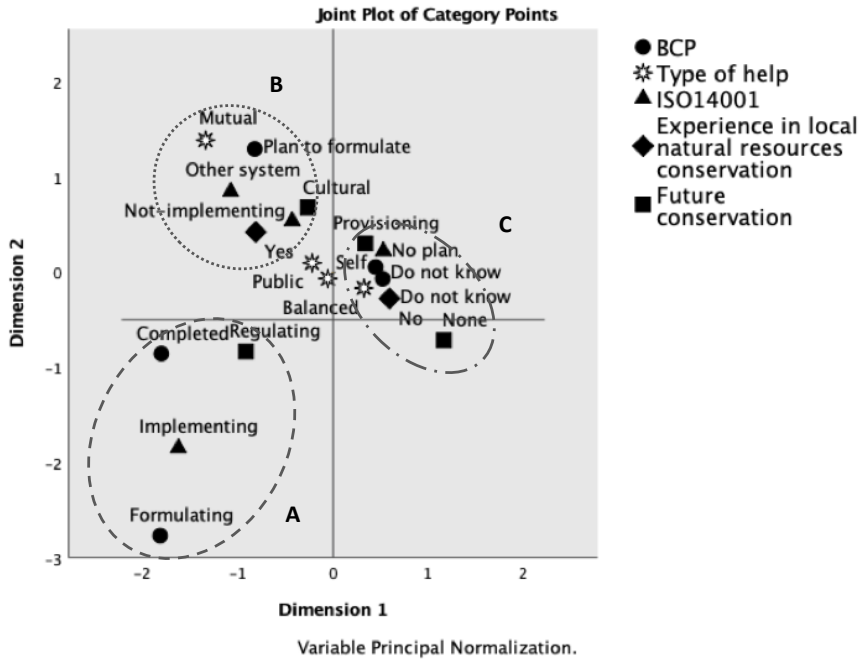


Figure 6.11 Multiple Correspondence Analysis between BCP formulation, type of help, ISO14001, and past and future participation in local natural resource conservation

In Fig. 12, groups A and B are located in the left half while group C is on the right half. This means that SMEs with a social responsibility mindset or that contribute to local society are more likely to have formulated a BCP. In addition, they have knowledge and information on both BCP and environmental management systems, and have managed to take tangible actions to achieve it. In fact, mutual help is located in the same left half.

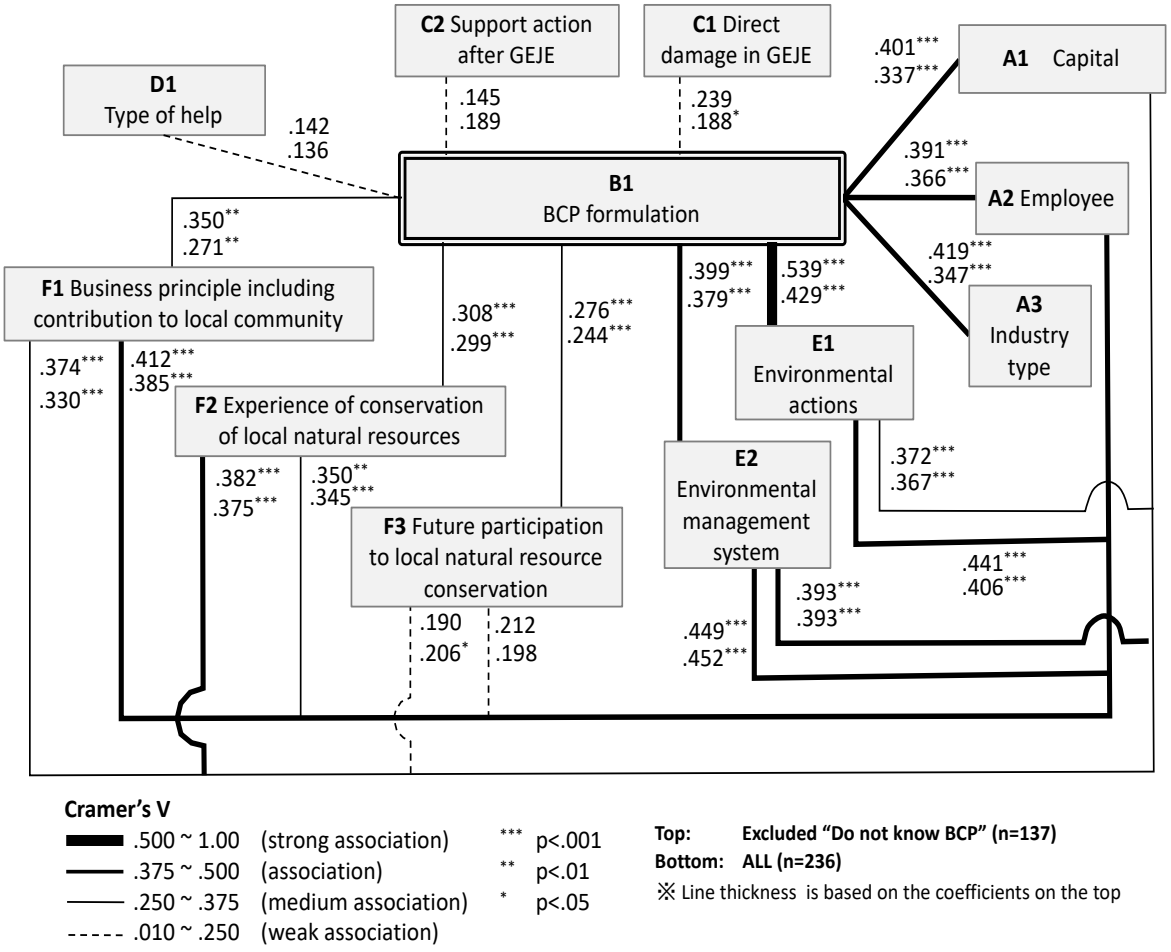


Figure 6.12 Strength of association by Cramér's V

Fig. 13 provides the results of Cramér's V. I examined the strength of association among the factors. Cramér's V is between 0 and 1. Its calculation results are usually low, and 0.1 can be considered the threshold of association (Suga, 2016). I set four levels for the coefficient: "strong association" when V≥.500, "association" when .500>V≥.375, "medium association" when .375>V≥.250, and "weak association" when .250>V≥.100 for clearer

distinctions. I calculated the two Cramér's V coefficients for indices: one was calculated with all valid samples (n=236), and the other without the "Do not know BCP" respondents (n=137). The first is displayed on the bottom, and the latter on the top in Fig. 13. The coefficient of association overall became higher when calculated without the group "Do not know BCP."

Table. 6.2 Strength of Association with BCP Formulation Status by Cramér's V (n=137)

Strong	▪ Environmental actions (E1)	.539***
↑	▪ Type of industry (A3)	.419***
|	▪ Capital (A1)	.401***
|	▪ Environmental management systems (E2)	.399***
|	▪ Number of employee (A2)	.391***
|	▪ Business principle with contribution to local community (F1)	.350**
|	▪ Experience of conservation of local natural resources (F2)	.308***
|	▪ Future participation to local natural resource conservation (F3)	.276***
|	▪ Direct damage in GEJE (C1)	.239
|	▪ Support actions after GEJE (C2)	.145
↓	▪ Type of help (D1)	.142
Weak		

*** p<.001 ** p<.01

As hypothesized in H1, a strong association (.539***) was observed between BCP formulation (B1) and environmental actions (E1). This was the strongest association of all. Environmental actions (E1) had an association with capital (A1) (.401***), number of employees (A2) (.441***), and industry type (A3) (.419***), but the strength of these was less than that of environmental actions (E1). Thus, environmental action (E1) has a stronger association with BCP formulation (B1). An environmental management system such as ISO14001 (E2) (.399***) also demonstrated a stronger association with B1 than number of employees (A2). Regarding H2, the association between BCP formulation and the experience of participation in local natural resource conservation (.308***) was "medium." Furthermore, future participation had a slightly weaker association with B1 (.276***).

Overall, for H3 and H4, I observed the association between business size (A1, A2) and both BCP formulation (B1) and environmental actions (E1) and environmental management system (E2). Number of employees (A2) demonstrated associations with environmental actions (E1) (.441***), environmental management system (E2) (.449***), experience of conservation of local natural resources (F2) (.382***), and business principles including contribution to the local community (F1) (.374***), which were significant.

Disaster experiences (C1, C2) and emphasized type of help (D1) demonstrated only weak associations (.239, .142, .145) with BCP formulation (B1), despite H5 and H6, although their coefficients were not statistically significant.

6.3.5 Occurrence Probability

At last, I examined the occurrence of probability of BCP formulation out of environmental related indices.

Table 6.3 Occurrence Probability of BCP formulation by Logistic Regression

Environment related indices							95% C.I.for EXP(B)	
	B	S.E.	Wald	df	Sig.	**Exp(B)**	Lower	Upper
Interest in local natural resources conservation	2.039	1.324	2.37	1	0.124	**7.681**	0.573	102.95
Local natural resources to conserve	0.782	1.265	0.382	1	0.536	**2.187**	0.183	26.108
Contribution to the local area and business principle	-0.377	1.296	0.084	1	0.771	0.686	0.054	8.696
Awareness-raising in working place	-0.394	1.092	0.13	1	0.718	0.674	0.079	5.735
Future conservation	-0.73	0.438	2.771	1	0.096	0.482	0.204	1.138
Experience in local natural resources conservation	-0.868	0.713	1.479	1	0.224	0.42	0.104	1.7
ISO14001	-0.88	0.28	9.892	1	0.002	0.415	0.24	0.718
Environmental actions	-1.187	1.35	0.774	1	0.379	0.305	0.022	4.299
Outcomes of environmental actions	-1.305	1.106	1.393	1	0.238	0.271	0.031	2.368
Constant	4.679	2.177	4.621	1	0.032	107.69		

The indices of "interest in local natural resource conservation" and "whether they have any specific local nature resource to conserve or not" showed the highest expectation, but not significant. The rest of environment related indices did not return any expectation of occurrence probability (Table 6.3).

6.4 Discussion

The results of the MCA and Cramér's V showed that BCP formulation status was strongly associated with environmental actions and environmental management systems. A medium association was also observed with participation in local natural resource conservation (Table 2). Thus, H1 regarding environmental action was adopted. H2, H3, and H4 were partly (association was observed, but not strong ones as hypothesized) adopted, following previous studies (e.g., Cabinet Office of Japan, 2015; Katori, 2014; Tonozaki, 2014). For H5 and H6, only weak associations were observed between direct damages in GEJE and BCP, which follows Haraguchi et al. (2016), who emphasize the extent of damage and disruption as key factors in BCP implementation and that those do not seem to encourage SMEs to work on autonomous pre-disaster measures. Thus, H5 and H6 were rejected.

Although it was found that environment-related actions have strong or medium associations with BCP formulation status, this does not necessarily mean that taking environmental actions would lead SMEs to autonomously work on formulating a BCP. This section discusses how these results can be interpreted and how they lead to the key for the further promotion of BCP formulation among SMEs as well as local sustainability.

6.4.1. Toward Promoting BCP Formulation Among SMEs

6.4.1.1. Collective action to overcome the limited number of staffs

Further information dissemination on BCP is a must, as nearly 42% of respondent SMEs indicated that they "Do not know BCP." However, providing information on BCP is not enough, especially for micro and small-size enterprises. In total, 70% of respondent SMEs have less than 20 employees or are single proprietors. It would not be easy for them to formulate a BCP on their own, even if they have information.

This may lead to the option of collective action for formulating a BCP, especially for micro and small-size enterprises. Here, 73% of SMEs emphasize self-help, but three-quarters have not yet formulated a BCP. Most respondent SMEs have recognized that preparations are important, but have not been able to take any tangible actions despite such cognition. With the problem of a limited number of staff, collective action would be a constructive option. For this, information on a simplified version of the BCP (Aichi Prefecture, 2008; Shiga Committee for Economic Development, 2013) as reference should be given to SMEs by organizations such as the CCI.

It is also important to emphasize BCP as a contribution to local society. This finding showed that contribution to local society in their business principles was associated with BCP formulation status, which supports it. To not load the task of BCP formulation onto individual SMEs, especially micro and small-size enterprises, the intentions of SMEs to contribute to local society can be more emphasized. This approach would reinforce cooperation and mutual help among SMEs within the city.

6.4.1.2. BCP with a philanthropic responsibility viewpoint

BCP formulation status had a strong association with environmental actions. For most enterprises, environmental actions are not the primary objective, but environmental actions

would most likely come under enterprises' philanthropic responsibility (be a good corporate citizen, provide for community betterment, or engage in volunteerism) (Carroll and Buchholtz, 2003). These environmental actions demonstrated a strong association with the BCP formulation "required and expected" by society.

In fact, most SMEs selected the local natural resources of cultural services (cleaning and maintaining recreational places, environmental education, protecting folk/cultural heritage) as seeming easier for them to work on. In addition, many SMEs with a completed/in progress BCP selected conserving the resources of regulating services (reducing CO2 emission, water quality, and aquatic habitats), as they use these local natural resources to keep their business running; thus, they feel obliged to take good care of it in the future. The association between BCP formulation and local natural resource conservation was not as strong as for environmental actions or management systems; nevertheless, these imply their spirit of being "good enterprise citizens" and of caring for local society. Thus, it would be more appealing for SMEs to perceive BCP from a philanthropic responsibility viewpoint so that there would be more positive understanding and actions for formulating BCP moving forward.

6.4.2. Promoting BCP Formulation and Local Sustainability

To summarize the above, the BCP by micro enterprises and SMEs should be formulated through collective actions with a hint of philanthropic responsibility. This would reinforce and provide tangible content to concepts such as the district continuity plan (Nishikawa et al. 2007; Isouchi et al., 2014; Hatakeyama et al. 2013), area business continuity planning (Okabe and Nagahira, 2013), or business continuity within a public-private partnership (Baba et al., 2015), all of which have been proposed in the last decade.

When collective actions are taken by micro and SMEs for BCP formulation from a philanthropic viewpoint, they will be recognized within disaster risk reduction in local society as “good enterprise citizens.” When BCP is implemented in a vis-à-vis relationship, it should be effective in an emergency case, meaning SMEs would more rapidly recover, helping them secure their crucial business and employment after a disaster occurs. This will ultimately benefit the local economy. As pointed out by previous studies, it is crucial for each enterprise to develop a company culture of having a BCP for quicker recovery (Blanke and McGrady, 2012) and norm of caring for local society from normal times (Yaguchi, 2015). The findings of this study provide a tangible approach that considers BCP part of mutual help to establish a culture of having a BCP and the notion of caring for the local environment and natural resources based on a sense of being a member of local society from normal times. The findings will also help both SMEs and local society build a seamless attitude toward disaster risk reduction and environmental conservation, which will contribute to local sustainability.

However, further studies on covariance and/or a regression analysis are needed to clarify the causality and occurrence probability of formulating a BCP through environmental actions/consciousness.

6.5 Summary

First of all, BCP is needed to be disseminated more widely and more thoroughly to SMEs as an important means to protect their business. However, it does not necessarily be formulated at individual business owners. Rather it can be formulated within collaboration. The enterprises with BCP completed also care and pay good attentions to the neighboring natural resource conservation as social responsibility. Based on the analyses, I have drawn the following conclusions:

Collective actions:

- Information on BCP is to be provided more thoroughly to SMEs, especially single proprietors and small-size enterprises
- Some organizations such as the CCI can play the role of a hub to help SMEs take collective action to formulate a BCP.
- Simplified versions of a BCP can be introduced so that more micro enterprises and SMEs can adapt them to their local circumstances.

BCP with a philanthropic responsibility viewpoint:

- It is key to send the message that BCP is as important and required by society as are environmental actions.
- Use local natural resources such as water, the landscape, and recreational places as key points by which to attract the attention of SMEs to promote a culture of developing pre-disaster measures and strengthen the connection within society. These local resources were those most selected by respondent SMEs as conservation activities in which to participate.

Notes

1 Suga (2016) divides Cramér's V to clarify the strength of association: .25 > V ≥ .1 (weak association), .5 > V ≥ .25 (association), and V ≥ .5 (strong association). As many results of Cramér's V in this study fall into the middle level (.5 > V ≥ .25), I further divided the middle level into two: .5 > V ≥ .375 for association and .375 > V ≥. 25 for medium association.

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CHAPTER 7

Disaster Preparedness and Local Ecosystem Conservation – Municipality

7.1 Introduction

This chapter deals with the actions and institutions on "*machi-zukuri* (city development) vision." The purposes of this chapter are 1) to find what countermeasures have been implemented and being planned for disaster risk reduction, 2) to consolidate the outcomes of questionnaires and the policy implementations, and 3) to find the current status of *Nanohana* Project, especially Bio-Diesel fuel purification and its use as well as constraints

7.2 Methods

In order to pursue the purposes given above, I used document analysis, map geoprocessing, and interviews. As for document analysis, I used the official documents, reports issued by the municipality government of Sukagawa City, in particular focusing on past disaster experiences and ongoing strategies and policies for disaster risk reduction. Regarding geoprocessing, I used ArcGIS (Esri) ver. 10.1 and base data downloaded from the Geospatial Information Authority of Japan (GSI) website. I had several interviews with the municipal officers of Department of Life Security and Environment of the Sukagawa city government. Below are the dates and the officers I interviewed.

1. May 24th, 2015 Section Head of Life Security
   Officer of Life Security
2. July 10th, 2017 Director of Department of Life Security and Environment
   Section Head of Environment Section
3. March 11th, 2019 Section Head of Environment Section
   Senior Officer of Life Security Section
   Officer of Life Security Section (in charge of DRR programs)

The purpose that I chose these methods (document analysis, interviews, and mapping) was to whether, and how, the municipality had grasped the current status of citizens' preparation behaviors, had recognized the ecosystem-based approach for DRR, with using place-names as a part of culture in the city as well as to find some niches to integrate pro-environmental actions and disaster risk preparation in the city. The concept of Eco-DRR or ecosystem service is not well-known, and neither is the role of ecosystem service in DRR readily understood by many of local governments (UNDRR, 2017). I hypothesized that 1) they may not grasp the citizens' preparation status, 2) they have not known ecosystem-based approach such the concept of Eco-DRR, and do not have tangible strategies yet and 3) they have the viewpoints of local ecosystem conservation within the Nanohana Project toward the recycling society and are going to keep implementing it.

7.3 Results

7.3.1 Trajectory of Countermeasures for Disaster Risk Preparation

Document analysis and interviews to city officials revealed their major disaster risk preparation: river improvement, revising and disseminating hazard map, as well as storages of stocks for three days.

The largest countermeasure for DRR was the river development of the Abukuma River and the Shakado River, both A-Class rivers (Figure 7.1 and Figure 7.2) as well as building Hamao Flooding Pond as a means of ecosystem-friendly flood control. These constructions were led by the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT). The city officials call them 'the Large Improvement in Heisei Era' that should prevent the river water flooded in case of rainfall once a thousand year (Section Head of Life Security Section and Officer of the Section, interview, May 24, 2015). According to the officials, they had some minor flooding in the city after the completion of the river banks and the pond completed, they were not from the two A-Class rivers but from the small streams or due to errors of the pumping system equipped at those streams (Section Head of Life Security Section and Officer of the Section, interview, May 24, 2015).

Their hazard map was revised in 2012. The revised hazard map was included in *bosai* guide issued by the municipality and distributed to all the households in the city in March 2016 (Section Head of Life Security, interview, May 24, 2015). They have been working on the revising the hazard map to consolidate the hazard map (in particular, landslides risks) issued by Fukushima Prefecture. It was told that they will complete and open to the public in a few years (Director of Department of Life Security and Environment, Section Head of Environment Section, interview, July 10, 2017). In the meanwhile, they established City Emergency Management Headquarter in the City Hall in 2016. In 2009 and 2010, they held

the study meeting for flood preparedness to mull over the preparation by local district (autonomous community level) with representatives from five districts (about 6 representatives per district, about 30 participants in total) (Director of Department of Life Security and Environment, Section Head of Environment Section, interview, July 10, 2017).

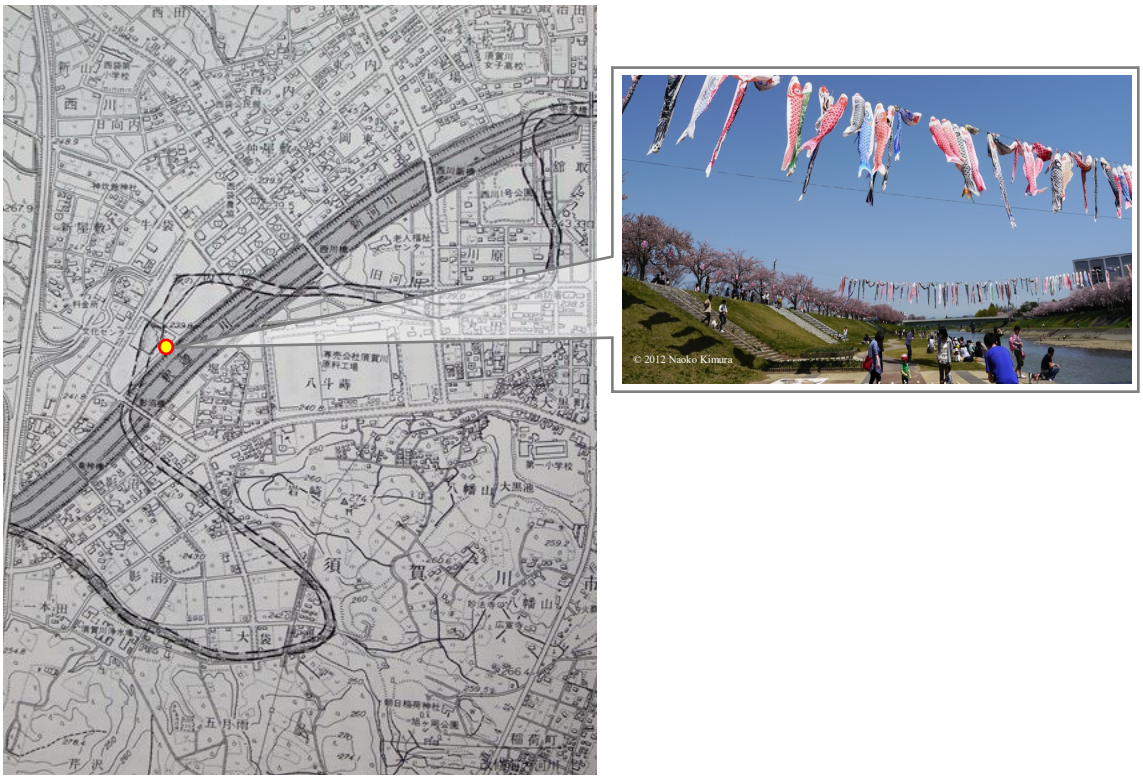

Figure 7.1 Before and After the river improvement of the Shakado (Source: Sukagawa 50th Anniversary of Water Supply (1988))

When the Basic Act of Disaster Management was amended in 2013, Community Disaster Management Plan was added and recommended to be formulated at local community level. Until today, 44 communities have worked as Community disaster Management models (Cabinet Office). In case of Sukagawa city, they have just started to hold study meetings as mentioned above, none of communities have tangibly completed a systematic Community Disaster Management Plan yet. Hence, the municipality is trying to encourage them to finish

formulating one (Director of Department of Life Security and Environment, Section Head of Environment Section, interview, July 10, 2017). I also asked how they had used place-names and past disaster records in disaster risk preparation. Although the officers know such documents exist and stored in the city library, such historical experience records had not been in tangible use for disaster risk reduction and preparation among the municipality work nor promoting awareness of disaster risks among citizens.

7.3.2 Trajectory of Countermeasures for Raising Awareness of Disasters and Promoting Preparedness

Regarding further awareness-raising of disaster awareness among citizens, the municipality started to pool *bosai* experts, so-called '*Bosai-shi*' with a certificate of DRR. They established a Non-Profit Organization (NPO) in the city to pool the citizens with the certificate and send them as lecturers or instructors to seminars and/or workshops in communities or organizations based on requests. The NPO has 64 experts registered as member (as of March 11, 2017) (Senior Officer and Officer of Department of Life Security Section, interview, March 11, 2017). I researched some references on place-names from publications (e.g., Takakuda, 1985) and interviewed local people and local community groups working for local cultural history. Their knowledges and studies have only been in some books or bulletins in the library shelves. I studied the local place names and expressed using GIS. Figure 7.2 is the results of GIS geoprocessing. This clearly shows that there are some districts that used to have water-related names (the area with purple stripes) as it experienced frequent floods. Superimposing these areas with possible inundation zones in the current hazard map, one-third of such areas overlap. A few districts perfectly match the old river flow and still have water-related place-names today (the areas with light blue stripes), however,

the areas are away from the current river course because the river course was changed due to river improvement.

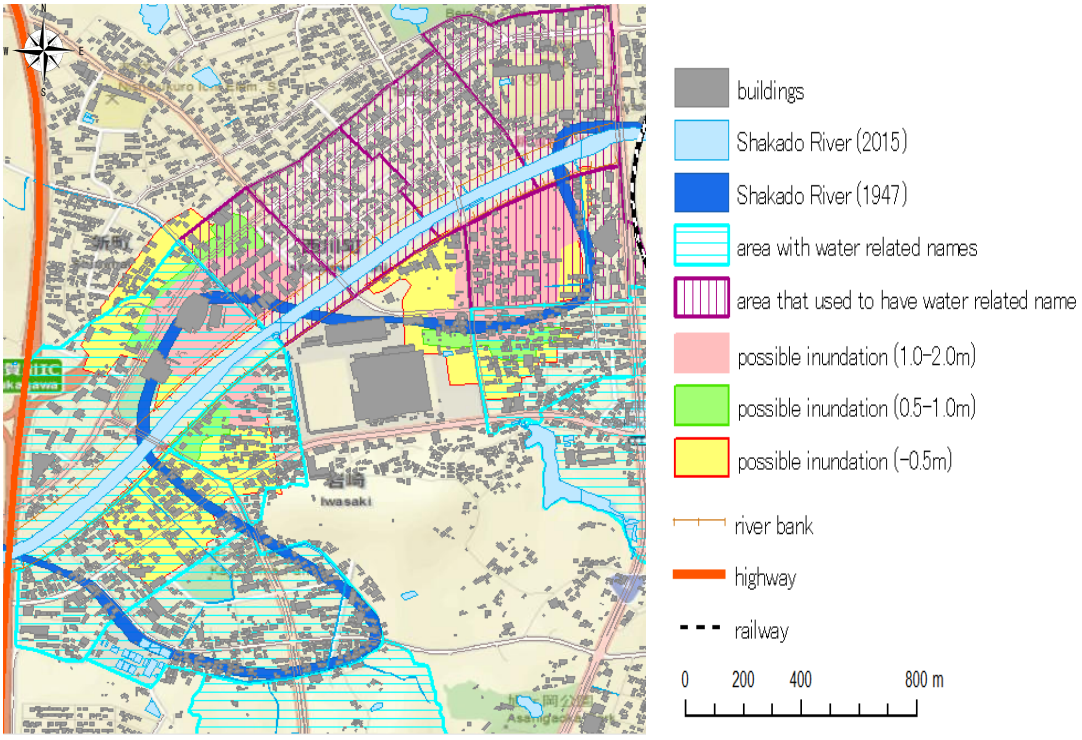

Figure 7.2 The same area expressed with GIS (superimposing the old river and improved river, and place-names related floods (light blue strips)

7.3.3 Trajectory of Countermeasures for Environmental Conservation

Document analysis and interviews to city officials clarified that major environmental conservation have shifted to the focus on reducing the carbon emission or low-carbon-society, and the city's environmental conservation and disaster risk preparation have been paralleled.

As mentioned in Chapter 3, they have implemented "*Nanohana* Project" aiming to realize the recycling-society since 2007 (Sukagawa City website). They produced organic cooking oil and bio-diesel fuel (BDF) out of Nanohana flowers grown in the unused agricultural lands, and the lees after squeezing oil was given to livestock. They have also produced BDF out of used cooking oil collected from households. This BDF was used to

garbage collecting car of the city (see also Chapter 3). The execution organization of the project is local NPO "*Habatake Yume Hiko 21*." According to the President of NPO, on the occasion of gasoline shortage after GEJE, the city managed to drive all the city garbage collecting cars with the BDF, thus there was no garbage bags that had long waited to be picked up and managed to keep cleaner conditions even in the devastating experience (Oyagi, K. Interview, May 23 2015). However, as these days the car engines have been far much developed and become delicate, the Nanohana BDF have become incompatible with the latest model of engines. Hence, they most likely will not use the BDF for their public vehicles any more in the future (Section Head of Environment Section, Interview, March 11, 2019). As for local ecosystem conservation, the municipality has meetings from representatives (5-7 students in each meeting) in order to collect their candid voices and opinions regarding local ecosystem or general environmental conservation in the city (Sukagawa City, 2013; 2018).

7.3.4 Consolidation of the Countermeasures and Questionnaire Results in Preceding Chapters

On the occasion of the meeting and interview on March 11, 2019, I presented the questionnaire survey results responded by citizens. The municipal officers were surprised to learn the only 31.6% of citizen respondents recognizing their *bosai* guide (hazard map). The result of correlation between natural environment and ecosystem service indices and disaster preparation behaviors seemed to be a good stimulus for further discussion. An example idea that we agreed in the meeting was to use that public recreation places for awareness-raising and promoting preparation behaviors in the meeting. Based on the finding of the correlation between citizens' interest in cultural services (e.g. maintaining folk heritages and recreation places) and some preparation behaviors (see Chapter 5, Section 6.3), our discussion came up to an idea to build emergency goods storages in recreation places. The municipality invites

children in the city to think of a slogan for promoting disaster preparedness and paint the slogans upon the storage walls with their painting. This would give a unique opportunity for children to be catalysts of promoting preparedness and DRR in the future.

7.4 Discussion and Summary

Through the document analysis, interview and mapping with GIS, it was found that the hypotheses 1) and 2) were supported. The citizens' disaster risk preparation was lower than they expected. The concept of ecosystem-based DRR such as Eco-DRR has not been known yet among city government officials. The city's development strategies "*Machi-zukuri* vision" in both 2013 and 2018 have no mentioning on the relation of DRR and ecosystem service functions, hence the concept of ecosystem-based approach for DRR has not been included in their DRR strategies. Hypothesis 3) was not supported. Environmental conservation has been perceived as maintaining landscape and/or realizing low-carbon-society. Also, Nanohana Project and its BDF will most likely be dwindled in Sukagawa city due to the running cost and social-technological changes.

The municipality have taken some initiatives to raise awareness and promote preparedness for disaster risks. They do not have tangible means to learn the progress of their initiatives targeting citizens. Meanwhile, the municipality officers well recognized the trend of place-names in the disaster risk reduction and management, however they have never used historical references such as place-names for promoting awareness. The place-name study by local historian (Takakuda, D.) and his publication on village names in Sukagawa city from the Edo era can be more utilized. They send out *bosai* experts for seminars and workshops, they could be an option to include the excerpts or essence from Takakuda's work or any other references on historical disasters in their talks or workshop contents. By doing so, bosai

experts whose average age is around 65-year-old can play a catalyst of important messages from the municipality to the wider population, or even to younger generation if they give seminars/ workshops at school or children's groups.

In short, it is the key to include the local historical disasters and people's efforts as local culture that represents the characteristics of their local area. Then, people may become interested in historical disaster topics as the analysis of this study found that their willingness to conserve cultural services of local ecosystem has association, furthermore, they are correlated and the occurrence of some preparation behaviors is expected.

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CHAPTER 8
Discussion

8.1 Introduction

This chapter discusses and interprets the results of correlations in the preceding chapters. I interpret the results shown in Chapter 4 (youth), Chapter 5 (citizens), Chapter 6 (small and medium-sized enterprises), and Chapter 7 (municipality) before leading to the final recommendation toward building a culture of disaster risk reduction for local sustainability.

8.2 Key findings of This Research

8.2.1 Ecosystem service as an effective topic for recognition of linkages (Chapter 4)

It was found that Ecosystem Services (ES) can be an effective topic to review and develop concepts of socio-economic as well as socio-ecological connections as individuals.

The workshop approach using the concept of ES should help participants understand the linkages between their daily lives and local ecosystem. ES of local natural resources can also be the source of recognition to the two sides of nature (benefits and disaster risks), which facilitates understanding local characteristics. This can be applied in consensus building processes in local natural resource conservation and sustainable development planning with a hint of disaster risk reduction viewpoints. For youth, discussion on local ecosystem conservation can play an opportunity to meet various ideas and opinions, to recognize social-ecological system, and to learn that they are living in the system.

8.2.2 Correlation between disaster risk preparedness and local ecosystem conservation – Citizens (Chapter 5)

The correlation and occurrence probability between disaster risk preparation behaviors and environment-related indices such as local ecosystem conservation was observed. The local ecosystem conservation, especially willingness to participate to cultural/folk heritages conservation (cultural services of ES), is correlated to disaster risk preparation behavior with occurrence probability with significant expectation. Also, willingness to take pro-environmental actions had the most associations with preparation behaviors (fixing furniture, having plural information sources for emergency, talking about emergency responses with family, checking routes to the nearest shelter, participating to emergency drills, and First aid/AED seminars). Not all of those were strong enough to lead to occurrence probability, this finding is the key to promote Eco-DRR in the future. Whereas past direct disaster experiences did not have very clear correlation with preparation behaviors, indirect disaster experience (seeing the disaster site) rather returned significant expectation of preparation behavior occurrence. Subjective resources such as knowledge of DRR showed the most expectations with preparation behaviors eventually, knowledge of environmental conservation also showed the second most occurrence probability.

By and large, it has been indicated that people who pays attention to cultural aspects of their local area and voluntary involvement have taken disaster risk preparation behaviors themselves as self-help. It can be said that they may have seen themselves objectively within the linkage of the domains in the structure of socio, eco, and geo levels (Figure 8.1). This may lead them to take individual disaster risk preparation as an issue of local society as they perceive cultural services of local ecosystem as the characteristics of their area. The city and citizens experienced GEJE in 2011, but the correlation and association of interest in

conserving ecosystem services or local natural places were stronger enough than direct disaster experience to have people take preparation behaviors. Knowledge of environmental conservation as subjective resource also showed as strong correlation as knowledge of DRR or local historical disasters. This was supported by the occurrence probability of disaster risk preparation behaviors with environment-related indices. Thus, it is reasonable to say that disaster risk preparation should be promoted not only as self-help but also as mutual help of the whole local society.

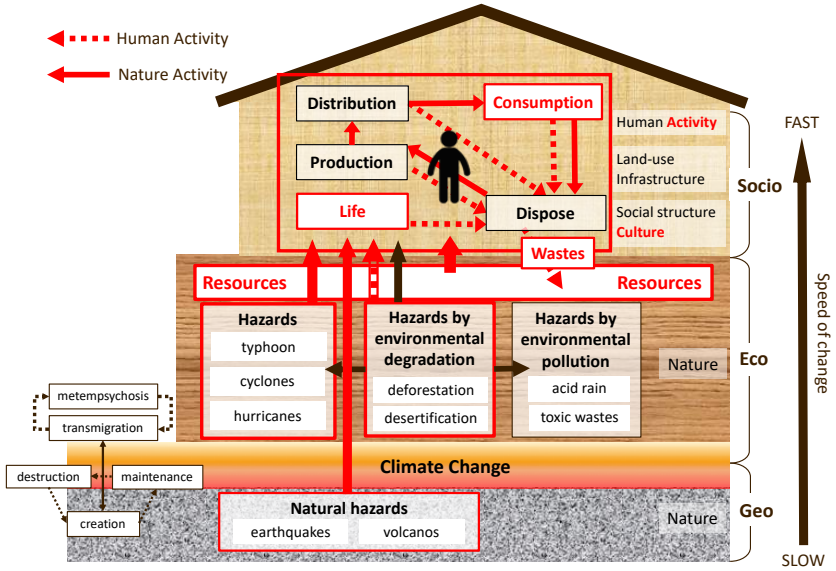

Figure 8.1 Domains of citizens' recognition to linkages within the levels of socio, eco, geo (Created by author based on Hagihara, 2006; Okada et al., 2006)

8.2.3 Correlation between disaster risk preparedness and local ecosystem conservation – SMEs (Chapter 6)

BCP is needed to be disseminated more widely and more thoroughly to SMEs as an important means to protect their business. It can be formulated within collaboration as collective actions. Information on BCP is to be provided more thoroughly to SMEs, especially

single proprietors and small-size enterprises. Simplified version of BCP can be a good start for many micro enterprises with some support by organizations such as the CCI.

Another finding was that BCP can be perceived with a philanthropic responsibility viewpoint. It is key to send the message that BCP is as important and required by society as are environmental actions. Many SMEs that had completed formulating BCP or been in the process of formulation had interests in conservation of regulating services (e.g., water quality, wetland conservation) of the local ES or cultural services (e.g., the landscape, and recreational places). Those SMEs provided the reasons as their business depends upon the local natural resources and ecosystems, and they need to strictly follow regulations of waste management as their social responsibility. This can be interpreted that SMEs with a completed BCP have a recognition of their position in society as well as within the linkage of domains of socio, eco, and geo levels (Figure 8.2).

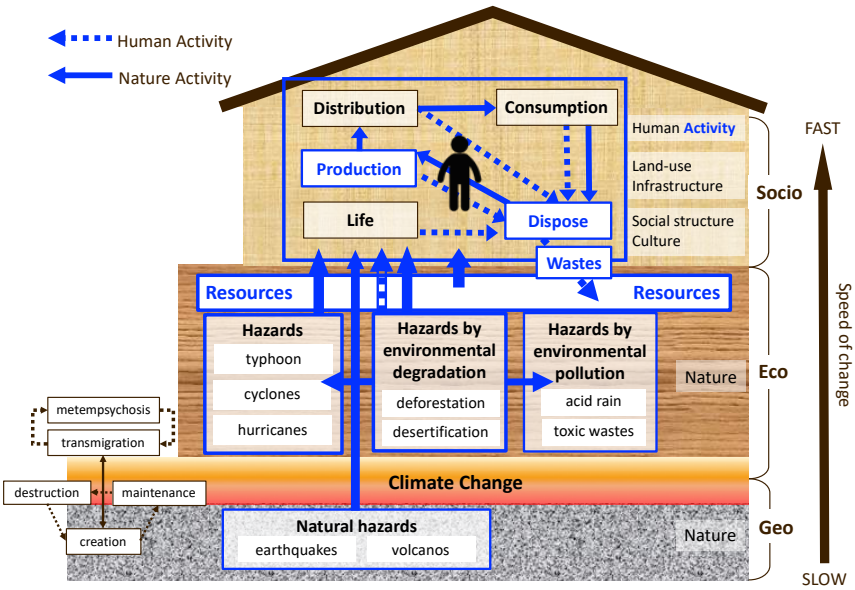

Figure 8.2 Domains of SMEs' recognition to linkages within the levels of socio, eco, geo (Created by author based on Hagihara, 2006; Okada et al., 2006)

In order to promote a culture of developing pre-disaster measures, SMEs' recognition to connections and connectivity of their business within society as well as local natural ecosystem would be the key. Hence, in case of SMEs, it can be a good option to include the message that disaster risk reparation such as BCP is a part of social responsibility and philanthropy.

8.2.4 Municipality and Eco-DRR (Chapter 7)

The municipality have taken some initiatives to raise awareness and promote preparedness for DRR such as updating the hazard map, dispatching bosai experts to lectures or workshops in each district, etc. However, the municipality has had some limitations to learn to what extent and how their citizens have been prepared for disaster risks. The concept of ecosystem-based DRR has not been well-known yet among city government officials. The city's development strategies "*Machi-zukuri* vision" in both 2013 and 2018, in case of Sukagawa City, have no sign of integration or interest of ecosystem conservation in DRR section. Environmental conservation has focused on the benefits side of nature. Although they set up opportunities to invite school students to collect their opinions on environmental conservation, it seems that such opportunities do not include DRR topics or local historical disasters. Also, Nanohana Project and its BDF will most likely be dwindled in case of Sukagawa city as the technological incompatibility with the latest diesel engines.

The place-names in the local area that reflect historical disasters and characteristics have not been in use for raising awareness of disaster risk preparation nor local environmental characteristics in EE. It is the key to include the local historical disasters as a local culture that represent local characteristics.

8.3 Ecosystem-based Approach with the Etymological viewpoint

The correlation was observed. However, questions raised here are: “Is Eco-DRR or ecosystem-based approach not a circuitous way for promoting disaster preparation?” “Why do we consider ecosystem or ecosystem services for DRR?” My answer to the first question is “No. It is not a circuitous way but a constructive way for a culture of DRR in the local context and local sustainability eventually.”

To answer the latter question, the English prefix “eco-” is derived from a Greek word ‘*oikos.’* A French word *écoumène* (‘inhabited’ in English) is also derived from an ancient Greek *οἰκουμένη*. Both ‘*oikos’* and ‘*οἰκουμένη’* mean ‘home’. Bate states that “a home is a house in which one does not live but dwell…and one can rest (2000, p. 274).” Regarding ‘dwelling,’ Heidegger asserts that “to dwell means to remain at peace within the free, the preserve, the free sphere that safeguards each thing in its nature, and the basic character of dwelling is to spare, to preserve” (1971, p. 147-48). While, Suzuki states that “the relationship between human being and eco (*oikos*) reflects the true meaning of the term as ‘something that belongs to me,’ or ‘something that has a connection with me’ (2017, p.111)” as well as that *oikos* itself is an organic system without delineating a spatiotemporal realm by modern physics (Suzuki, 2017, p. 125). Suzuki further declares that *oikos* helps people secure their own identity and gives them a place to come from and return to (Suzuki, 2017, p. 126). Hence, ‘eco’means home or where we live, thus, ecosystem can be a part of where we live. And we take care of where we live.

Ecosystem with sound management nurtures biodiversity. Conservation of biodiversity and ecosystem connect to the preserving of local industries, landscapes, thus the community and the livelihood of residents (MoE, 2016).

8.4 Ecosystem-based Approach in Reconstruction Stage

Ecosystem with sound management contributes to our living at any time. Even after disaster, they provide us with construction materials, drinking water and water for living. This is clearly proven from the case of GEJE. People in the tsunami affected area used the wood and lumbers from nearby mountains to reconstruct residents and small common building for the local community. Using the local resources enhanced their attachment to the area, which gave the actors long-temporal views to success their local tradition (Chiba, 2014).

After disasters, some people write poems or novels to express their feeling and emotions. Natural environment and ecosystem functions often become the material of those literal works and they soothe people's mind and give strength to restart their lives. Ecosystem, its functions, and healthy biodiversity help us in such an indirect manner (e.g., Kimura, 2019).

8.5 Ecosystem-based Approach in Time of Uncertainty

Ecosystem-based approach for DRR has limitation. It is rather slower compared to conventional civil engineering approach of DRR using large concrete structures. Taking into account that we are in time of uncertainty with extreme weather event that are not more extreme but "a new normal (Pihl et al., 2019, p. 17)," it would be a good option to consider the hybrid Eco-DRR integrated with civil engineering techniques (Furuta & Shimatani, 2018).

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CHAPTER 9
Conclusions

9.1 Introduction

This chapter presents conclusions and answers to the three purposes set in the beginning of this thesis. Section 9.2 responds to the purpose: 1) to understand the current status of disaster preparation, willingness in local ecosystem conservation, and experiences and knowledge of local disasters among residents. Section 9.3 answers to the second purpose: 2) to clarify the correlation between disaster preparation behavior/intention and willingness to conserve local ecosystems among residents including enterprises. Then, Section 9.4 provides recommendations in responding to the third purpose: 3) to make recommendations for promoting disaster risk preparedness, namely how to use and incorporate the local ecosystem conservation in disaster risk management as well as what is to be enhanced, altered, or added in ongoing local disaster management strategies. Limitations and way forward are given at the end.

9.2 The current status of disaster preparation behaviors and willingness to conserve local ecosystem conservation

Having selected Sukagawa City, this research clarified the current status of disaster risk preparation among citizens, SMEs, and municipality government. By and large, the status of disaster preparation behaviors has not been very high yet. Citizens who have prepared for disaster risks were about only one-third of the all respondents. For example, city's *bosai* guide

that includes hazard map was kept handy by only 31.6%. Participation to drills and seminars was experienced by less than 20%. About half of respondents have prepared by talking about emergency response with family and keeping plural information sources for emergency were prepared. Location and routes to the nearest shelter has been well-recognized by around 70% of citizens. Regarding BCP formulation by SMEs, only 8 % has completed formulating a BCP, and 12 % including SMEs with BCP formulation in process. 75% have no plan to formulate one or do not know about BCP. Municipality government have had the river development led by MLIT for the two A-Class rivers as disaster risk preparation. They have been proud of the civil engineering work as they expect that it can prevent the rivers from large-scale flooding. They have installed five storages for stocks in the city as preparation as well. They are going to install more storages in the future. Place-names as a catalyst of local characteristics has not been used for disaster risk preparation in any practical manner. Ecosystem-based approach for DRR or Eco-DRR was not familiar with city officials, and official document of city development strategies has had no sign of such concept.

This research found that citizens, SMEs, and municipality have their willingness to conserve local ecosystem. About the one-third of respondents of citizen and SMEs showed strong or moderate interests in participating to conservation. Cultural services of ES were the most selected to participate, and regulating services followed. However, municipality government is considering to stop using BDF out of Nanohana Project for their official vehicles due to incompatibility issues with the latest diesel car engines. Municipality government has held some meetings with students and district representatives, and it seems that they have used their voice to management and improvement of public recreational places.

9.3 The correlation between disaster preparation behaviors and willingness to conserve local ecosystems

This research found out the correlation between disaster preparation behaviors and willingness to conserve local ecosystem conservation about both citizens and SMEs.

Youth in Shiga Prefecture who are interested in local rivers showed their interest in local historical disasters. Student who have interest in global climate issues showed their good understanding on connection and connectivity between ecosystem services and their lives. Correlation between their past volunteer experience of environmental conservation and interest in local historical disasters was observed.

In case of citizens in Sukagawa city, interest in cultural services (maintaining folk heritages, landscape, and recreation places) of ES and environmental conservation knowledge gained higher occurrence probability of disaster risk preparation behaviors with significance.

As for SMEs, the association between BCP formulation and pro-environmental actions at office was stronger than that of business sizes (capital, number of employees). The group of SMEs with careful attentions to water resources have formulated BCP and installed environmental management system such as ISO14001. Although the occurrence probability with environmental indices was not significant, cross-analysis and MCA showed the correlation between their interest in conservation of regulating services and their attitudes emphasizing mutual help or help within collaboration with neighbors.

This research pointed out that municipality has a challenge of transversal collaboration in realizing ecosystem-based approach or Eco-DRR. The viewpoint of biodiversity conservation may be a help to build such collaboration in building a culture of DRR with ecosystem conservation management for local sustainability.

9.4 Recommendations

9.4.1 To Include Two-Sides of Nature in Environmental Education (Chapter 4 – Youth)

The two sides of nature (benefits and risks) should be included in the Environmental Education (EE). In particular, it is vital to provide such opportunities for youth or young generations. Learning the two sides of nature would help young people understand regulating services of ES to mitigate disaster risks and vice versa. This enables young people to recognize the linkages of social-ecological system within which they are living.

Learning contents can be group discussion topics on local ecosystem so that it enables young people or participants to think what natural resources they have in their local area and why those exist, what brought today's ecosystem in their area. This allows to give opportunities to re-visit not only the characteristic of local area and benefits but also the disaster risks they have. Group discussion can also contribute to vis-à-vis understanding and learning among participants. Such step can be implemented in formal education or non-formal setting with trained trainers/teachers. Hence, training of trainers/teachers is to be considered in parallel with contents development. Collaboration with the Board of Education should be necessary and the key to implement these.

9.4.2 Local Historical Disasters as Local Culture (Chapter 5 – Citizens)

Local disaster history or historical disaster is to be used more for awareness raising of potential disaster risks as well as promoting disaster risk preparedness. Such disaster history and how ancestors fought with disasters should be provided as a part of local characteristics. As mentioned in the sub-section 9.4.2, these can be included in EE contents as aspect of countermeasures and records by people.

This research found out that people with good knowledge on local place-names and local disasters have taken disaster risk preparation behaviors. Most of them were in their 50s or higher. This tells that such historical disasters should be transferred to younger generations for promoting disaster preparedness as well as raising awareness of local ecosystem. Young people may play a role of catalysts to the mid-generation, 30s and 40s.

The point is to provide these historical disaster experiences as a part of local culture. It can be a source to learn how their city/town/village has become today's condition and to think about how they would like to develop or manage in the future. When historical disaster topic given only within the framework of DRR, those stories and experiences may scare people. Feeling of fear or scariness would be important, however, it may shrink their attitude to take actions when those feeling are too strong (Slovic, 2010).

9.4.3 To Encourage Collective Action among SMEs for Business Continuity Planning (Chapter 6 – SMEs)

For disaster preparedness of SMEs, the key can be collective action and the sense of co-living with local society. Toward more dissemination and formulation of BCP, a simplified version with support of the local CCI would be effective for SMEs to find the primary actions they should take. This may contribute to overcome trade-off thinking and enable small-scale business owners to work together, which can be expected to function as mutual help in emergency case.

9.4.4 To Build New Connection and Collaboration (Chapter 7 – municipality)

In order to implement the recommended actions given above, it is necessary to build a transversal collaboration within municipality government. Figure 9.1 shows the recommended collaborations within the local DRR governance system. The black arrows

have already existed in most local areas. I would recommend to build or reinforce the connection with red arrows for developing EE contents with local historical disasters as a part of local culture. The arrows in blue are recommended collaboration for promoting BCP among SMEs with support by CCI.

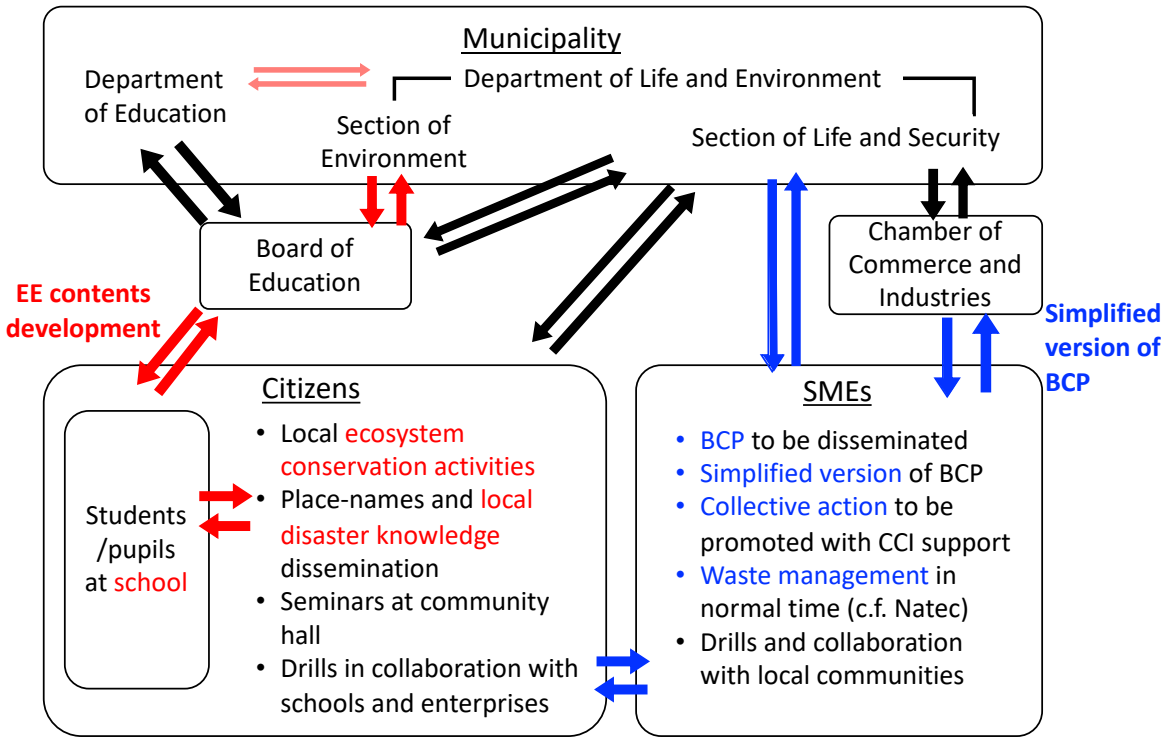

Figure 9.1 Framework and Recommendation to build new collaborations

This research concludes that both citizens and enterprises, regardless ages, take preparation behaviors when their consciousness to society. Without care or attention to society and the connection, linkages with others, they do not take preparation behaviors. Thus, it is vital to enhance caring society and/or recognizing the linkage among wider population for disaster preparation behaviors themselves. It needs to link the local natural ecosystem and disaster risk reduction with multi-temporal (short to long term) goal setting and it is to be

regularly checked as part of preparedness. Also, citizens' awareness of richness of ecosystem and potential local disaster risks are the key for the linkage of ecosystem-based DRR.

9.5 Limitations

This research has implemented surveys only two sites in Japan. Ecosystem-based solutions for DRR are in greater demand by various stakeholders such as governments, tax payers and countries where there may be limited choice but to invest in ecosystems as the most readily available and effective solution to reducing underlying risk factors. More researches in those countries/regions will be needed in order to clarify the correlation between disaster risk preparedness and local ecosystem conservation as well as the extent to which willingness to participate to local ecosystem conservation have occurrence probability in other areas in Japan or countries/regions.

9.6 Way Forward

We still need to study whether Eco-DRR is a methodology or ideology. The ultimate purpose of DRR is our surviving and life-protection from natural hazards and disasters. When we think about this purpose and together with ecosystem-based adaptation, it is vital to examine how ecosystem-based DRR can contribute to our survivability. There lies a long way of research tasks to clarify whether Eco-DRR as ideology – a set of emerging normative beliefs and conventions to which we must abide or methodology – a particular procedure of approaching the goal of protecting lives and properties in the time of Climate Change, global warming, aging and depopulation and urbanization happening at the same time. This research may be a tiny one in the wide research world, but I deem that this research would be an important start for a theorization and practices in the future.

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Appendices

APPENDIX A: Questionnaire to citizens

The Sukagawa City
Department of Sustainable Rural Development,
Graduate School of Global Environmental Studies, Kyoto University
Joint Survey

Questionnaire on Disaster Risk Preparedness and Local Natural Environment in Sukagawa

About this questionnaire

Targeted people: Citizens in Sukagawa city
Purpose: To grasp the status of citizens' perceptions and participation to natural disaster risk and local natural conservation in order to make suggestions for future disaster risk reduction and sustainable development
Time: approximately 15 minutes

※Please send your response by September 17 (Sun.)
with the envelope enclosed

Contact Persons in charge of this survey
Naoko Kimura
PhD candidate
Graduate School of Global Environmental Studies, Kyoto University

Sukagawa City
Department of Life and Environment

A Your preparation status for natural disaster risks

For Q1～Q12, please give a circle either YES or NO about your status of preparation.

Q1.	Have you completed anti-seismic reinforcement of your house?	YES	NO
Q2.	Are you fixing your furniture so that they do not fall down when a tremor?	YES	NO
Q3.	Are you familiar with the geological conditions (geographical characteristics, possibility of liquification etc.) of your house?	YES	NO
Q4.	Do you have plural means to get information in emergency case?	YES	NO
Q5.	Do you talk about emergency responses and how to check your family's safety in a case of emergency? (If you live alone, with your friend, neighbors etc.)	YES	NO
Q6.	Do you have stock (water and food) for three days?	YES	NO
Q7.	Do you have stock commodities (flashlight, radio, medicine, blankets, emergency toilet etc.) for three days?	YES	NO
Q8.	Do you have keep the "Bosai Guide" by Sukagawa City at hand?	YES	NO
Q9.	Have you checked the closest evacuation place near your house?	YES	NO
Q10.	Have you checked the route to the closest evacuation place near your house?	YES	NO
Q11.	Have you participated in any seminar or fire drills held by the prefecture or city, your district etc.?	YES	NO
Q12.	Have you taken a lecture on how to use AED and/or first aid for injury?	YES	NO

To those who answered "NO" to Q1 ~ Q12, please provide your reasons

B Questions about your past disaster experiences

For Q13 ~ 18, please choose one that is closest to you and give a ◯ in the box (You can give only ONE ◯ each question).		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q13.	When you experienced <u>earthquakes</u> in your house, you felt that your life was at risk.					
Q14.	When you experienced <u>earthquakes</u> in your house, you thought that preparation for disasters is important.					
Q15.	When you experienced <u>floods</u> in your house area, you felt that your life was at risk.					
Q16.	When you experienced <u>floods</u> in your house area, you thought that preparation for disasters is important.					
Q17.	When you <u>saw a disaster site yourself</u> (you did not have damages or injuries), you thought that preparation for disasters is important.					
Q18.	When you <u>watched a disaster site on TV, newspaper, or mass media</u> (you did not have damages or injuries), you thought that preparation for disasters is important.					

C About your resident area

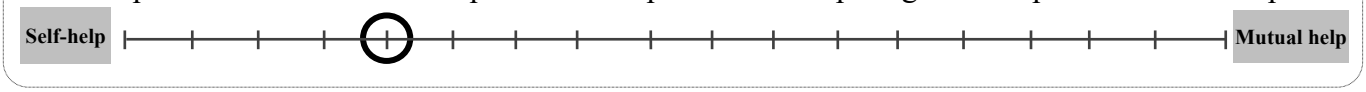
For 19 ~ 21, please choose one that is closest to you and give a ◯ in the box (You can give only ONE ◯ each question).		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q19	You know the origin of the place-name of your resident area.					
Q20	You know what disasters have happened in your resident area in the past.					
Q21.	You know the geographical and/or geological characteristics of your resident area.					

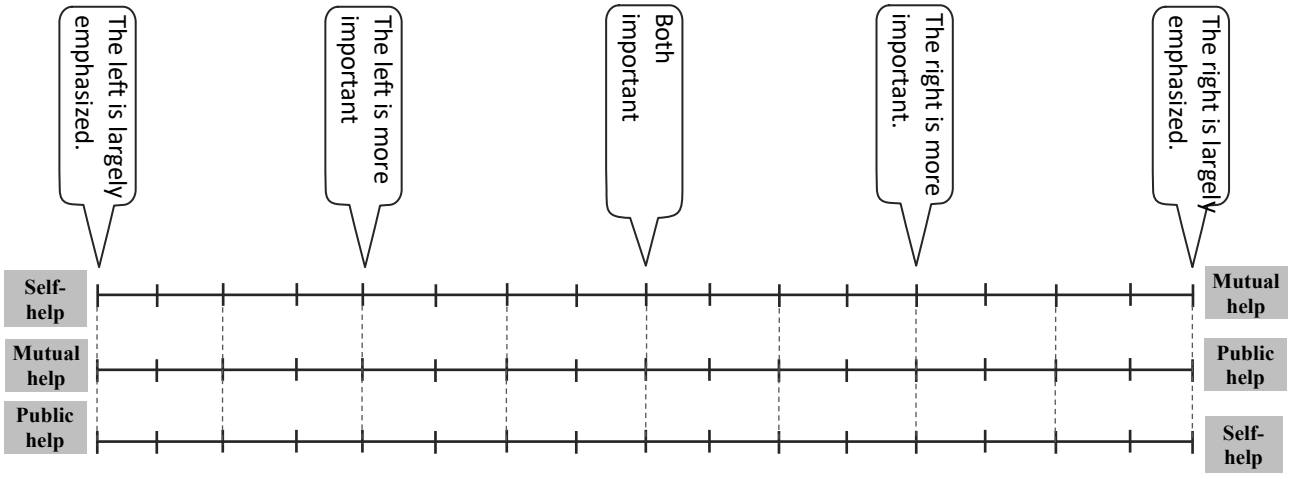
D About self-help, mutual help, public help

Below are the meanings of self-help, mutual help, and public help in this questionnaire.
Self-help • • • • To take care and prepare yourself or at each household
Mutual help • • • To help and prepare with neighbors or a given community
Public help • • • Rescue, Support, or preparation by the government administration (municipality, the police, fire department etc.)

Q22. Comparing "Self-help and Mutual help," "Mutual help and Public help," "Public help and Self-help," pairwise, which is more emphasized? Please give a ◯ at the level that is closest to your on the ┼┼┼┼┼.

【Example】 You think "'self-help' is more emphasized" comparing 'self-help' and 'mutual help.'





E About your self-help

For Q23 and Q24, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q23.	You want to customize your preparation items considering you and your family's physical and mental health in case of emergency, including stock and commodities advised in "Bosai Guide" provided by the city.					
Q24.	You want to have opportunities to talk about your resident area's history and characteristics as a preparation for emergency case.					

F About preparation for emergency cases

For Q25and Q26, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q25.	Preparation for disaster risks must be taken by each individual or household.					
Q26.	Preparation for disaster or emergencies can be taken care of by the public. As far as they provide strong infrastructure, that would be enough.					

G About your environment regarding preparation for emergencies

For Q27 and Q28, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q27.	Your friends and colleagues are positive about preparation for disaster risks and emergencies.					
Q28.	Information related to disasters around your resident area have increased in the last 5 years.					

H About your opinion about nature environment in Sukagawa

For Q29 ~Q32, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q29.	Sukagawa city has rich nature environment.					
Q30.	Sukagawa city has many disaster risks.					
Q31.	My resident area has rich nature environment.					
Q32.	My resident area has many disaster risks.					

I About your opinion on general natural environment

For Q33 and Q34, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q33.	The information on global environmental issues have increased in the last 5 years.					
Q34.	We have had more influence of Climate Change in Sukagawa in the last 5 years.					

J About pro-environment behaviors

For Q35 and Q36, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q35.	Pro-environmental behaviors (waste segregation for recycling, saving electricity, using soap etc.) must be promoted each individual or household.					
Q36.	Pro-environmental behaviors are not necessary if the public implement sound services. be taken by the public					

K About social environment around you

For Q37and Q38, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q37.	Your friends and/or colleagues are positive about environment conservation.					
Q38.	Information on natural environment conservation has increased in the last 5 years.					

L About natural environment conservation in Sukagawa

Regarding each category of conservation activity, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
a	You want to participate to conservation activity of agriculture and fishery or other related to food.					
b	You want to participate to conservation activities related to forest resources.					
c	You want to participate to activities related to energy.					
d	You want to participate to activities related to reduce CO_2r emission.					
e	You want to participate to conservation activities related to wetland/aquatic animals and plants.					
f	You want to participate to conservation activities related to river water quality.					
g	You want to participate to activities related to landscape preservation, Environmental Education, or scientific study.					
h	You want to participate to cleaning or maintaining recreation places.					
i	You want to participate to activities for cultural heritage or folk culture transmission.					

M In relation with disaster risk reduction and environmental conservation

For Q40 and Q44, please choose one that is closest to you and give a ◯ in the box. (You can give only ONE ◯ each question.)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q40.	You have enough <u>time</u> for activities of disaster risk reduction and/or environmental conservation.					
Q41.	You have enough <u>money</u> for activities of disaster risk reduction and/or environmental conservation.					
Q42.	You have enough <u>stamina</u> for activities of disaster risk reduction and/or environmental conservation.					
Q43.	You have enough knowledge on disaster risk reduction.					
Q44.	You have enough knowledge about environmental conservation.					

About yourself

Please give ◯ to the one that is closest to you.

Gender	1. Male	2. Female	
Age	1. 10s	2. 20s	3. 30s
	4. 40s	5. 50s	6. 60s
	7. 70s or more		
Occupation	1. Office worker	2. Self-owned business	3. Professional
	4. Public service worker	5. Student	6. Housewife
	7. Part-time worker	8. Unemployed	9. Others
Type of your house	1 Own house (detached)※	2. Own house (apartment)※	3. Rented house (detached)
	4. Rented house (apartment)	5. Dormitory	6. Others
		※including your family-member is the owner	
Years of dwelling	1. Less than 5 years	2. 5～10 years	3. 10～20 years
	4. 20～30 years	5. 30～50 years	6. Longer than 50 years
Number of housemates	1. Alone	2. Two people	3. Three people
	4. Four people	5. Five people	6. More than 6 people
Number of children	1. Zero	2. One	3. Two
	4. Three	5. Four	6. More than five

Name of your resident area

Town / district (*aza*) name	

Please leave your comments.

＜Protection of Personal Information＞

1. The answers given will be used only for analysis of this survey.
2. Any personal information about the respondent will neither be open to any third party nor outsider.

This is the end of questionnaire.
Thank you very much for your cooperation.

APPENDIX B: Questionnaire to small and medium-sized enterprises

The Sukagawa Chamber of Commerce and Industries
Department of Sustainable Rural Development,
Graduate School of Global Environmental Studies, Kyoto University
Joint Survey

Questionnaire on Disaster Risk Preparedness and Environmental Management of Enterprises in Sukagawa

About this questionnaire survey

- Targeted group: Members of the Sukagawa Chamber of Commerce and Industries
- Purposes:
  1) To clarify the status of formulating Business Continuity Plan, disaster risk preparation, and environmental management of enterprises in Sukagawa; and
  2) To make suggestions for future actions towards local sustainability in Sukagawa
- Time required: About 15 minutes (Your cooperation would be most appreciated.)

Notes
In order to collect the responses as an organization, this survey is to be answered by the manager or a person in charge of risk management.

※Please send your response by March 10, 2017with the envelope enclosed.

Contact Persons in charge of this survey

Naoko Kimura
PhD candidate
Graduate School of Global Environmental Studies, Kyoto University

Nobuyuki Soeta
Secretary General,
Director of Small and Medium-sized Enterprises Counselor's Office
the Sukagawa Chamber of Commerce and Industries

A Questions about preparation and actions for the disaster risks

Q1. Have you completed anti-seismic reinforcement at your office?
1 Yes 2 No

Q2. Have you completed fixing cabinets and shelves to prevent them from falling down?
1 Yes 2 No

Q3. Have you installed a system of remote office or working at home for emergency cases?
1 Yes 2 No

Q4. Have you multiple system of command for emergency cases?
1 Yes 2 No

Q5. Have you prepared some stock (water, food, flashlight, radio, blanket, emergency toilet etc.) at your office?
1 Yes 2 No

Q6. Have you had any cooperation system of supply-chain with other enterprises within your neighbor or Sukagawa city?
1 Yes 2 No

Q7. Have you had any cooperation system of supply-chain with other enterprises outside of your neighbor or Sukagawa city?
1 Yes 2 No

Q8. Have you prepared an emergency contact list?
1 Yes 2 No

Q9. Have you implemented fire drills at your office voluntarily?
1 Yes 2 No

Q.10 Have you participated to disaster risk related events (drills, seminars, etc.) held by Sukagawa city or your district community as an enterprise/organization?
1 Yes 2 No

Q11. Have you taken a seminar about how to use AED (Automated Externa Defibrillator) or first aid as an enterprise/organization?
1 Yes 2 No

Q12. If another large disaster happened, how long do you think your enterprise/organization will take to recover? (Please choose ONE).
1 Quickly, in short time.
2 Rather quickly.
3 Do not know.
4 Rather slowly.
5 Slowly, in long time.

B About Business Continuity Planning (BCP)

In this questionnaire, "Business Continuity Plan: BCP" means a strategic plan along which an enterprise can avoid suspension of their critical business or can recover the critical business quickly if it is interrupted, even when contingencies arise, including natural disasters, disruption of supply chains and abrupt changes in business environment.

Q13. Have you formulated a Business Continuity Plan (BCP)? (Choose only one)

1 Completed（When: ）
2 Formulating now
3 Will formulate
4 Have no plan to formulate.
5 Do not know BCP

Q14. Do you think BCP brings you some benefits in normal time though it basically aims to mitigate the disruption in business by abrupt events such as emergency?

1 YES → To Q14-1　　2 NO → To Q15

Q14-1《To those who answered YES for Q14》 Which one of the following statements is the best benefit of BCP in normal time? (Please choose ONLY ONE.)

1 Risk perception at the work place can be shared.
2 Risk awareness in the office is raised and/or firmly established.
3 It makes our fund-raising from financial institutions more smooth.
4 The feel of safe and employees' morale are enhanced.
5 Our attitude of social responsibility is well-reputed by consumers and local citizens.
6 Others（For example _____）

→To Q15

C About past disaster experiences

Q15. Have you experienced any natural disaster?

1 YES → to Q15-1　　2 NO → To Q16

Q15-1.《To those who answered YES for Q15》 What was the disaster? (Please choose all applicable below.)

1 Earthquake　2 Flood, Inundation　3 Storm (e.g. typhoon)
4 Landslide, Avalanche　5 Drought　6 Others（ ）

→To Q16

Q16. When you had the Great East Japan Earthquake (hereinafter GEJE), did you have any damage to your office building, facilities, or equipments? How much damage was it?

1 Yes, we had damages. ⟶ 1 All collapsed　2 Half collapsed　3 Partly damaged　4 Equipment was broken.

2 No, we did not have any significant damage.

Q17. What was the direct damage you had in GEJE? Please choose the closest one below.

1 0～500, 000 JPY 2 Less than 1 million JPY 3 More than 1 million JPY

4 More than 3 million JPY 5 More than 10 million JPY 6 More than 30 million JPY

Q18. Did you take any voluntary action to support the local area after GEJE?

1 YES → To Q18-1 2 NO → To Q19

Q18-1. 《To those who answered YES for Q18》 What was the action? Please provide some details.

【Example】

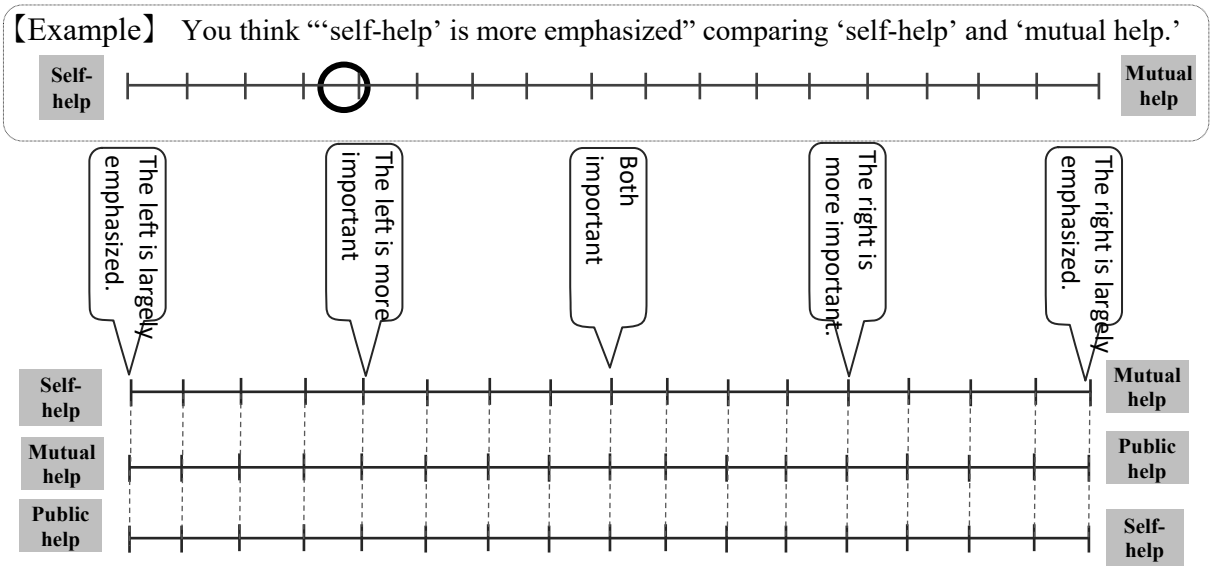
- We had opened our building to the neighbor as an evacuation place for ○ days.
- W provided our stockpiles (futon, matless, plastic sheets, foods etc.) to the city.

→ To Q19

D About self-help, mutual help, public help

Below are the meanings of self-help, mutual help, and public help in this questionnaire.
Self-help • • • • To take care and prepare yourself or at each household
Mutual help • • • To help and prepare with neighbors or a given community
Public help • • • Rescue, Support, or preparation by the government administration (municipality, the police, fire department etc.)

Q19. Comparing "Self-help and Mutual help," "Mutual help and Public help," "Public help and Self-help," pairwise, which is more emphasized? Please give a ○ at the level that is closest to your on the ⊣⊣⊣⊣⊣⊣ .



E About environmental management

Q20. Currently, are you doing any pro-environmental actions?

1 YES → To Q20-1 2 NO → To Q20-2

Q20-1. 《To those who answered YES for Q20》 What is the reason of your environmental actions? Please choose the closest one. (Please choose ONE.)

1 To reduce cost
2 To meet the regulations, laws, or institutions
3 To fulfill social responsibility as an enterprise
4 To improve our social image as an enterprise
5 To respond the request from our clients
6 Other（Details:＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿）

→ To Q21

Q20-2. 《To those who answered NO for Q20》 What is the reason that you are NOT taking any pro-environmental actions? (Please choose ONE.)

1 It is not helpful for cutting cost.
2 We do not have information on regulations, laws, or institutions.
3 We have neither enough personnel nor time to respond for it.
4 We cannot expect much effect.
5 Others（Detail:＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿）

→ To Q24

Q21. Have you implemented ISO14001 for environmental management?

1 Already implemented ISO14001 (Certification: Done / Not yet)

2 Implemented another system for environmental management (e.g., Eco-Action21, KES, Eco-stage, Green management etc.)

3 We know ISO14001, but have not implemented it yet.

4 We do not know ISO14001.

Q22. Have you got any effects of environmental actions?

1 YES 2 NO

Q23. Do you feel that environmental actions raised employees' awareness?

1 YES 2 NO

Q24. Please provide the appealing points of your environmental actions.

【Example】We participated environment seminars periodically. / We established our original action plan for environmental conservation. / We set up solar panels. etc.

→ To Q25

F About participation to local area, conservation for natural environment and resources

Q25. Do you have contribution to local area in the business principles of your enterprise?

1 YES 2 NO

Q26. Aer you interested in local natural environment and natural resource conservation in Sukagawa City as an enterprise?

1 YES 2 NO

Q27. Have you participated to conservation for local natural environment and/or natural resource as an enterprise?

1 YES → To Q27-1 2 NO → To Q28

Q27-1. 《To those who answered YES for Q27》 What was the targeted natural resource of the conservation activities that you have participated before? Please choose the ones that are closest (Please mark all that are applicable.)

1 Agricultural products, fishing products
2 Forest resources (woods, timbers, fuels etc.)
3 Energy generation related items
4 Reducing carbon dioxide emission
5 Conserving wetland, aquatic animals/plants
6 Conserving river water quality
7 Conserving landscape
8 Maintaining and cleaning recreation places
9 Protecting cultural and folk heritages
10 Others (Details:_____)

→ To Q28

Q28. Are you willing to participate to conservation for natural environment and/or natural resource in Sukagawa in the future? If so, which one of the followings would you like to target to? Please choose ONE.

↓Please mark **either one** of the following.

	Group 1: Agriculture, fishery, forest resources, energy generation related.
	Group 2: Reducing CO2, conserving wetland and ecosystem along the rivers, water river quality related.
	Group 3: Conserving landscape, maintaining recreation places, protecting cultural heritages related.
	Neither of those above.

Q29. Please provide the reason of your answer given for Q28.

Q30. 《To all》 Do you have favorite natural environment or natural resources in Sukagawa?

1 YES → Please provide the name of the place (as many as you have).
2 NO

About your enterprise / respondent

Name of your enterprise			
Location			
Section		Position title	
TEL		FAX	
E-mail			

Your major business (Please mark ONE)

manufacturing	1. Food	2. Fiber	3. Paper, pulp
	4. Chemist	5. Medical, pharmacy	6. Oil, rubber, ceramic
	7. Machinery	8. Iron, steel, metal products	9. Electronic instruments
	10. Transport machinery	11. Precision machinery	12. Other (……..)
Non-manufacturing	1. Construction	2. Wholesale	3. Retailing
	4. Finance, Insurance	5. Real estate	6. Transport, Storage
	7. Information, Communication	8. Electricity, Gas	9. Restaurant, Accommodation
	10. Medical, Welfare	11. Service	12. Other (……..)

Capital of your enterprise (Please mark ONE.)

1. Less than 10 million JPY	2. 11～20 million JPY
3. 21～30 million JPY	4. 31～50 million JPY
5. 51～100 million JPY	6. More than 100 million JPY

Number of employees of your enterprise (including part-time workers). (Please mark ONE.)

1 zero	2 1～20	3 21～50
4 51～75	5 76～100	6 101～150
7 151～300	8 301～500	9 More than 501

The Chamber of Commerce and Industries – Sukagawa has been open for consultation on BCP. Would you like to take a consultation?

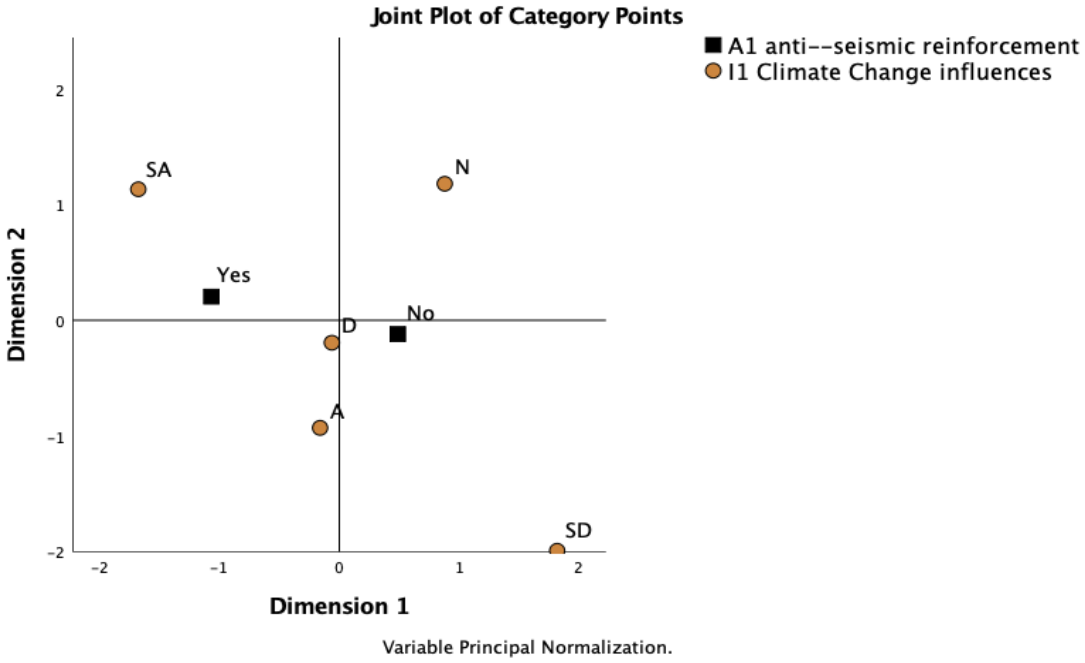
1 YES, we would like to have a consultation	2 NO.

＜Protection of Personal Information＞

1. The answers given in this questionnaire will be used only for analysis of this survey.
2. Any private information about the respondent will neither be open to any third party nor outsider.

This is the end of questionnaire.
We appreciate your kind cooperation.

APPENDIX C: Chapter 5 Results of Multi Correspondence Analysis Analysis (1)



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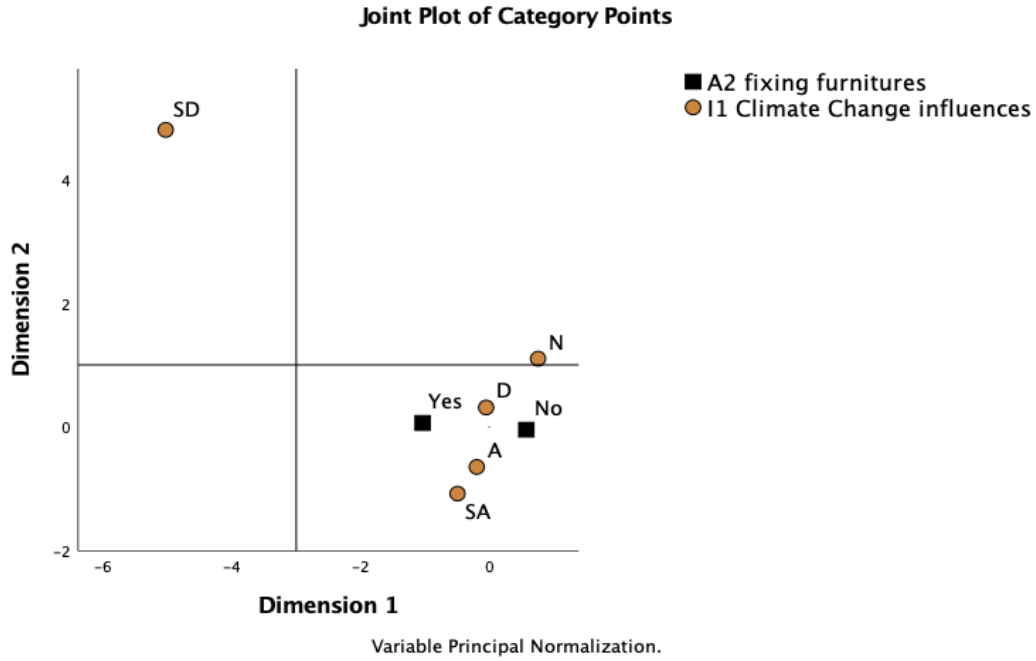

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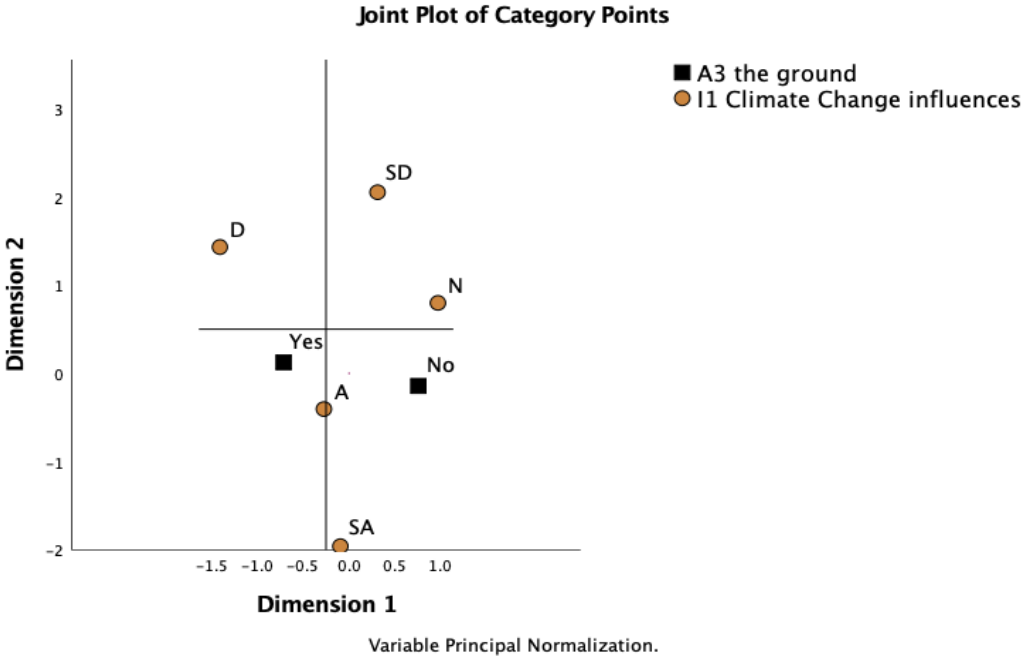
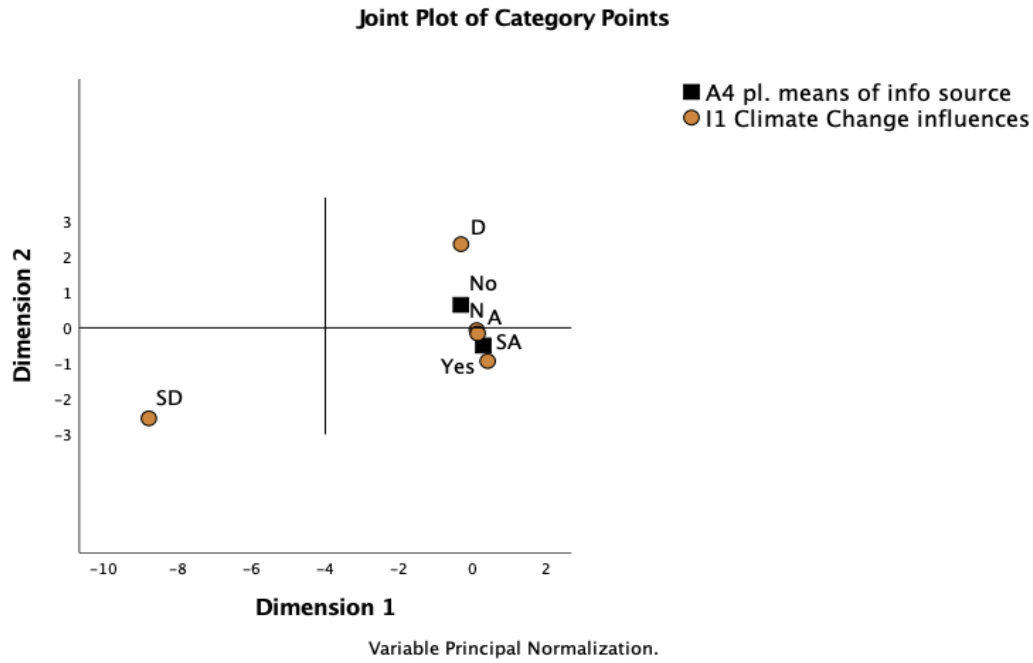
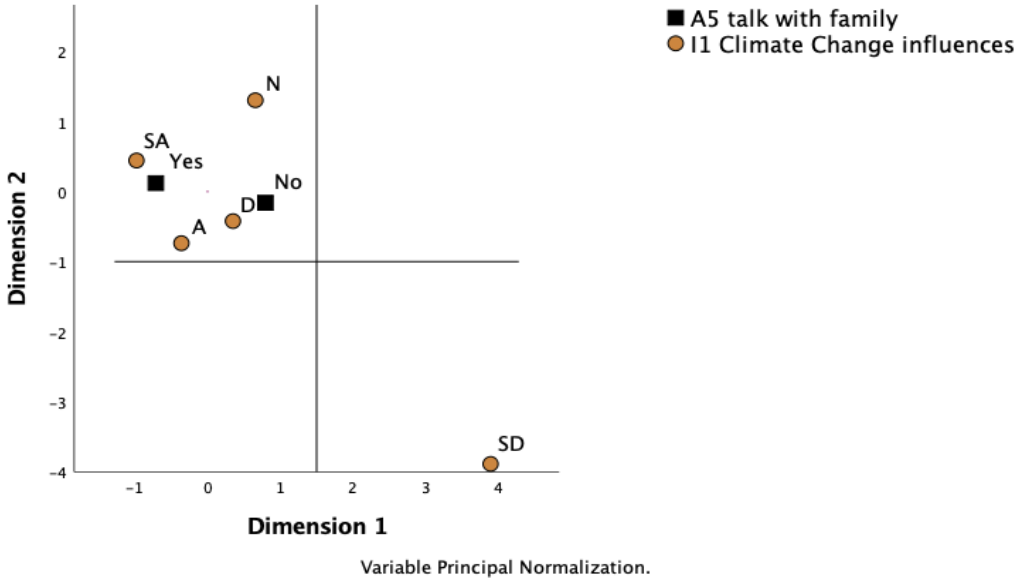

Joint Plot of Category Points
A3 the ground
I1 Climate Change influences
SD
D
N
Yes
No
A
SA
Dimension 2
Dimension 1
3
2
1
0
-1
-2
-1.5
-1.0
-0.5
0.0
0.5
1.0
Variable Principal Normalization.

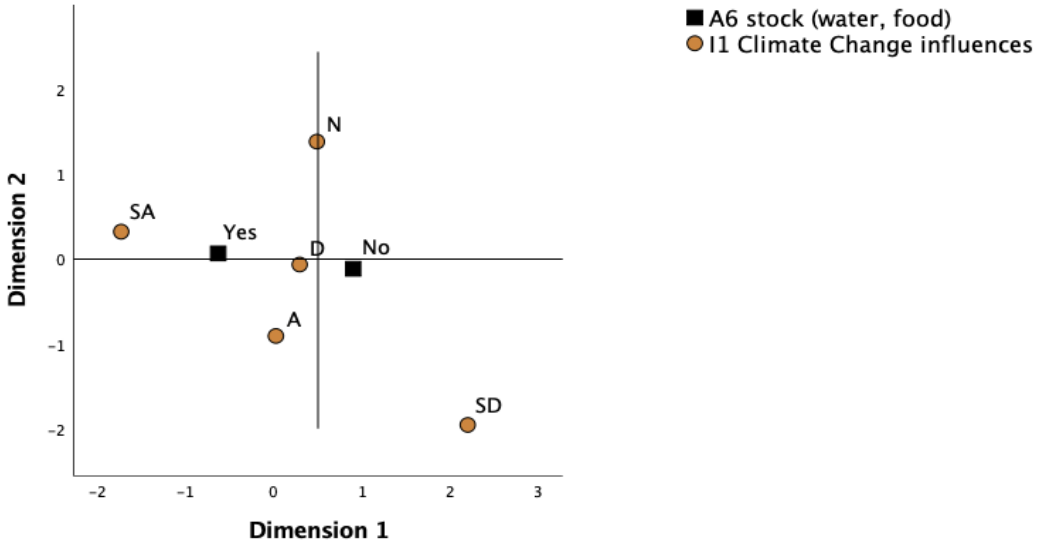

Joint Plot of Category Points
A4 pl. means of info source
I1 Climate Change influences
D
No
N
A
SA
Yes
SD
Dimension 2
Dimension 1
3
2
1
0
-1
-2
-3
-10
-8
-6
-4
-2
0
2
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

Joint Plot of Category Points



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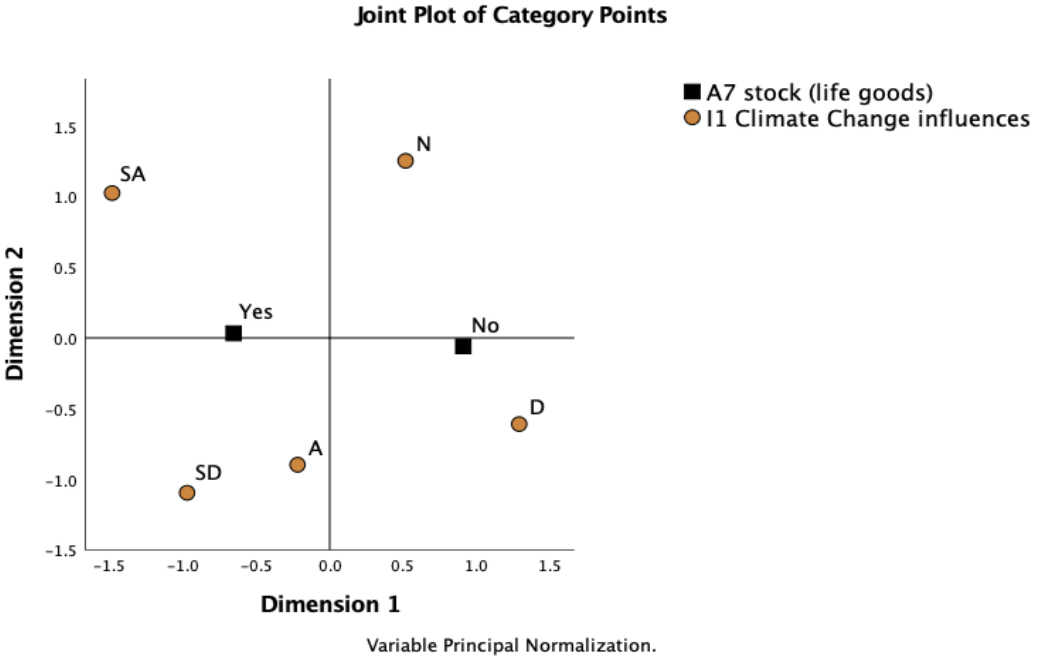
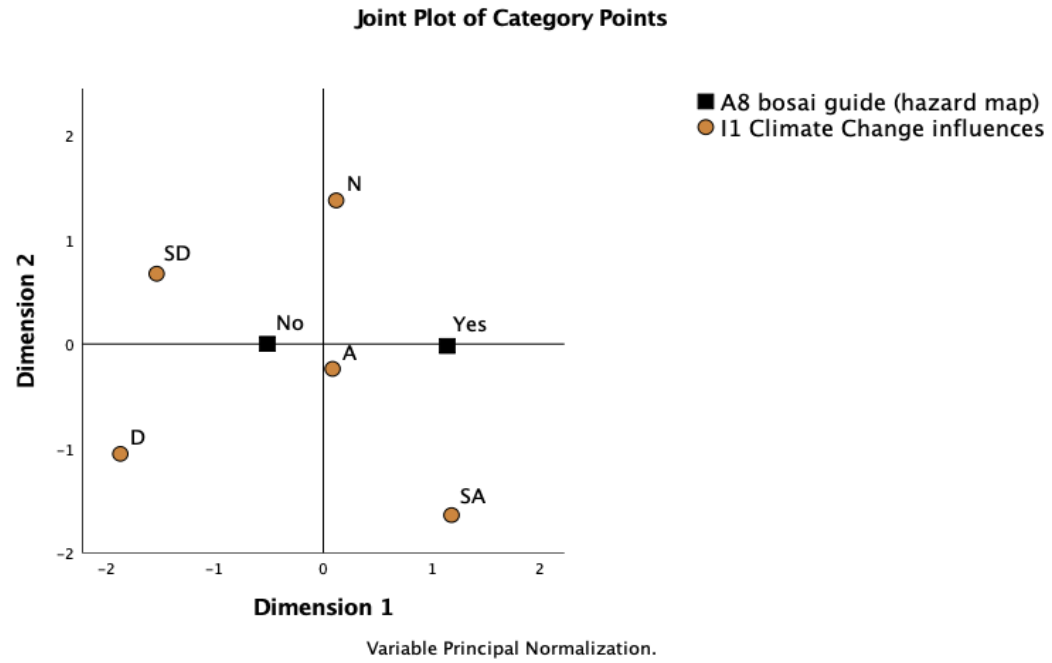
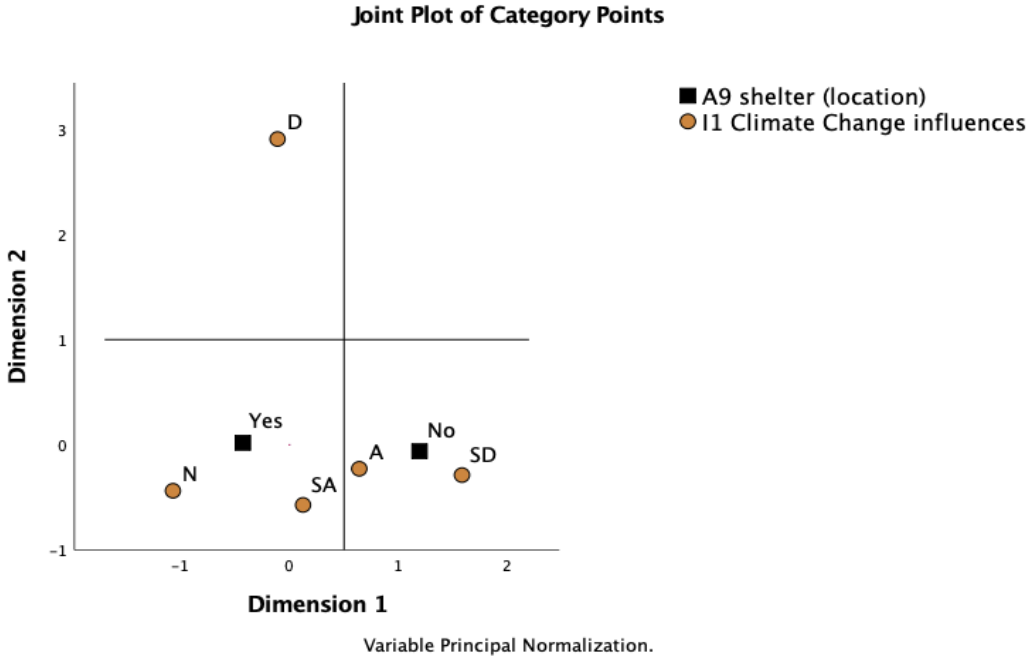
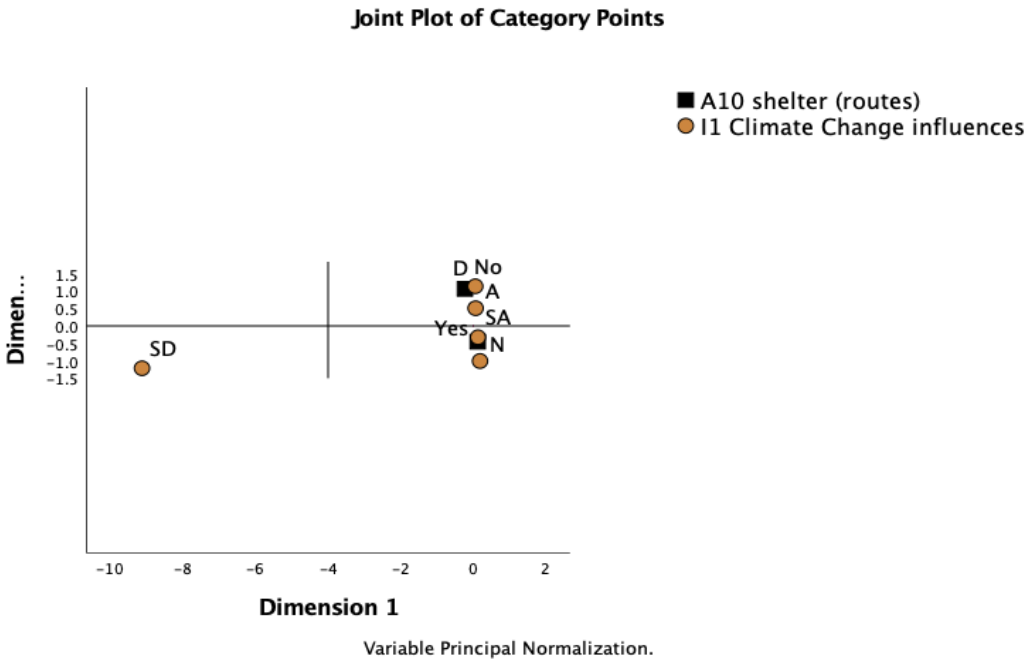
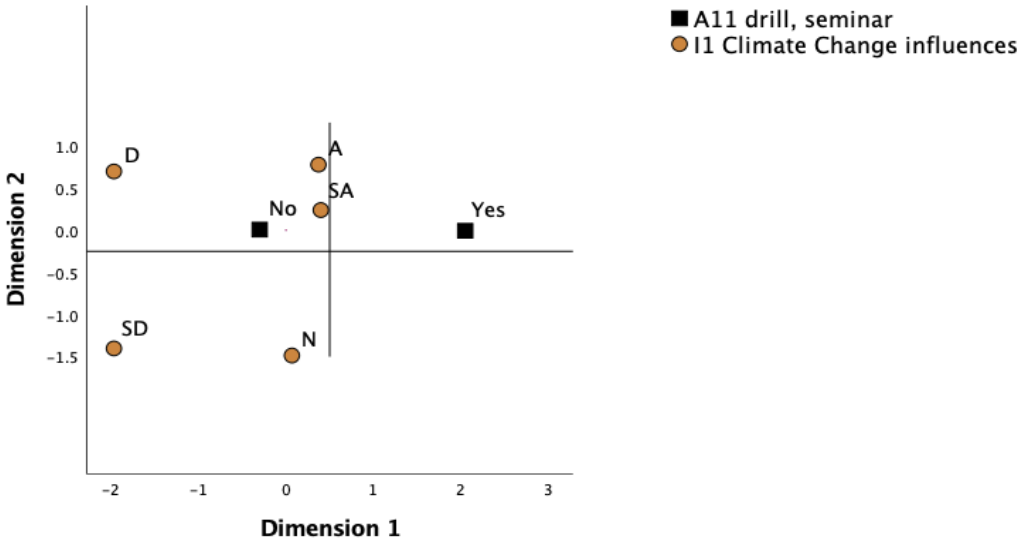

Joint Plot of Category Points
A7 stock (life goods)
I1 Climate Change influences
N
SA
Yes
No
D
A
SD
Dimension 2
Dimension 1
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Variable Principal Normalization.


Joint Plot of Category Points
A8 bosai guide (hazard map)
I1 Climate Change influences
N
SD
No
Yes
A
D
SA
Dimension 2
Dimension 1
2
1
0
-1
-2
Variable Principal Normalization.


Joint Plot of Category Points
A9 shelter (location)
I1 Climate Change influences
Dimension 2
Dimension 1
D
Yes
No
A
SD
N
SA
3
2
1
0
−1
−1
0
1
2
Variable Principal Normalization.

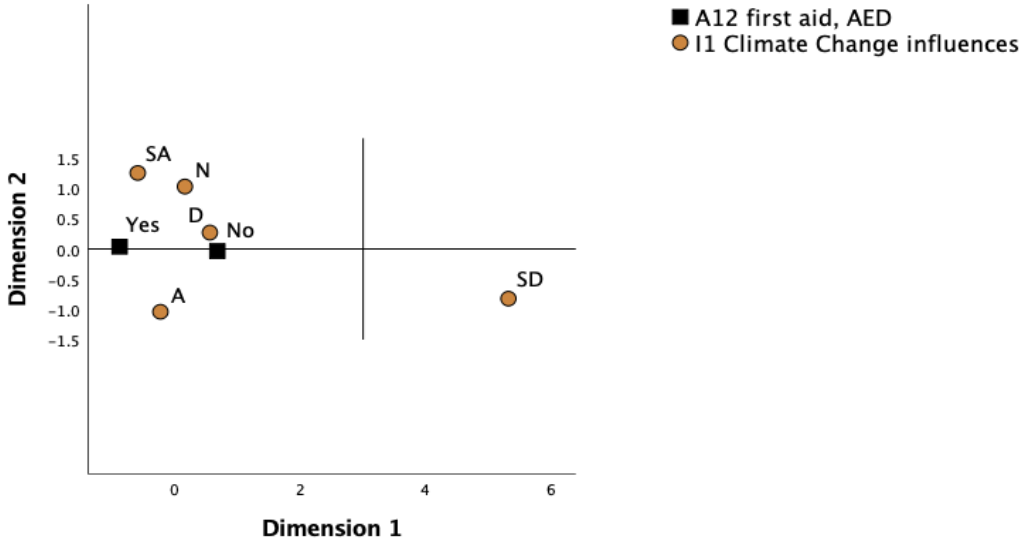

Joint Plot of Category Points
A10 shelter (routes)
I1 Climate Change influences
Dimen...
Dimension 1
D No
A
SA
Yes
N
SD
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−10
−8
−6
−4
−2
0
2
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

Joint Plot of Category Points



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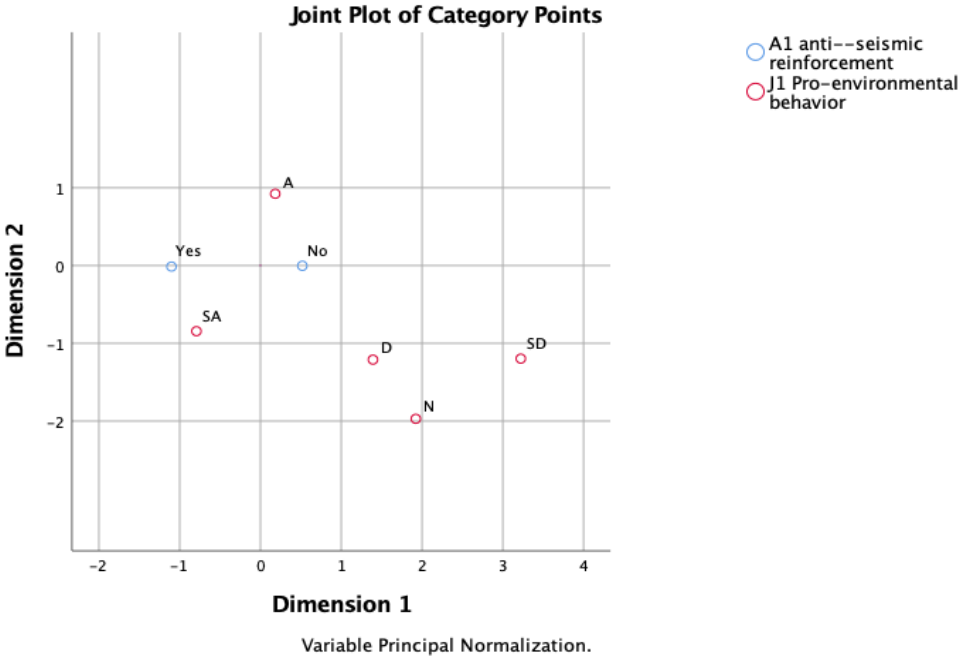
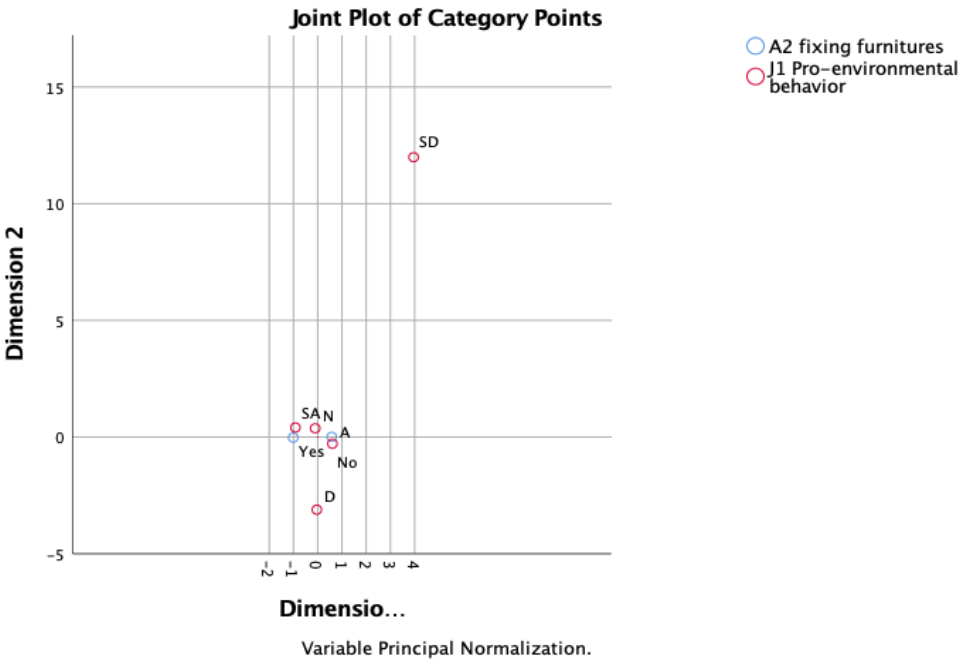
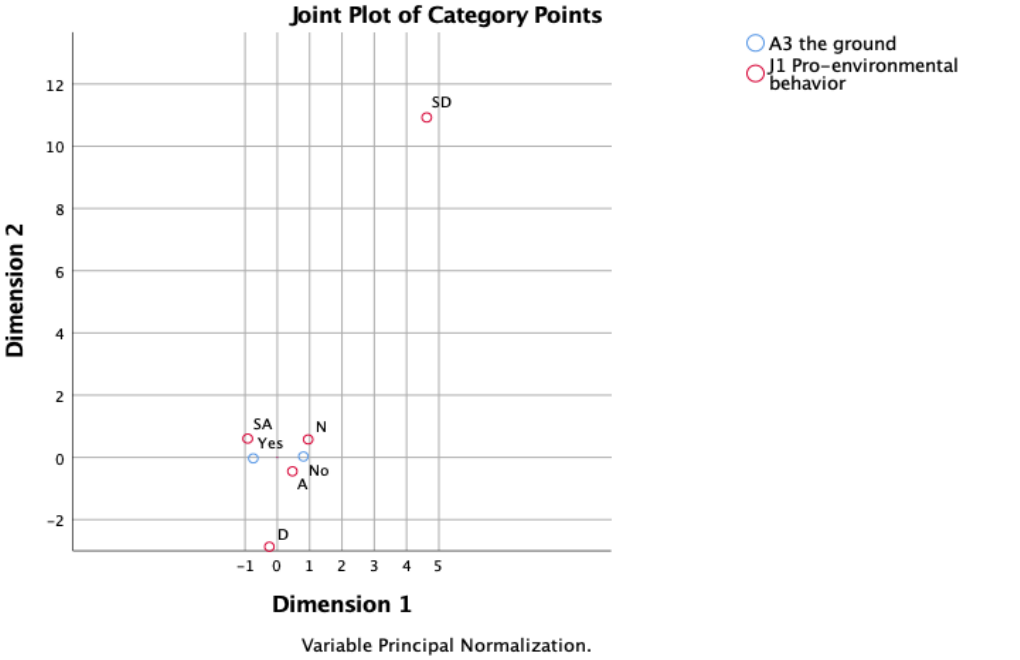
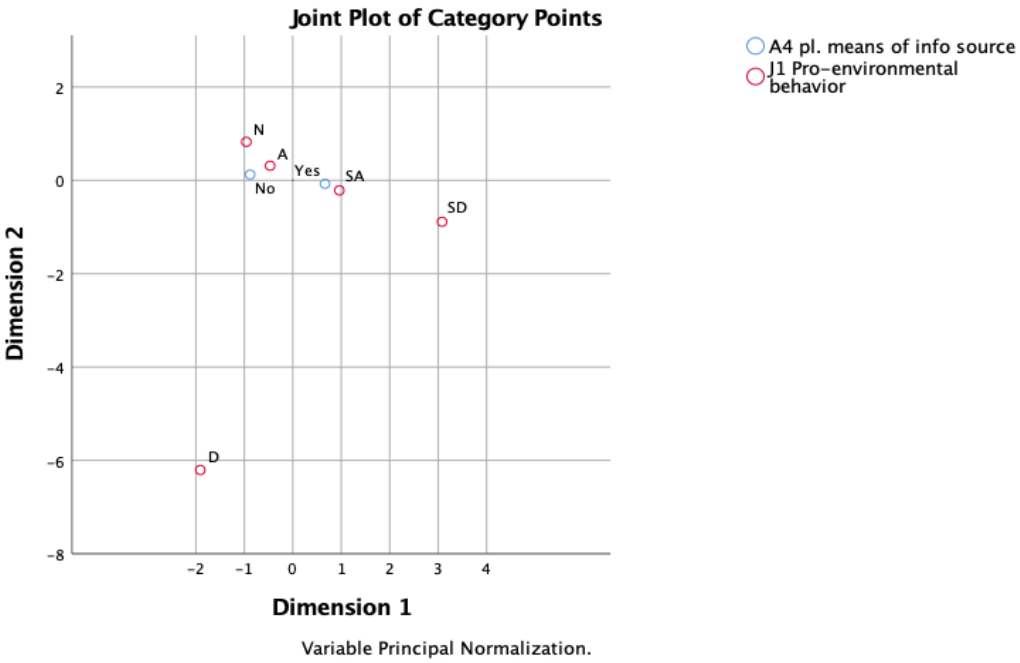


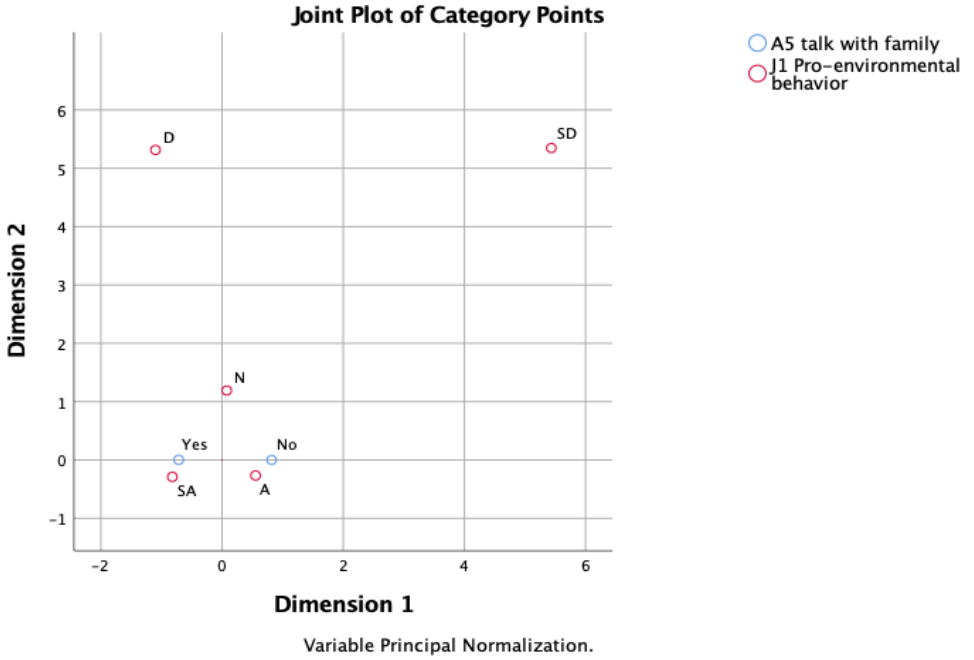
Variable Principal Normalization.



Variable Principal Normalization.


Joint Plot of Category Points
A3 the ground
J1 Pro-environmental behavior
Dimension 2
Dimension 1
SD
SA
Yes
N
No
A
D
Variable Principal Normalization.


Joint Plot of Category Points
A4 pl. means of info source
J1 Pro-environmental behavior
Dimension 2
Dimension 1
N
A
Yes
SA
No
SD
D
Variable Principal Normalization.



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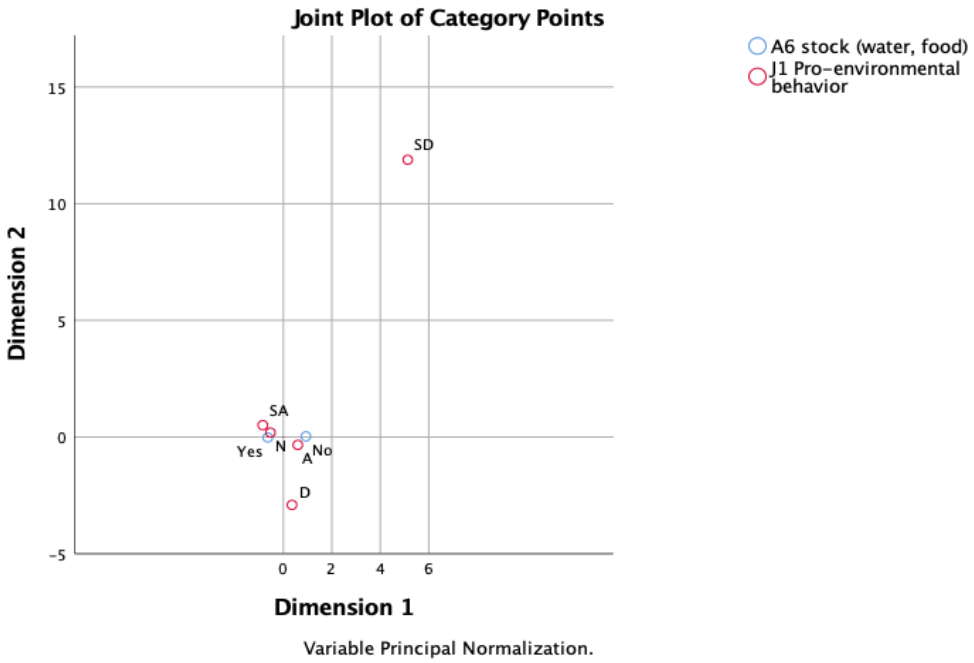
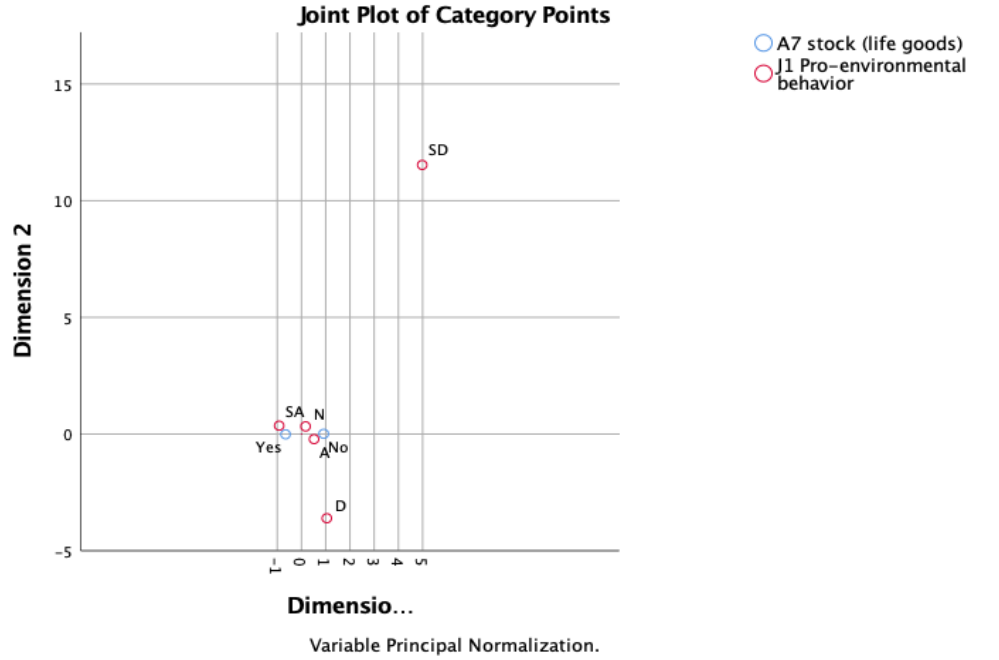
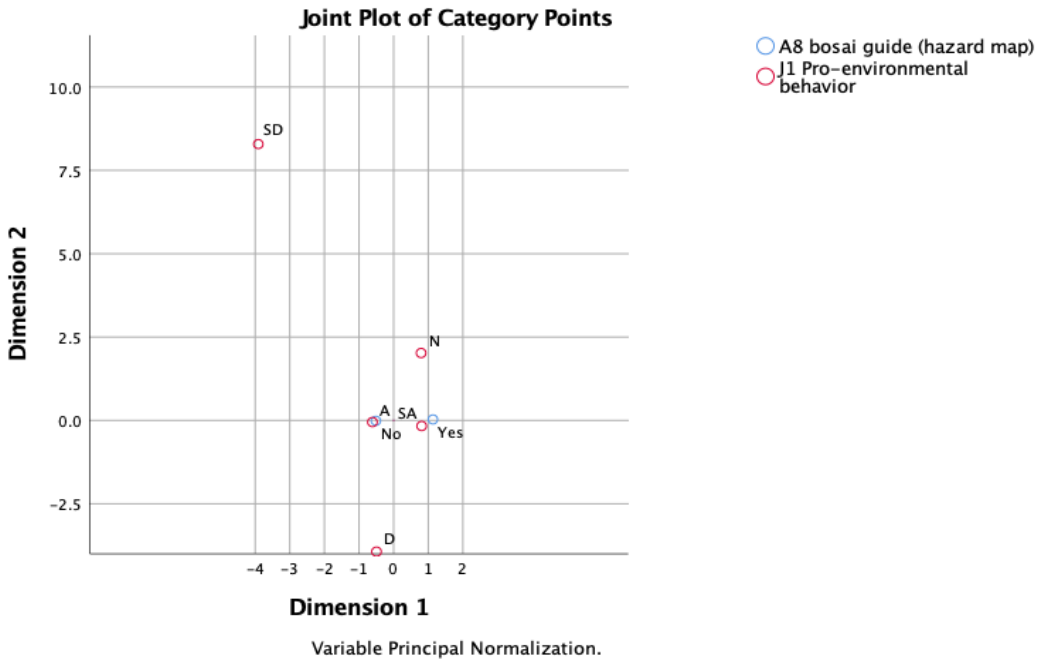
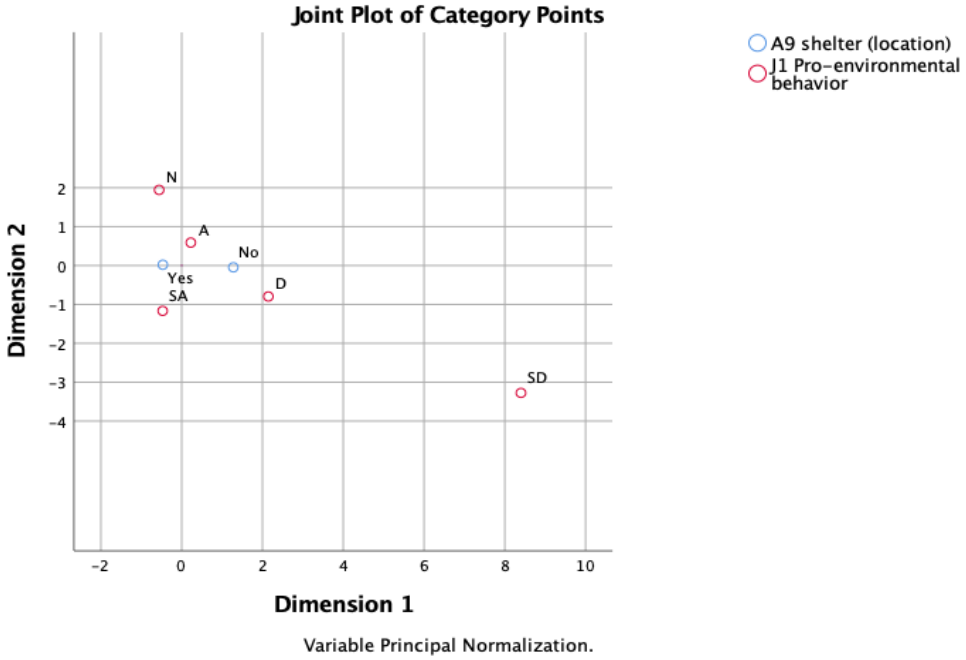
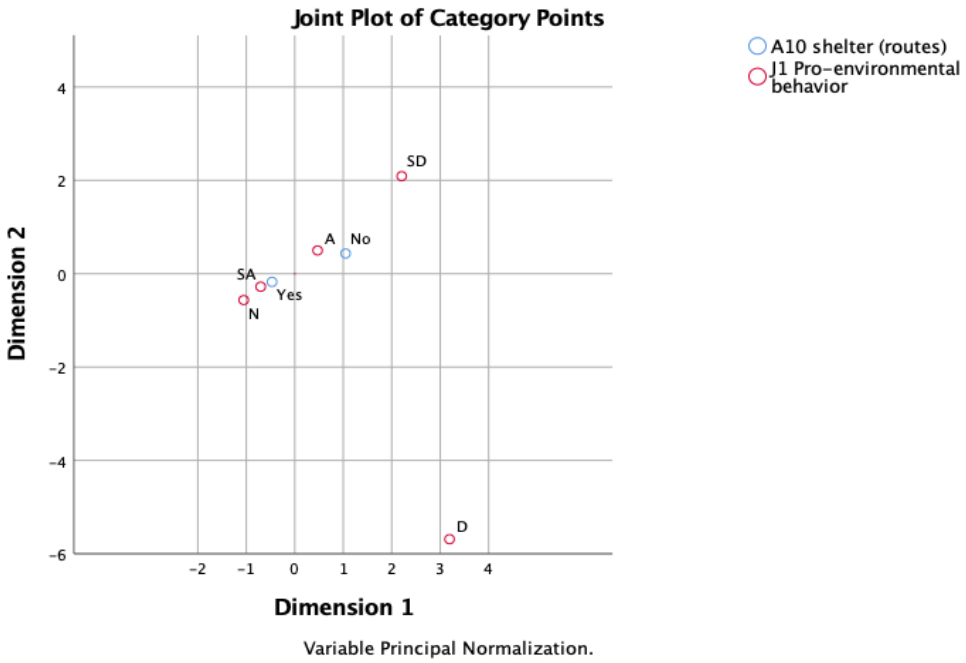


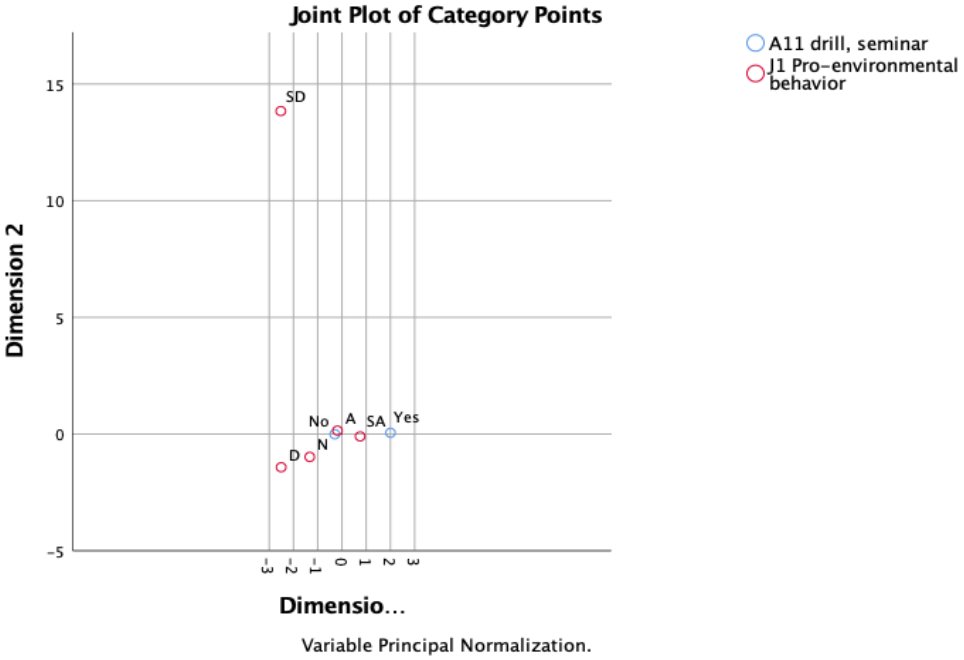
Variable Principal Normalization.

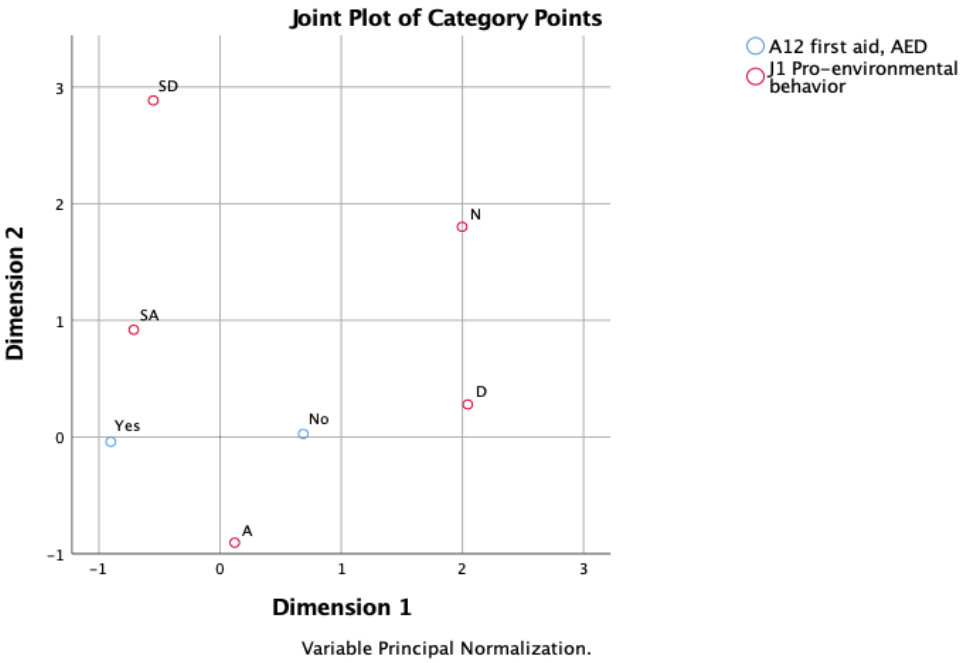

Joint Plot of Category Points
A7 stock (life goods)
J1 Pro-environmental behavior
Dimension 2
15
10
5
0
-5
SD
SA
N
Yes
A
No
D
-1
0
1
2
3
4
5
Dimensio...
Variable Principal Normalization.

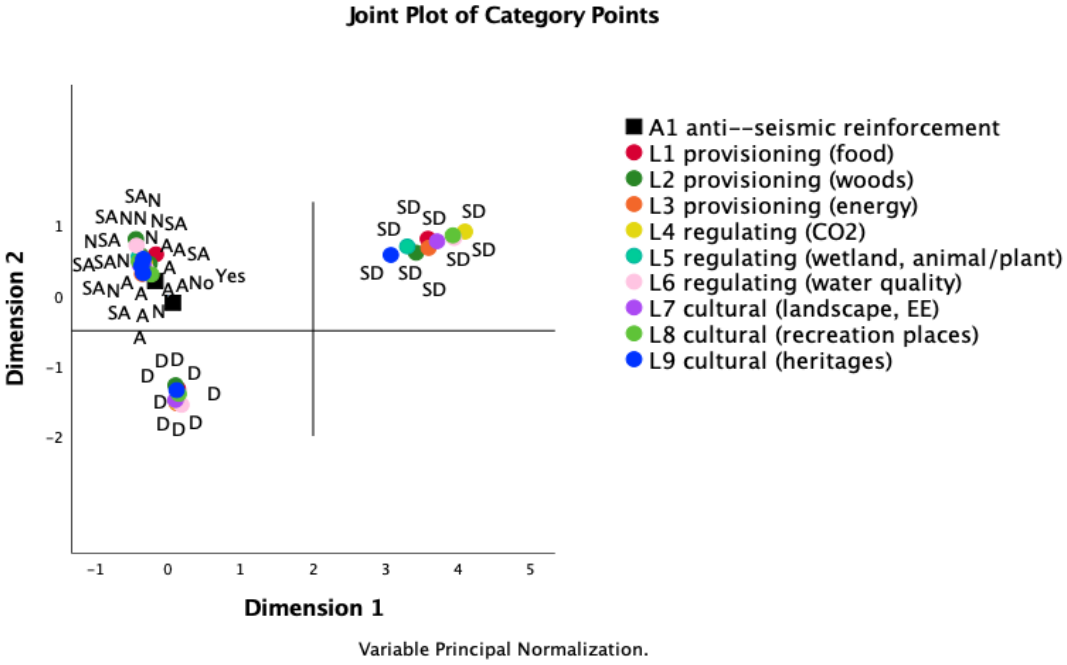

Joint Plot of Category Points
A8 bosai guide (hazard map)
J1 Pro-environmental behavior
Dimension 2
10.0
7.5
5.0
2.5
0.0
-2.5
SD
N
A
SA
No
Yes
D
-4
-3
-2
-1
0
1
2
Dimension 1
Variable Principal Normalization.

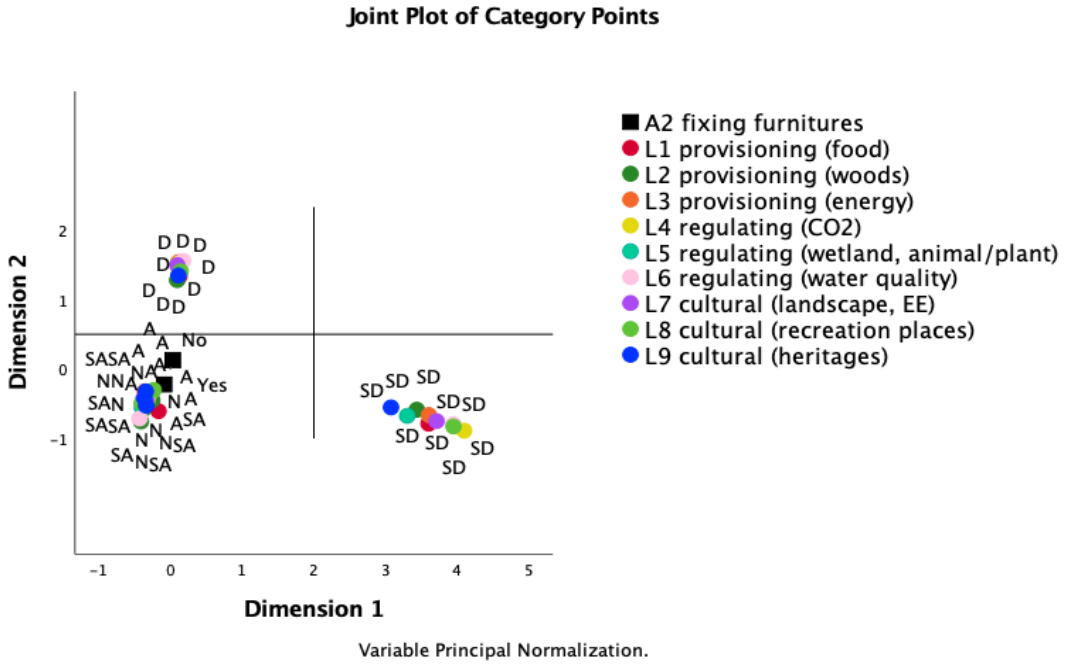

Joint Plot of Category Points
A9 shelter (location)
J1 Pro-environmental behavior
N
A
No
Yes
SA
D
SD
Dimension 2
Dimension 1
Variable Principal Normalization.


Joint Plot of Category Points
A10 shelter (routes)
J1 Pro-environmental behavior
SD
A
No
SA
Yes
N
D
Dimension 2
Dimension 1
Variable Principal Normalization.

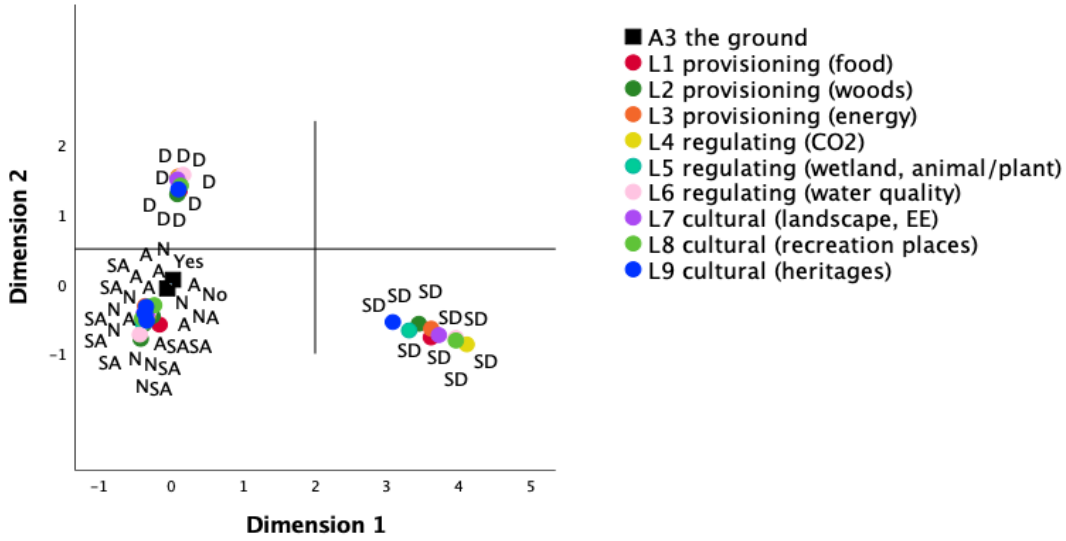

Joint Plot of Category Points
A11 drill, seminar
J1 Pro-environmental behavior
Dimension 2
15
10
5
0
-5
SD
No
A
SA
Yes
N
D
-3
-2
-1
0
1
2
3
Dimensio...
Variable Principal Normalization.


Joint Plot of Category Points
A12 first aid, AED
J1 Pro-environmental behavior
Dimension 2
3
2
1
0
-1
SD
N
SA
D
Yes
No
A
-1
0
1
2
3
Dimension 1
Variable Principal Normalization.


Joint Plot of Category Points
Dimension 2
Dimension 1
A1 anti--seismic reinforcement
L1 provisioning (food)
L2 provisioning (woods)
L3 provisioning (energy)
L4 regulating (CO2)
L5 regulating (wetland, animal/plant)
L6 regulating (water quality)
L7 cultural (landscape, EE)
L8 cultural (recreation places)
L9 cultural (heritages)
Variable Principal Normalization.

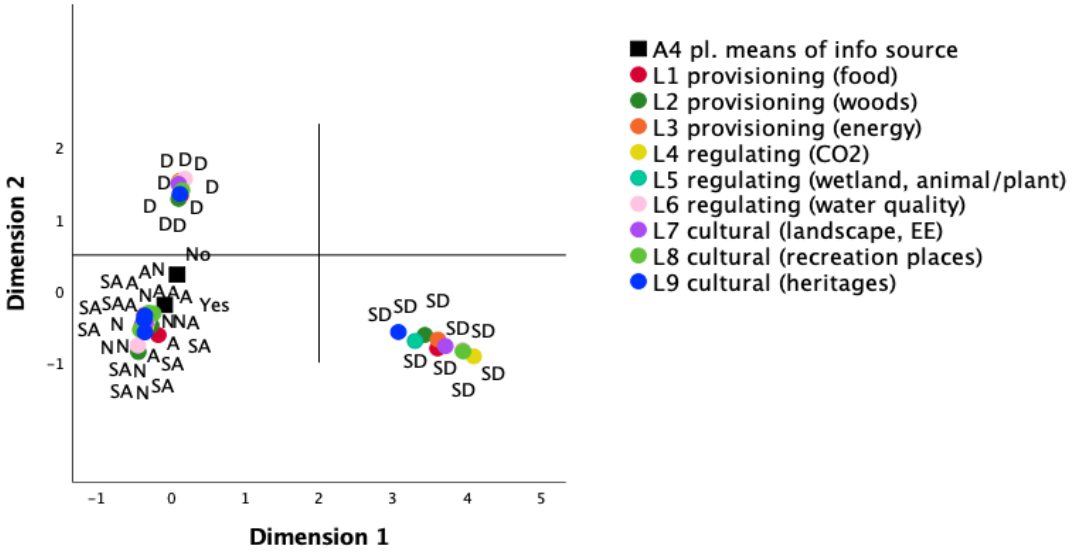

Joint Plot of Category Points
Dimension 2
Dimension 1
A2 fixing furnitures
L1 provisioning (food)
L2 provisioning (woods)
L3 provisioning (energy)
L4 regulating (CO2)
L5 regulating (wetland, animal/plant)
L6 regulating (water quality)
L7 cultural (landscape, EE)
L8 cultural (recreation places)
L9 cultural (heritages)
Variable Principal Normalization.

Joint Plot of Category Points



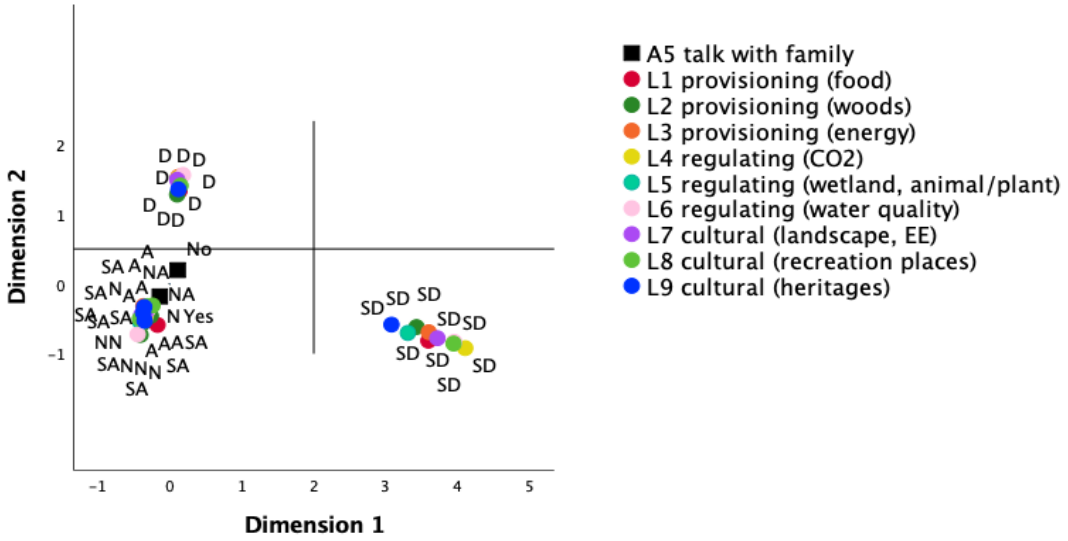
Variable Principal Normalization.

Joint Plot of Category Points



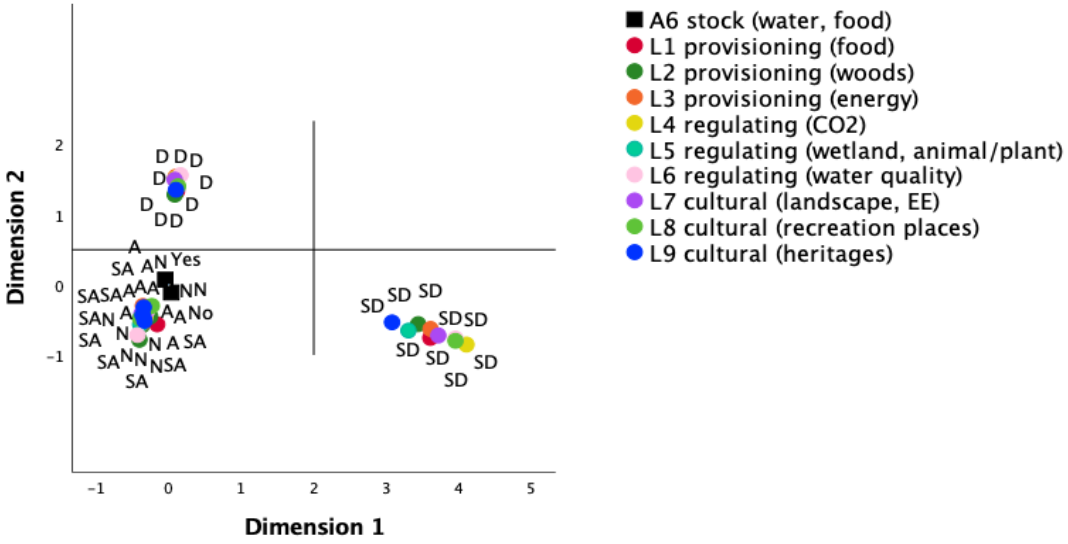
Variable Principal Normalization.

Joint Plot of Category Points

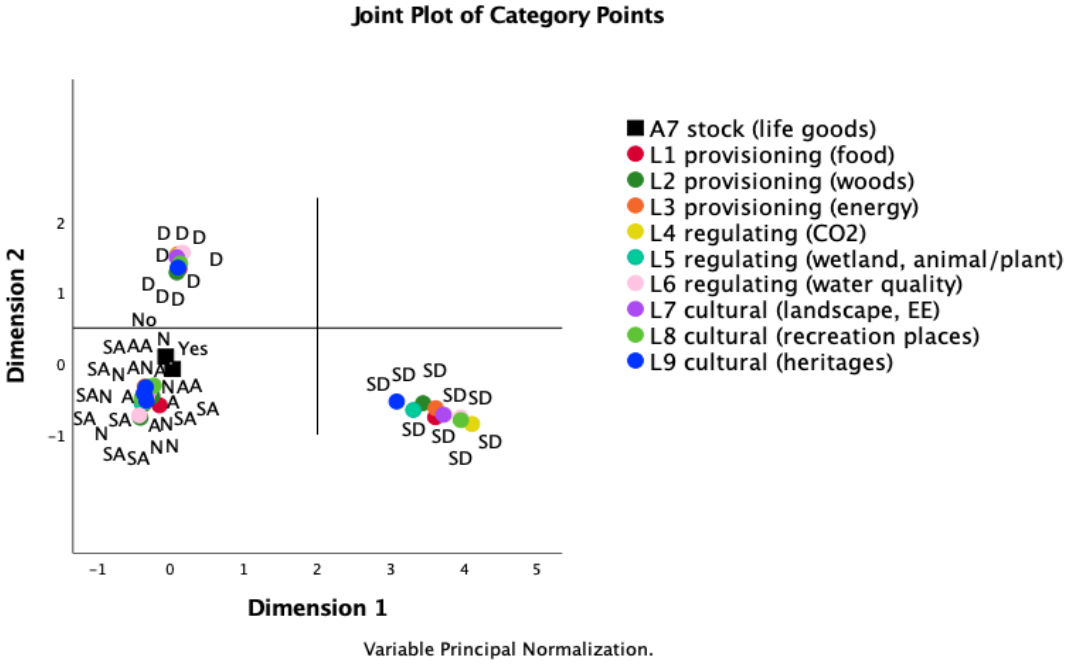


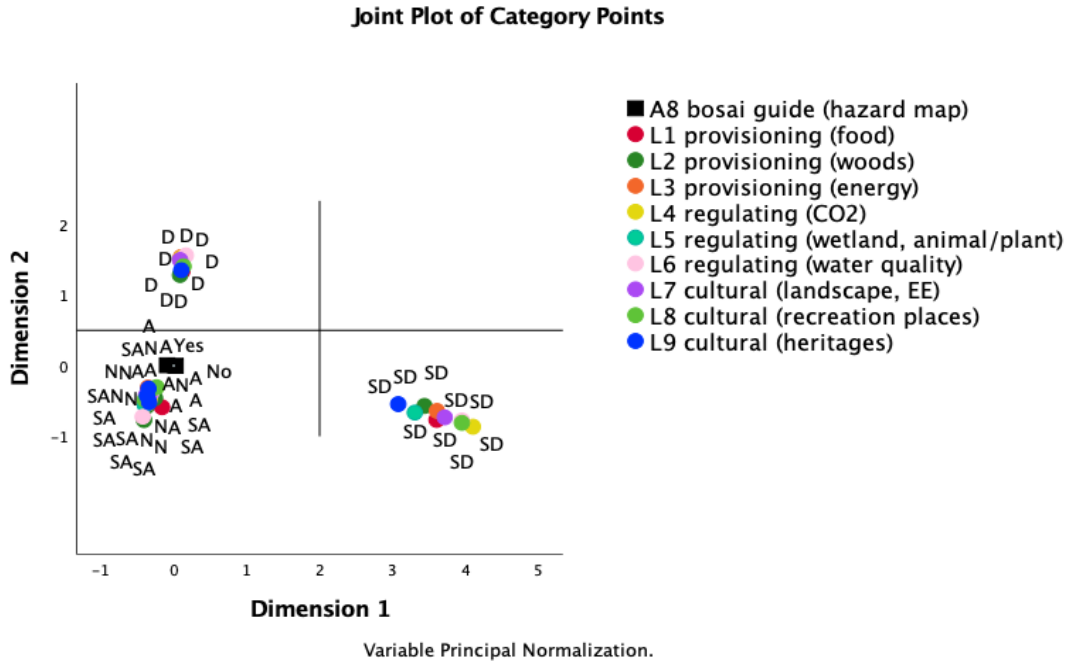
Variable Principal Normalization.

Joint Plot of Category Points

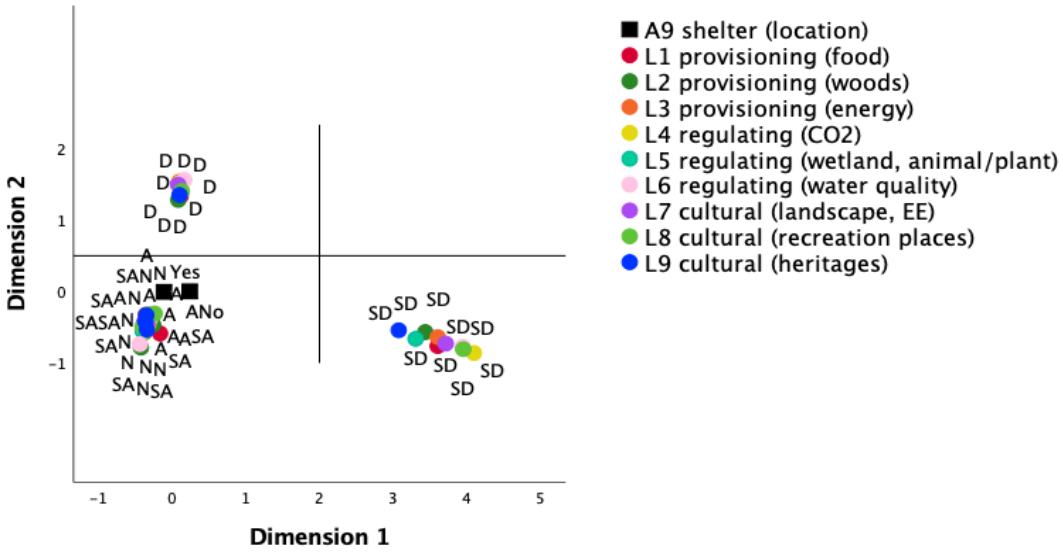


Variable Principal Normalization.


Joint Plot of Category Points
Dimension 2
Dimension 1
A7 stock (life goods)
L1 provisioning (food)
L2 provisioning (woods)
L3 provisioning (energy)
L4 regulating (CO2)
L5 regulating (wetland, animal/plant)
L6 regulating (water quality)
L7 cultural (landscape, EE)
L8 cultural (recreation places)
L9 cultural (heritages)
Variable Principal Normalization.

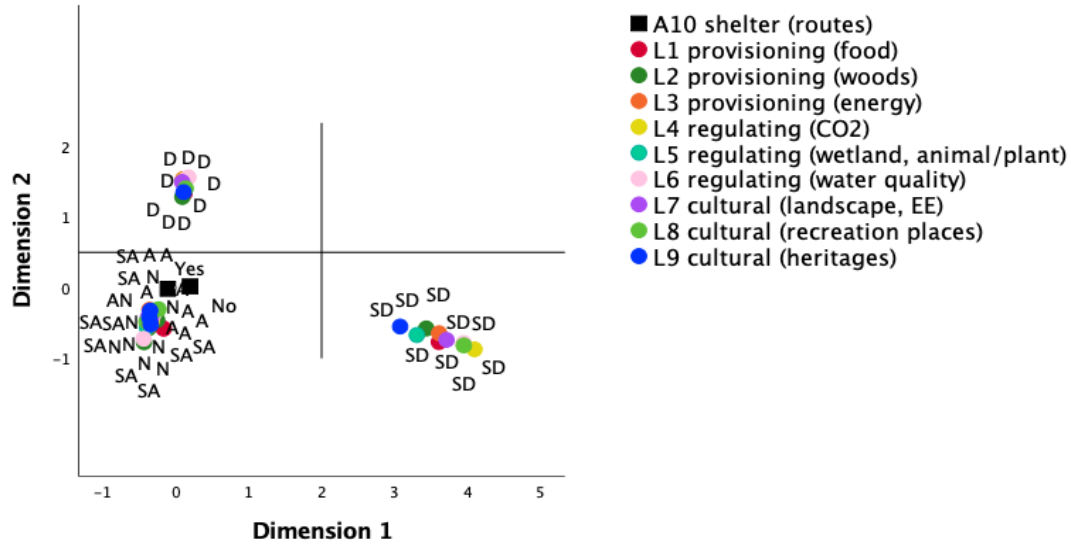

Joint Plot of Category Points
Dimension 2
Dimension 1
A8 bosai guide (hazard map)
L1 provisioning (food)
L2 provisioning (woods)
L3 provisioning (energy)
L4 regulating (CO2)
L5 regulating (wetland, animal/plant)
L6 regulating (water quality)
L7 cultural (landscape, EE)
L8 cultural (recreation places)
L9 cultural (heritages)
Variable Principal Normalization.

Joint Plot of Category Points



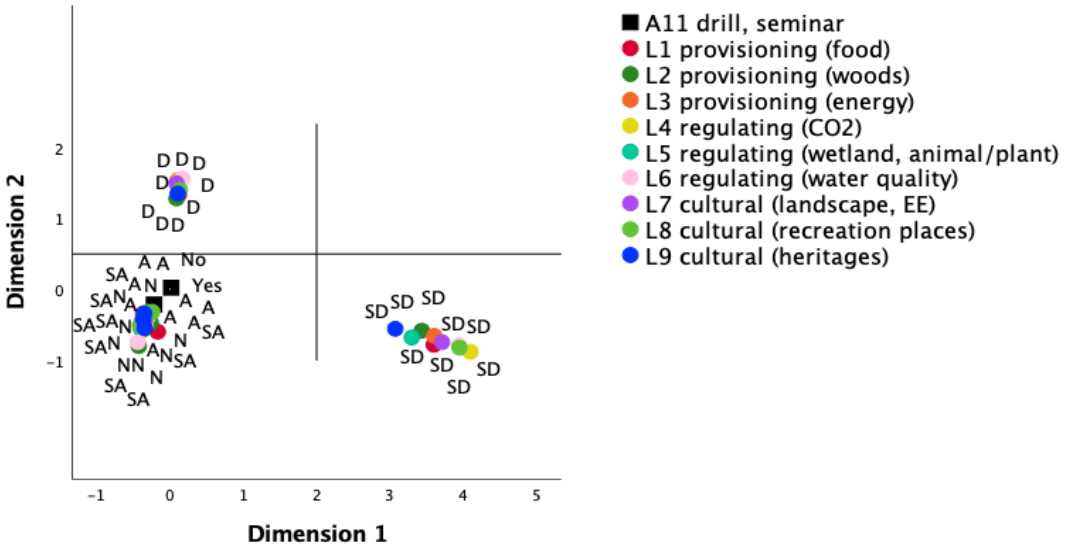
Variable Principal Normalization.

Joint Plot of Category Points



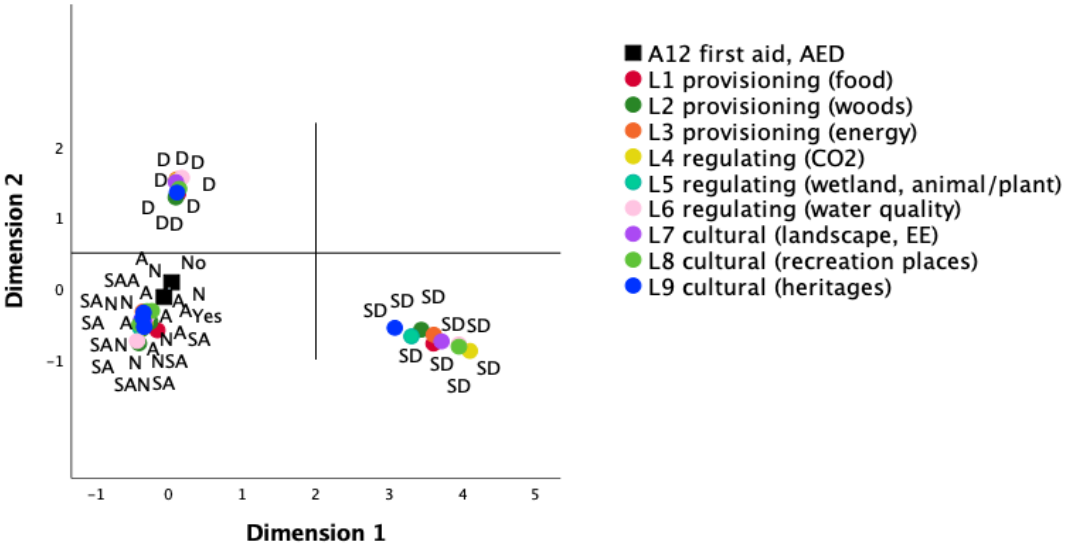
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

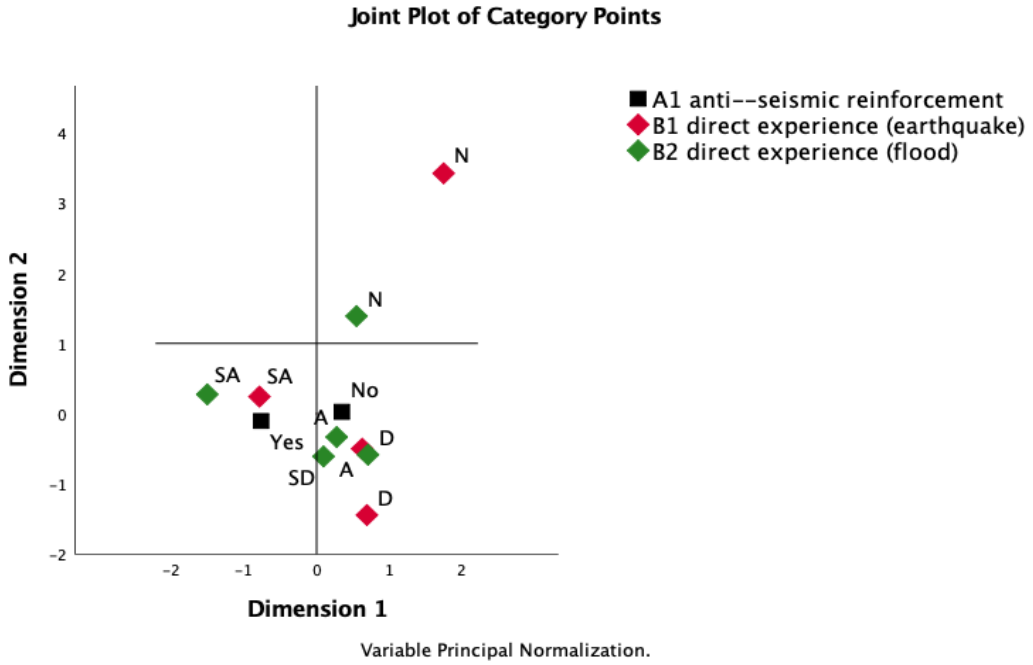
Joint Plot of Category Points

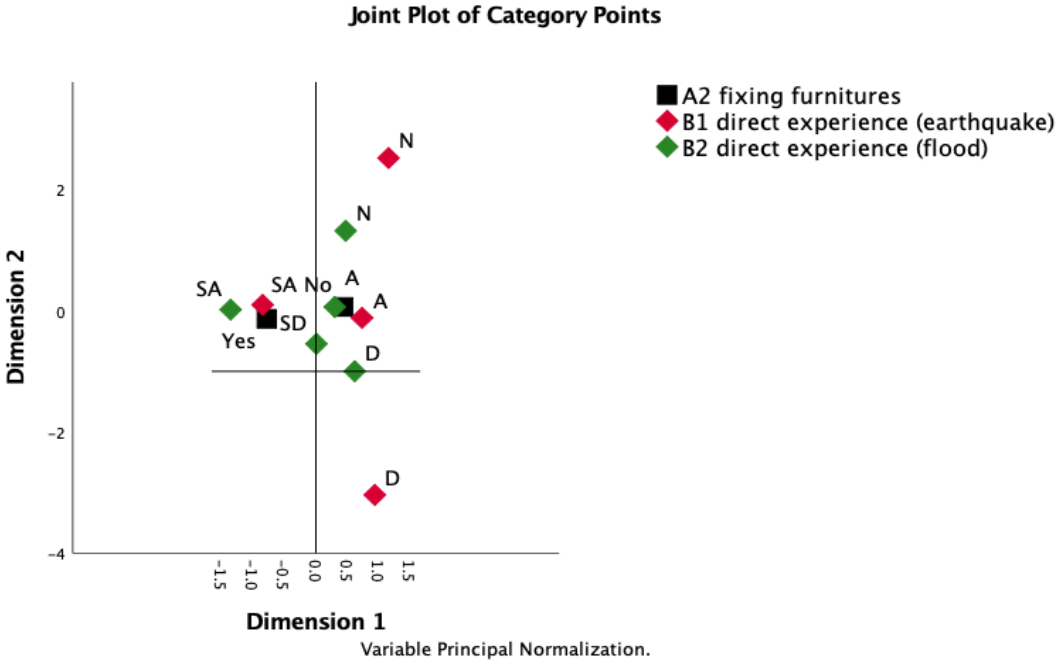


Variable Principal Normalization.

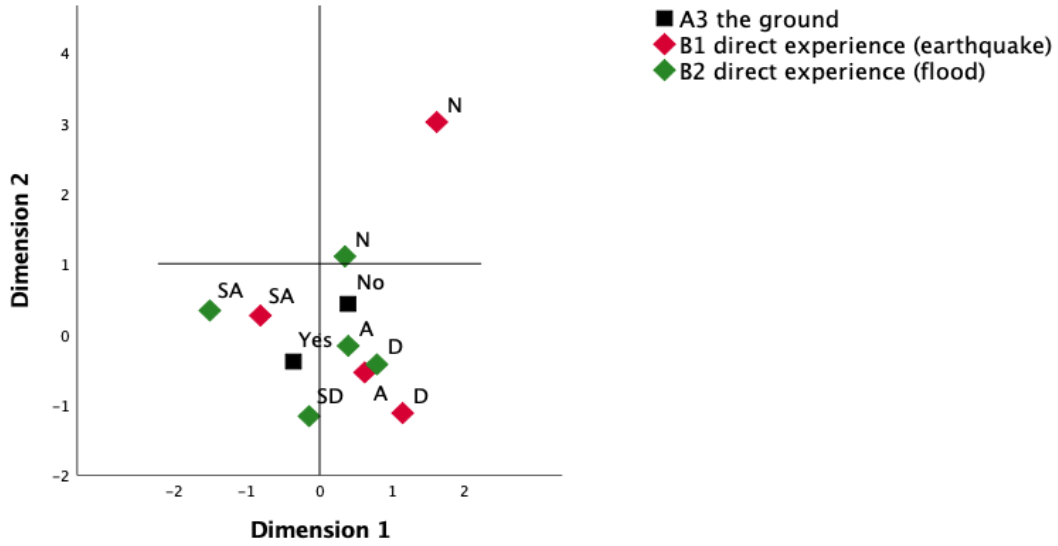
APPENDIX C: Chapter 5 Results of Multi Correspondence Analysis

Analysis (2)



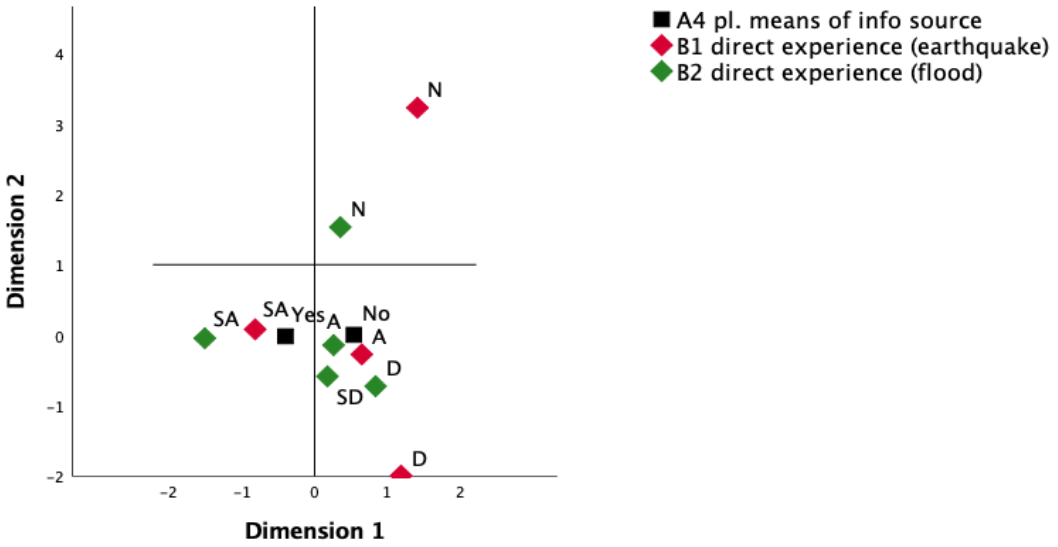


Joint Plot of Category Points



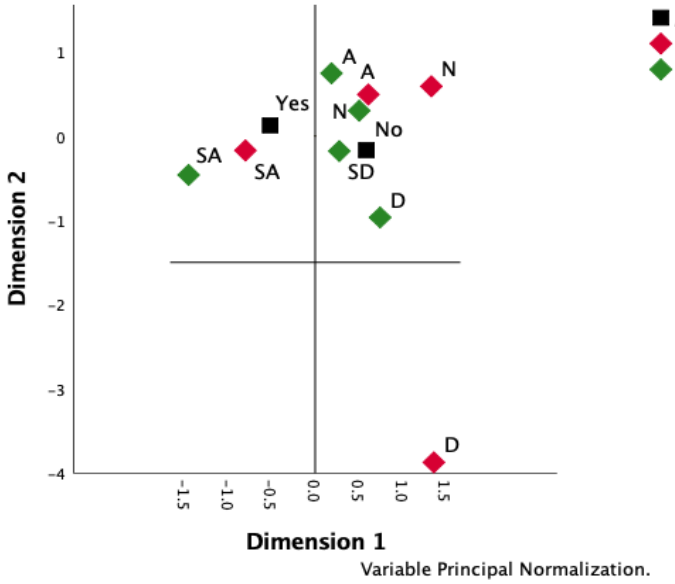
Variable Principal Normalization.

Joint Plot of Category Points



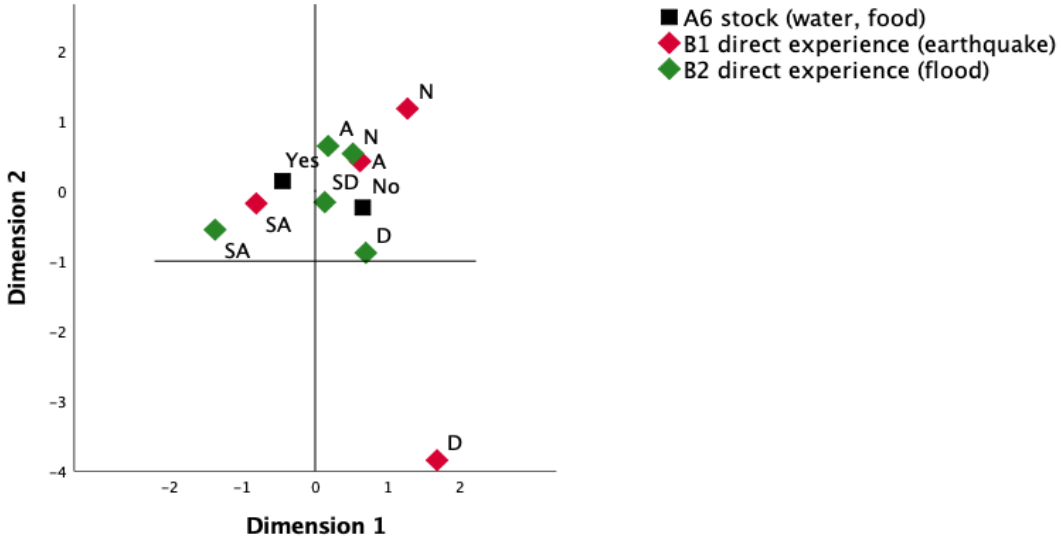
Variable Principal Normalization.

Joint Plot of Category Points



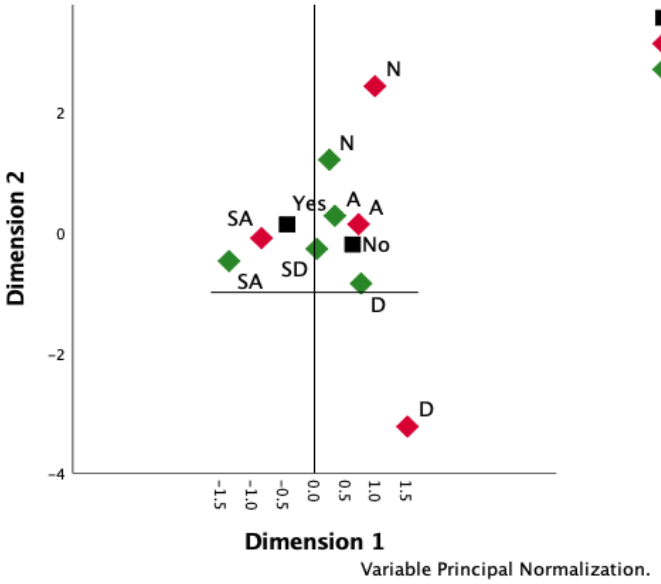
Variable Principal Normalization.

Joint Plot of Category Points



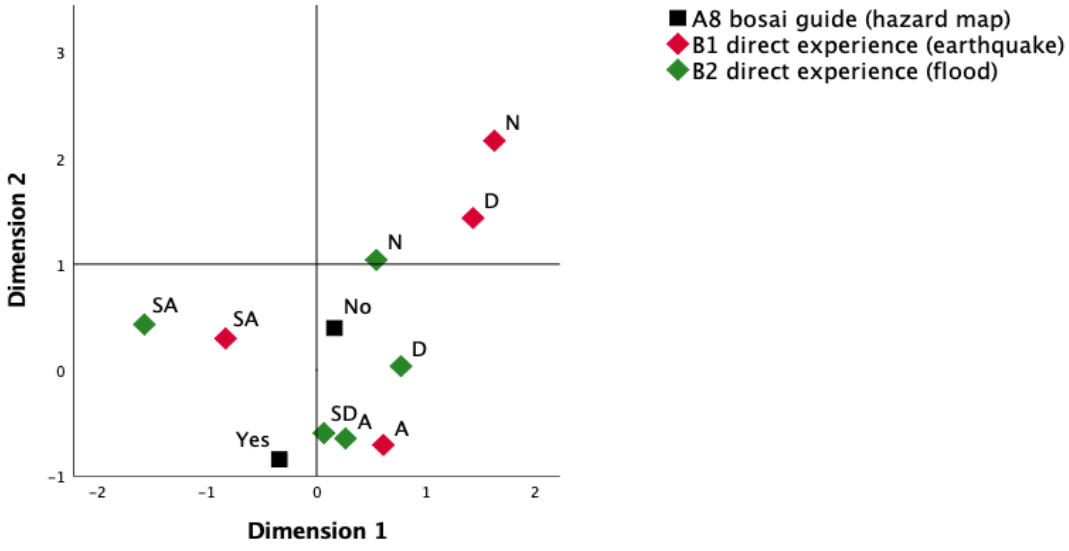
Variable Principal Normalization.

Joint Plot of Category Points



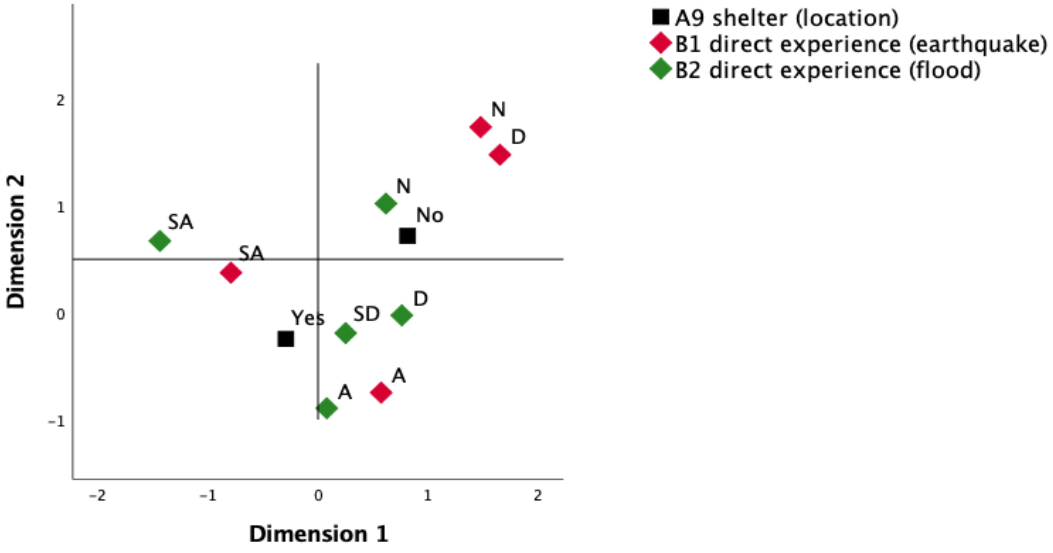
Variable Principal Normalization.

Joint Plot of Category Points



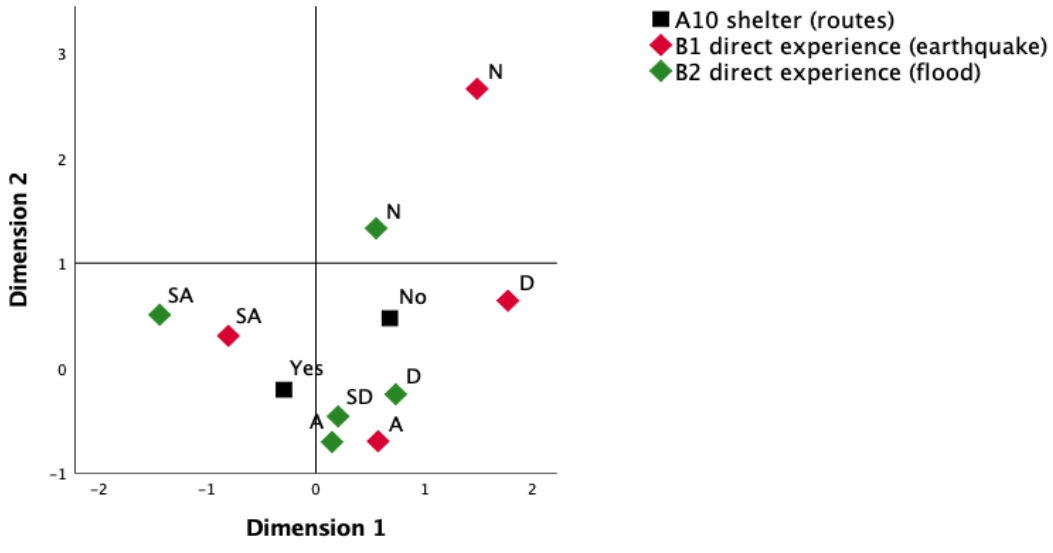
Variable Principal Normalization.

Joint Plot of Category Points

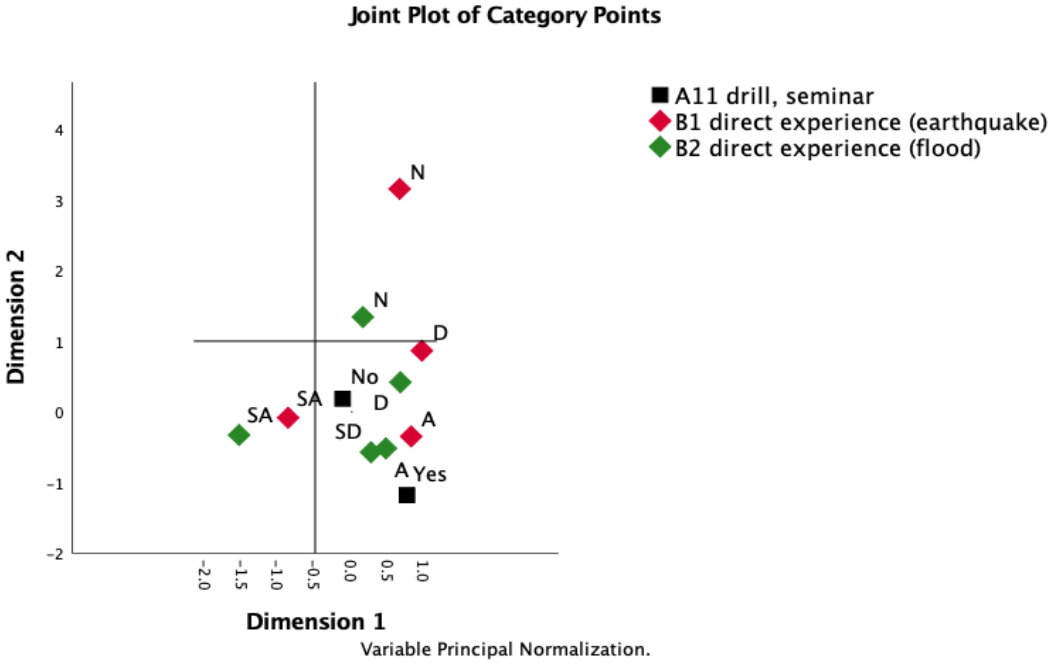


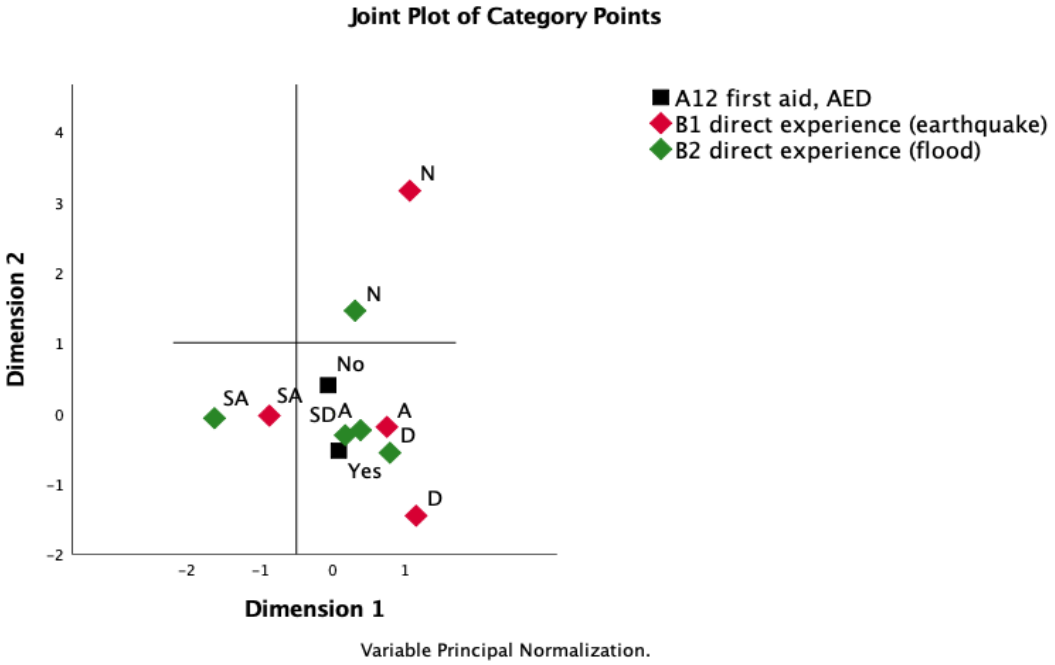
Variable Principal Normalization.

Joint Plot of Category Points

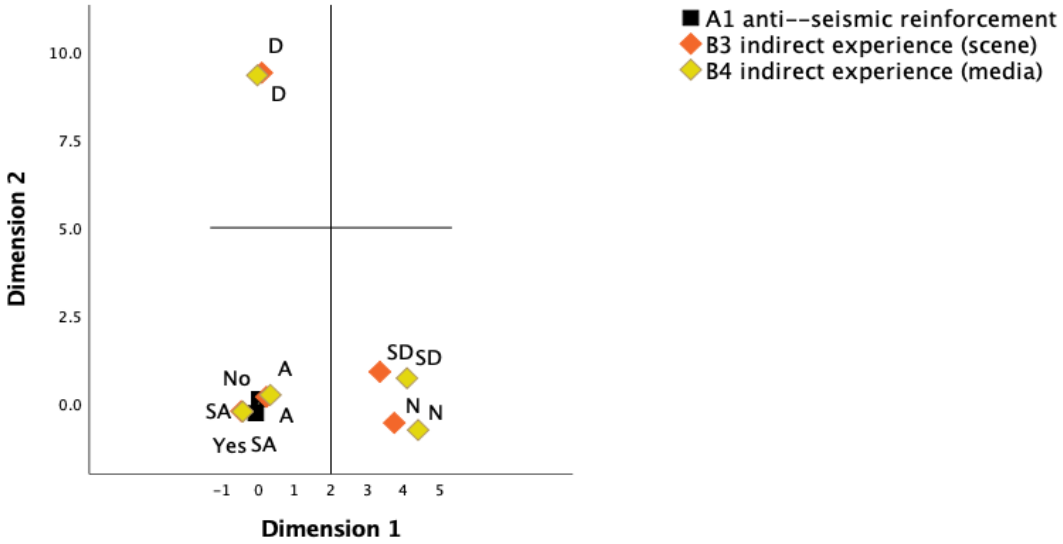


Variable Principal Normalization.


Joint Plot of Category Points
A11 drill, seminar
B1 direct experience (earthquake)
B2 direct experience (flood)
Dimension 2
Dimension 1
N
N
D
No
SA
SA
D
SD
A
A
Yes
Variable Principal Normalization.

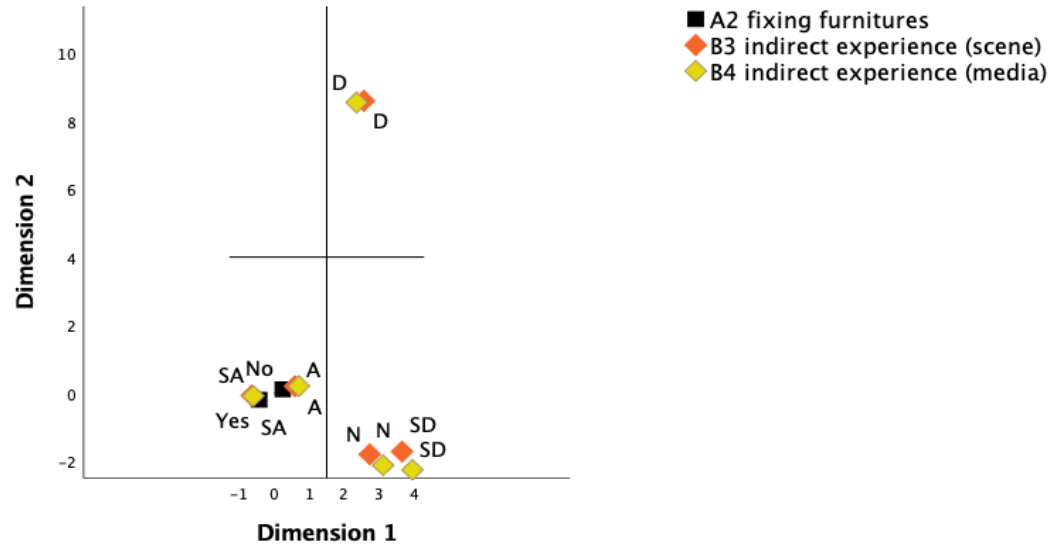

Joint Plot of Category Points
A12 first aid, AED
B1 direct experience (earthquake)
B2 direct experience (flood)
Dimension 2
Dimension 1
N
N
No
SA
SA
SD
A
A
D
Yes
D
Variable Principal Normalization.

Joint Plot of Category Points



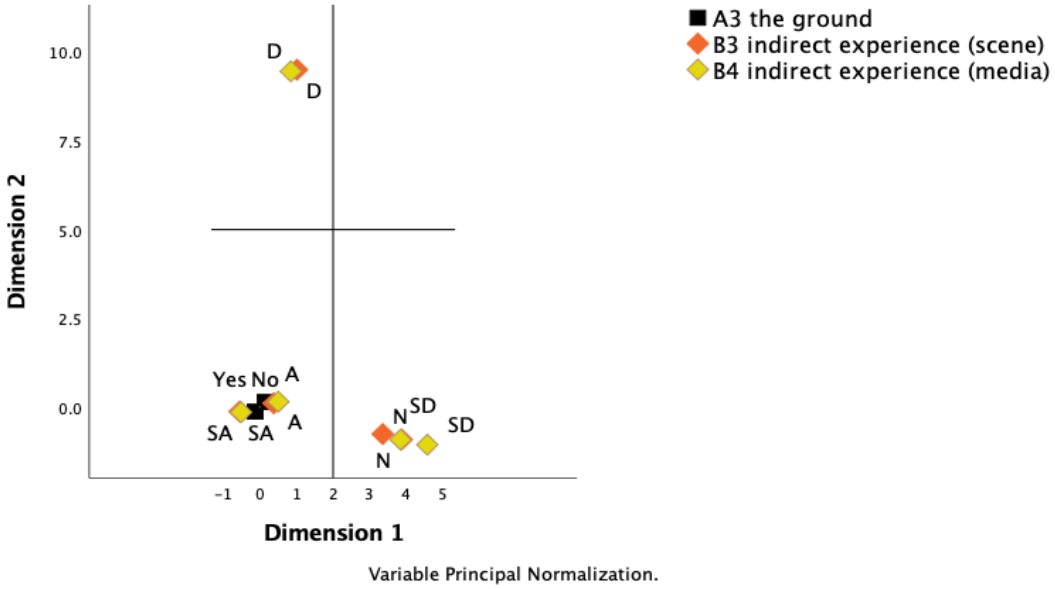
Variable Principal Normalization.

Joint Plot of Category Points



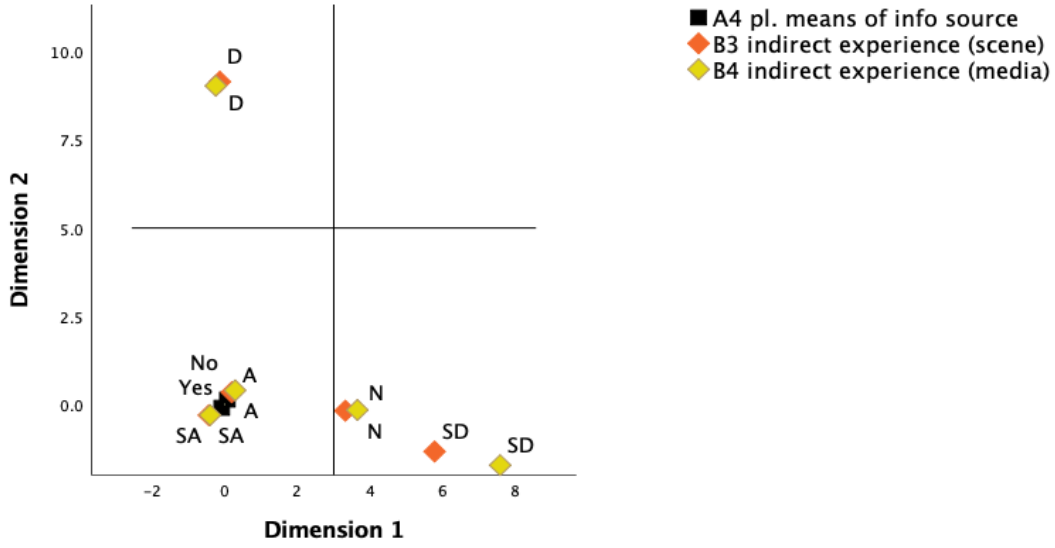
Variable Principal Normalization.

Joint Plot of Category Points



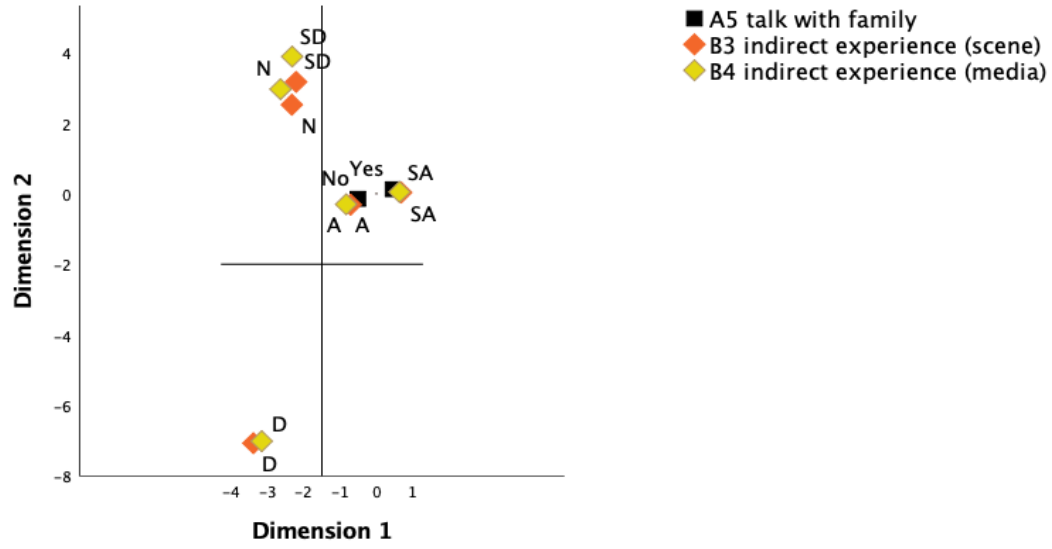
Variable Principal Normalization.

Joint Plot of Category Points



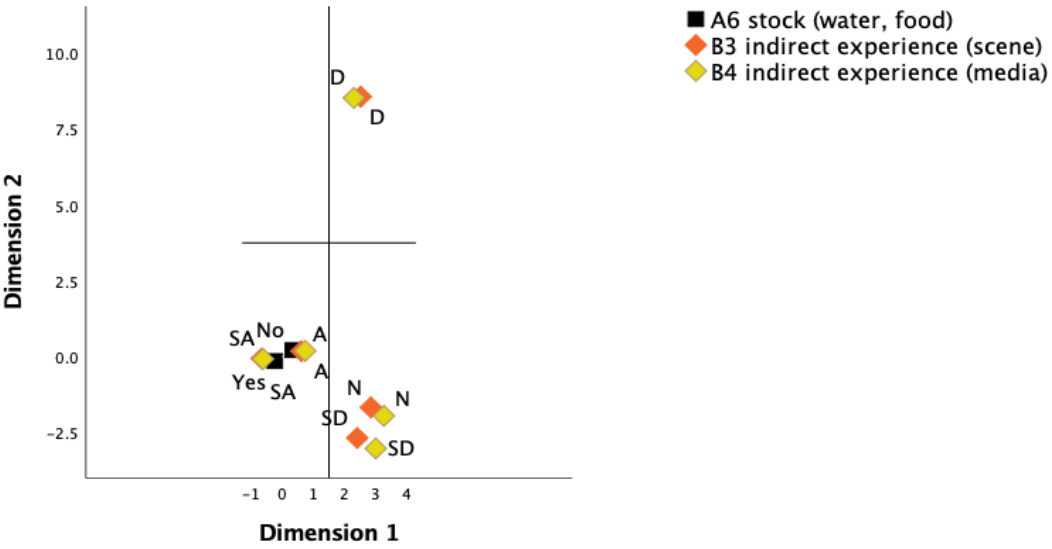
Variable Principal Normalization.

Joint Plot of Category Points



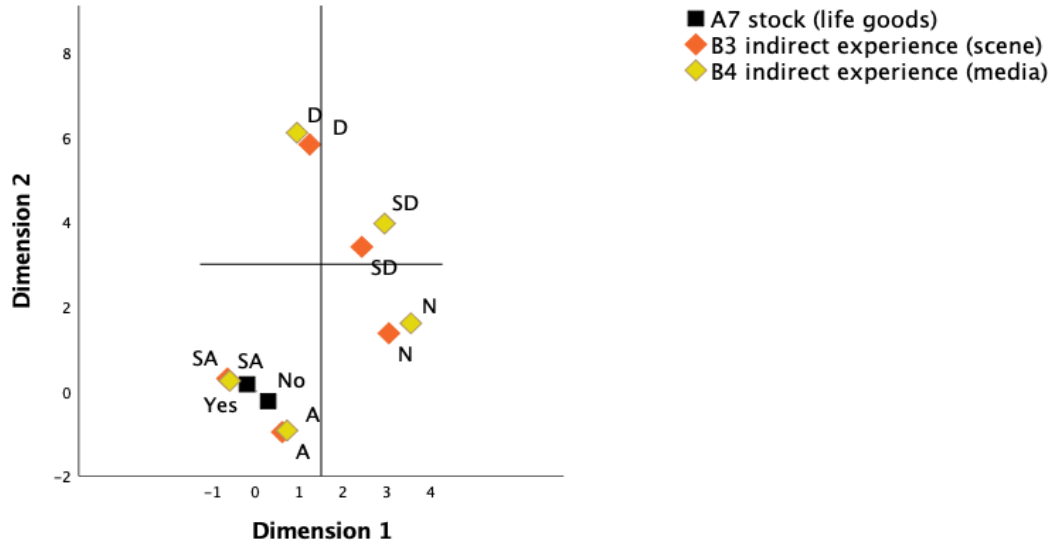
Variable Principal Normalization.

Joint Plot of Category Points



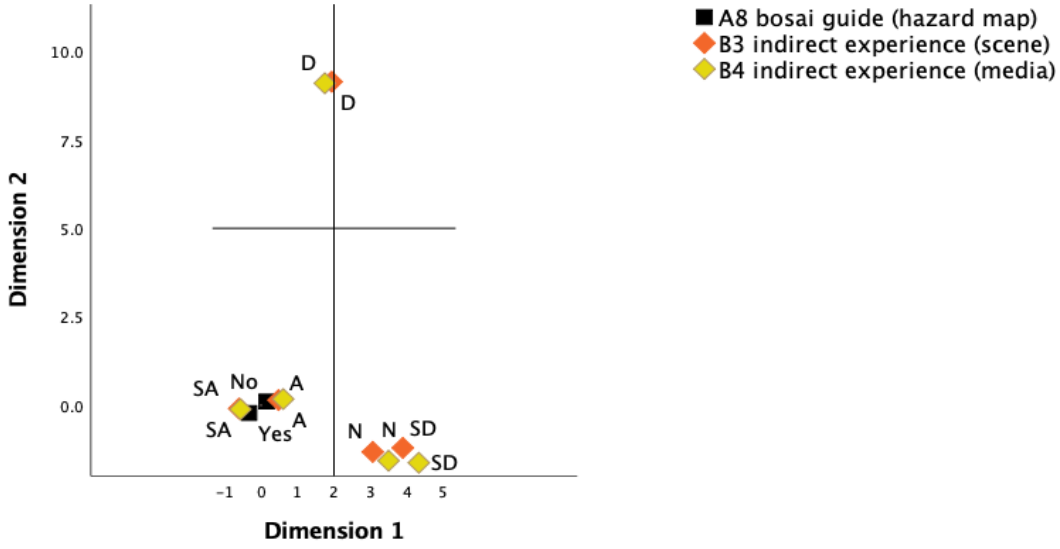
Variable Principal Normalization.

Joint Plot of Category Points



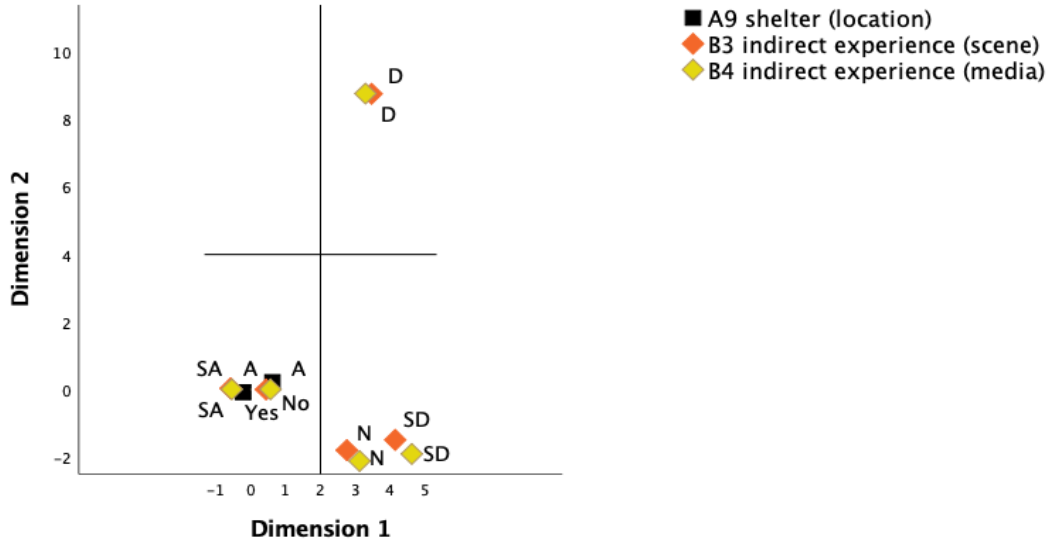
Variable Principal Normalization.

Joint Plot of Category Points



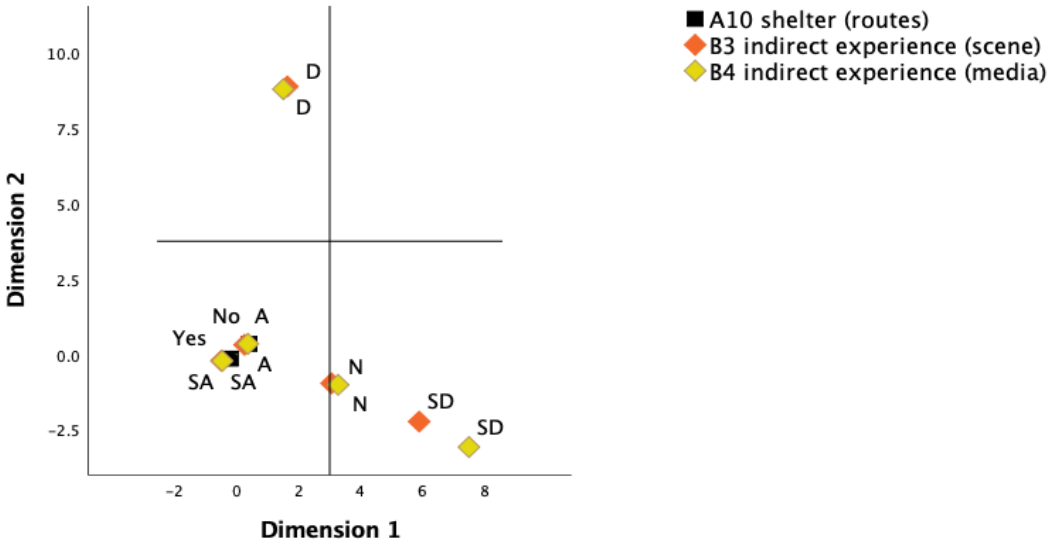
Variable Principal Normalization.

Joint Plot of Category Points



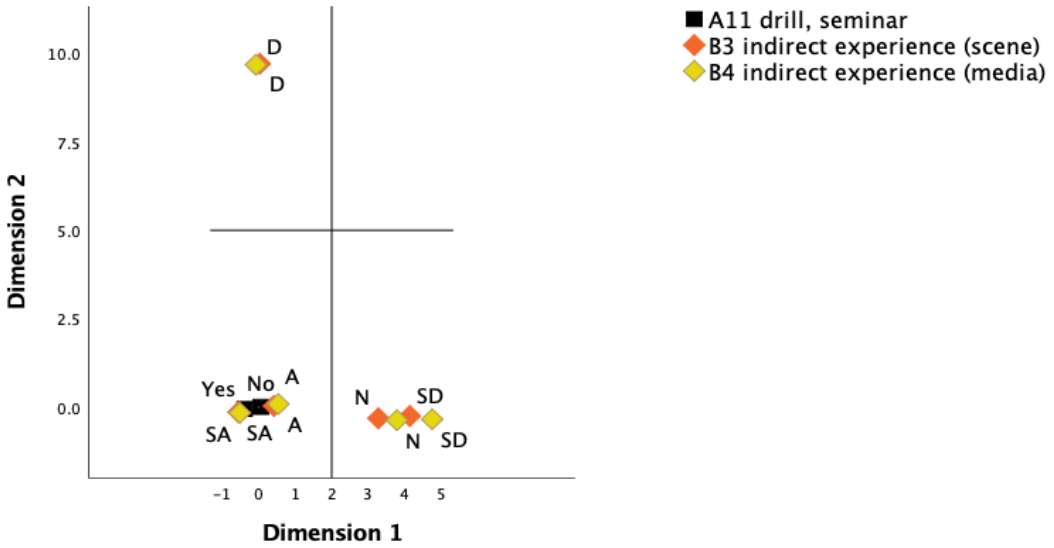
Variable Principal Normalization.

Joint Plot of Category Points



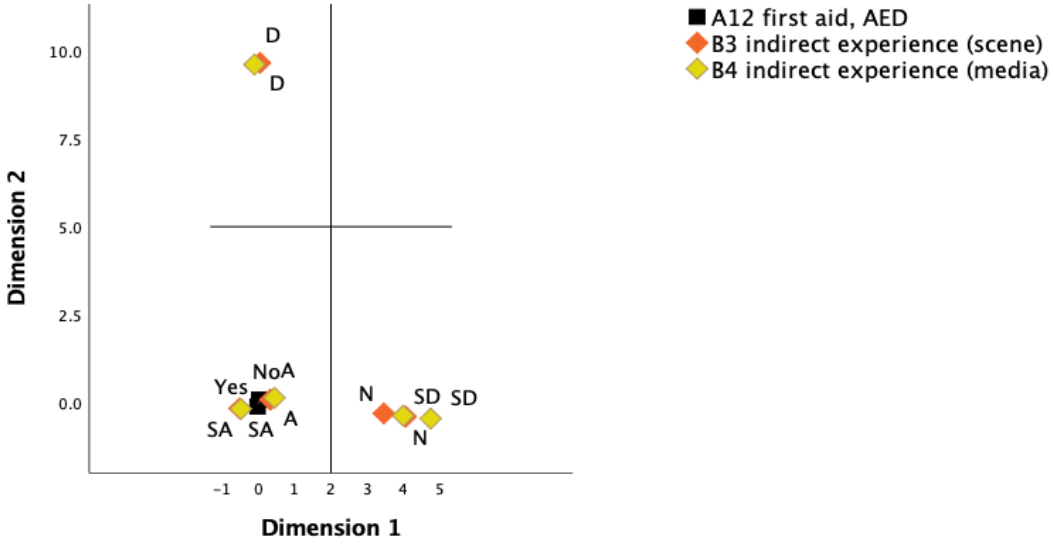
Variable Principal Normalization.

Joint Plot of Category Points

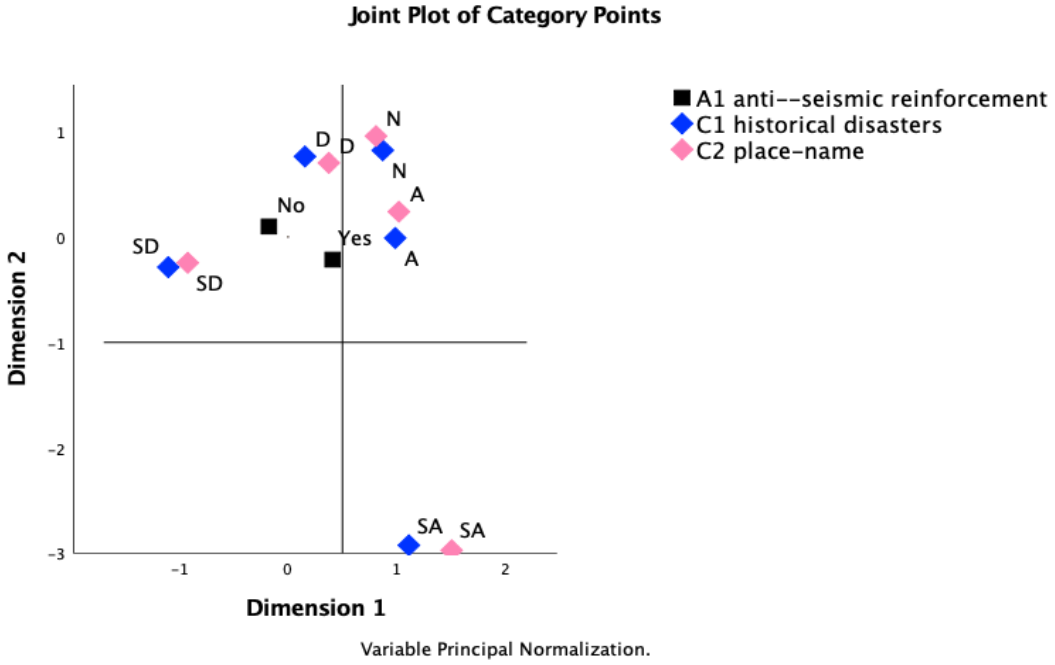


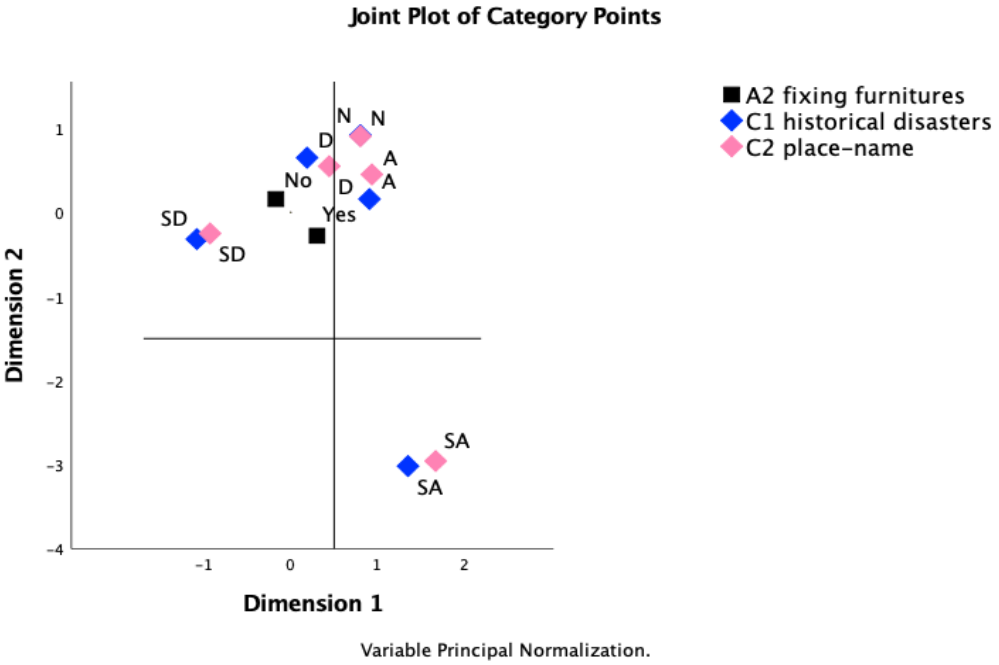
Variable Principal Normalization.

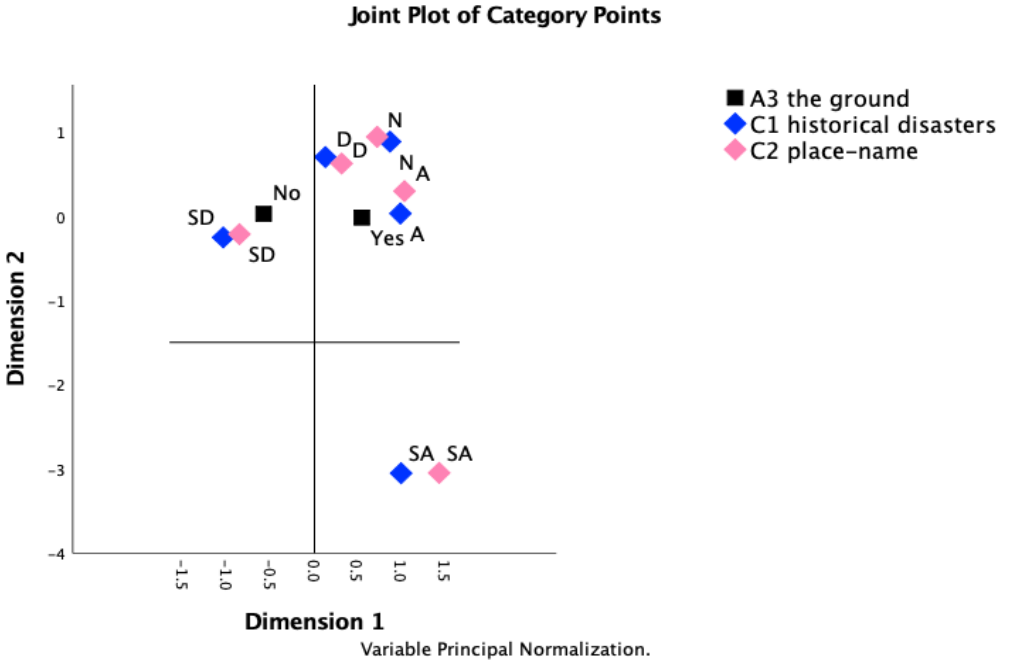
Joint Plot of Category Points

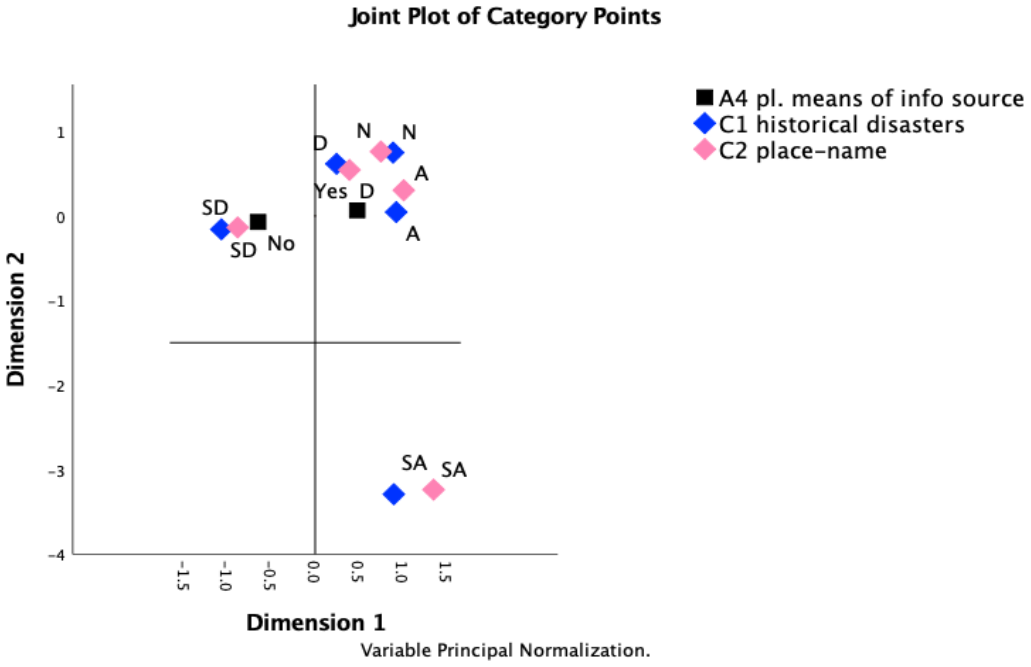


Variable Principal Normalization.

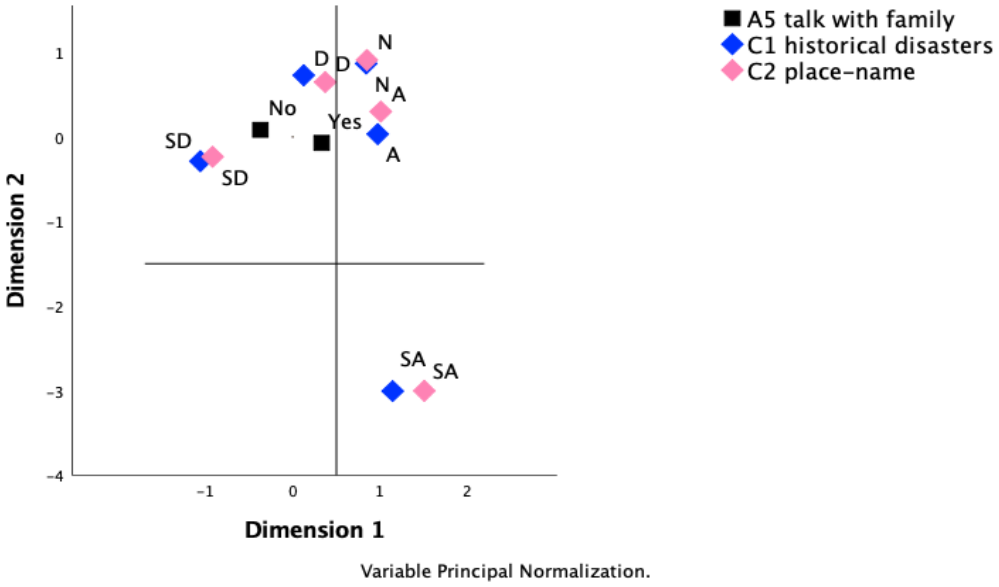

Joint Plot of Category Points
A1 anti--seismic reinforcement
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
N
D
D
N
A
No
Yes
A
SD
SD
SA
SA
1
0
-1
-2
-3
-1
0
1
2
Variable Principal Normalization.


Joint Plot of Category Points
A2 fixing furnitures
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
N
N
D
A
No
D
A
Yes
SD
SD
SA
SA
1
0
-1
-2
-3
-4
-1
0
1
2
Variable Principal Normalization.


Joint Plot of Category Points
A3 the ground
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
Variable Principal Normalization.
N
D
D
N
A
No
SD
Yes
A
SD
SA
SA

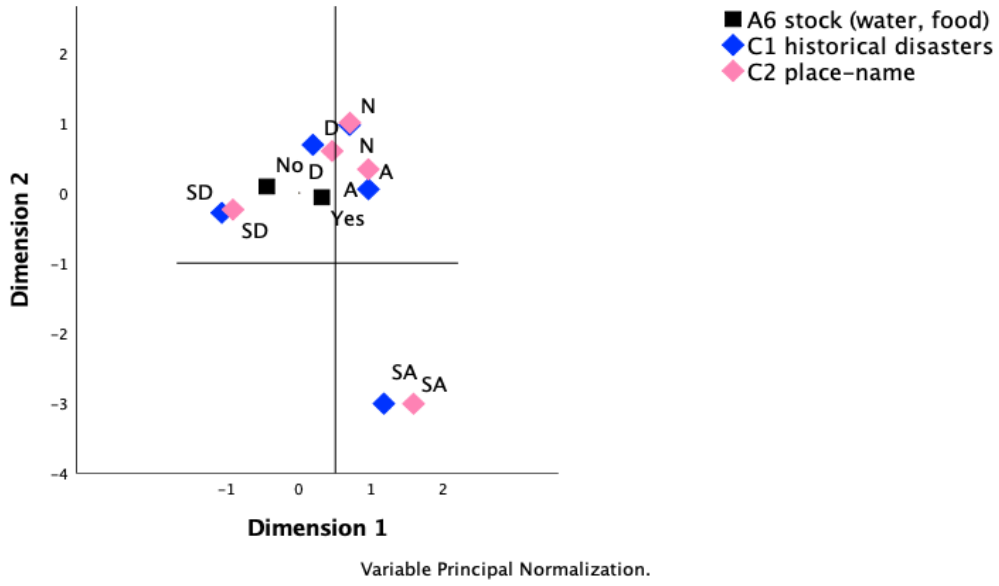

Joint Plot of Category Points
A4 pl. means of info source
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
Variable Principal Normalization.
D
N
N
A
Yes
D
SD
A
SD
No
SA
SA

Joint Plot of Category Points

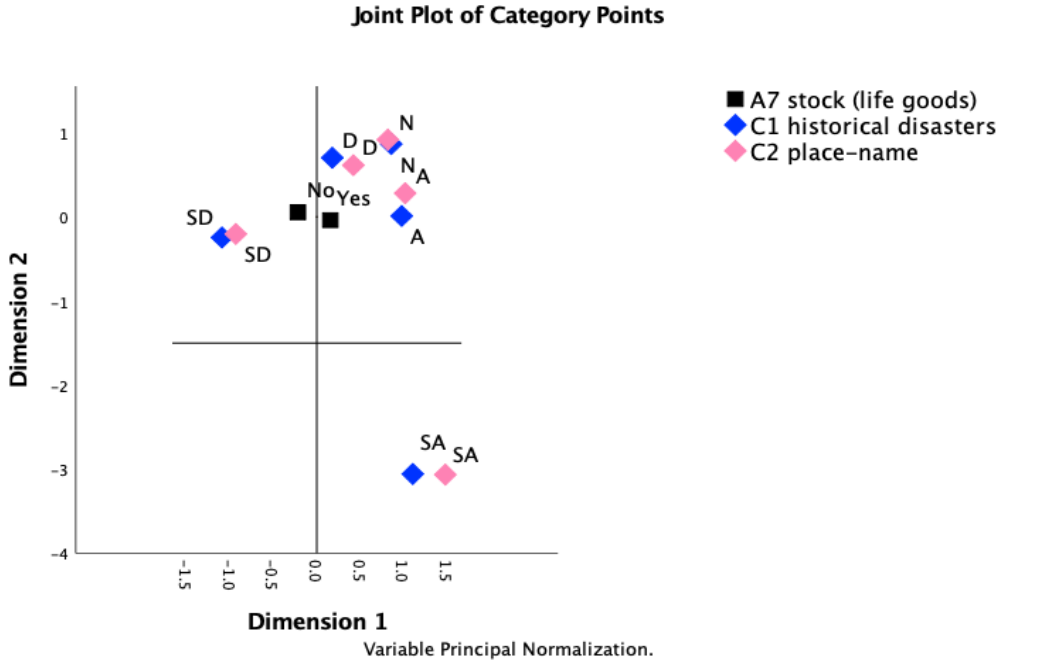


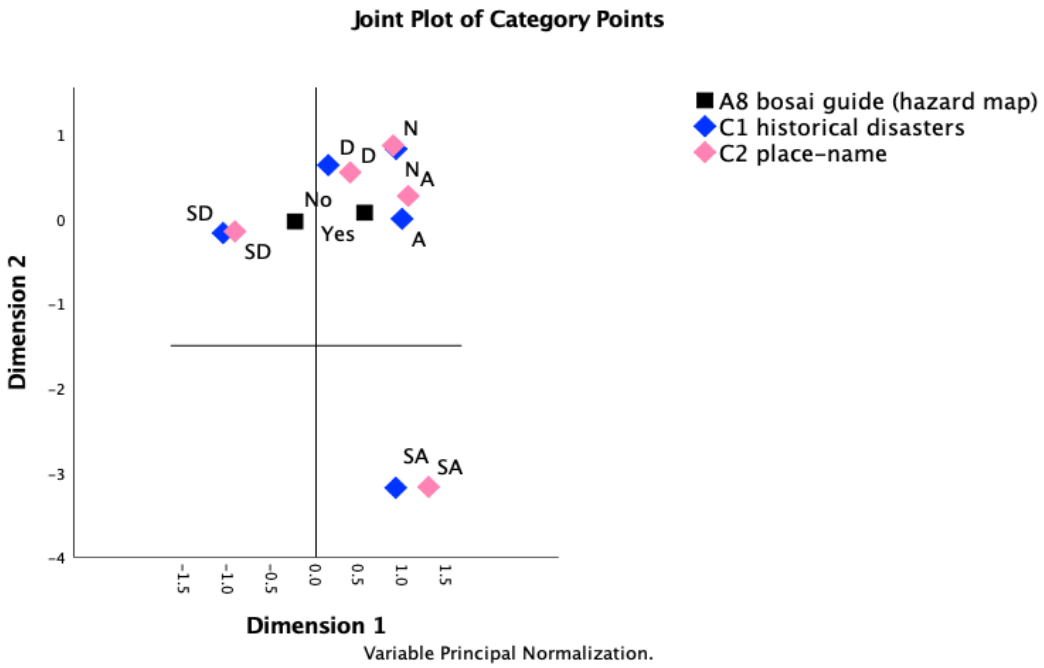
Variable Principal Normalization.

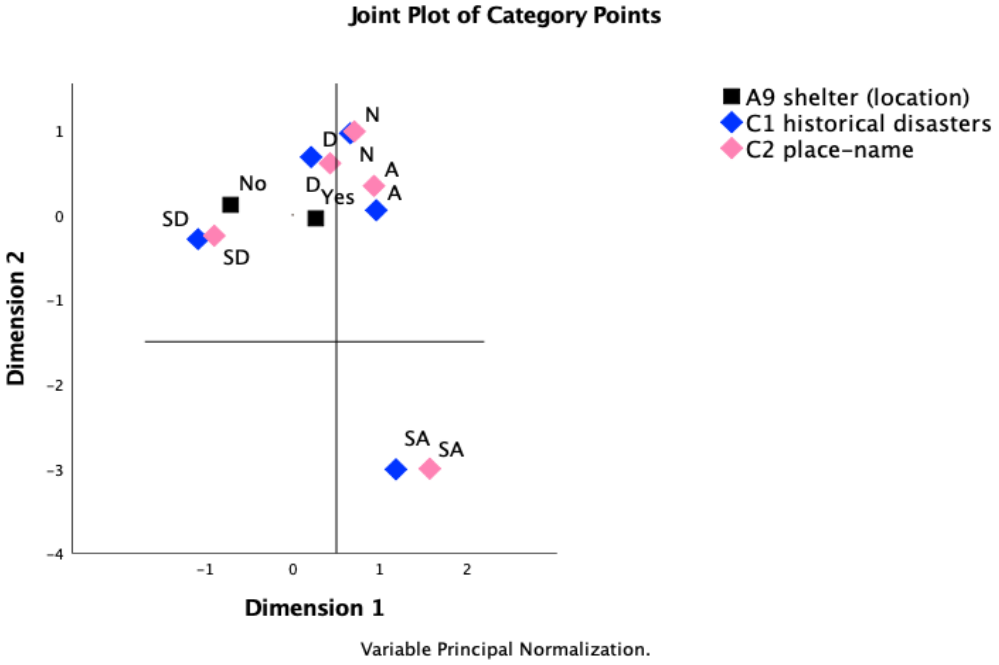
Joint Plot of Category Points

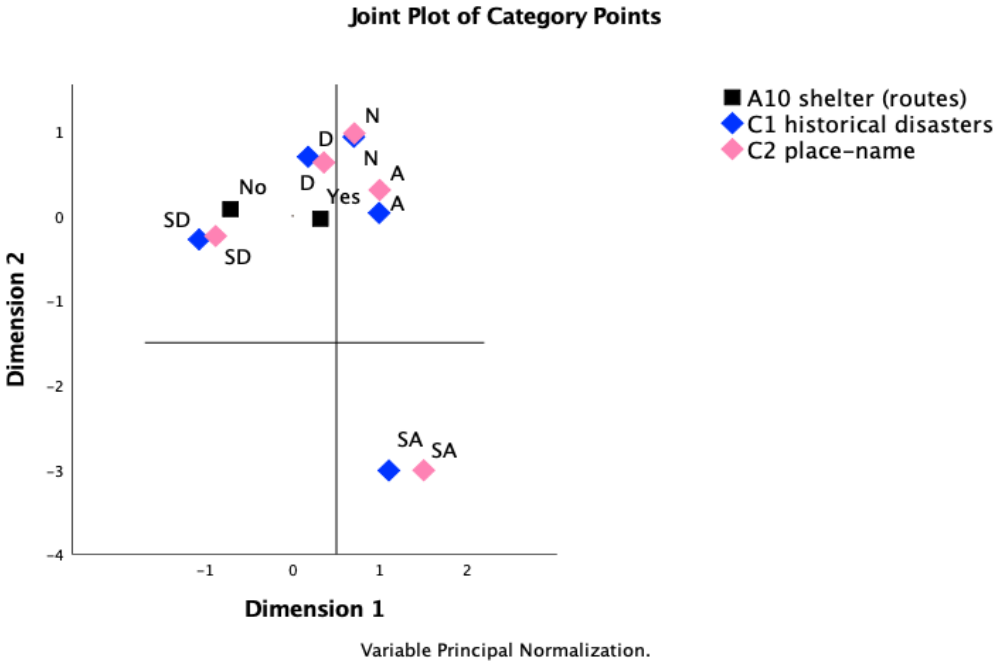


Variable Principal Normalization.

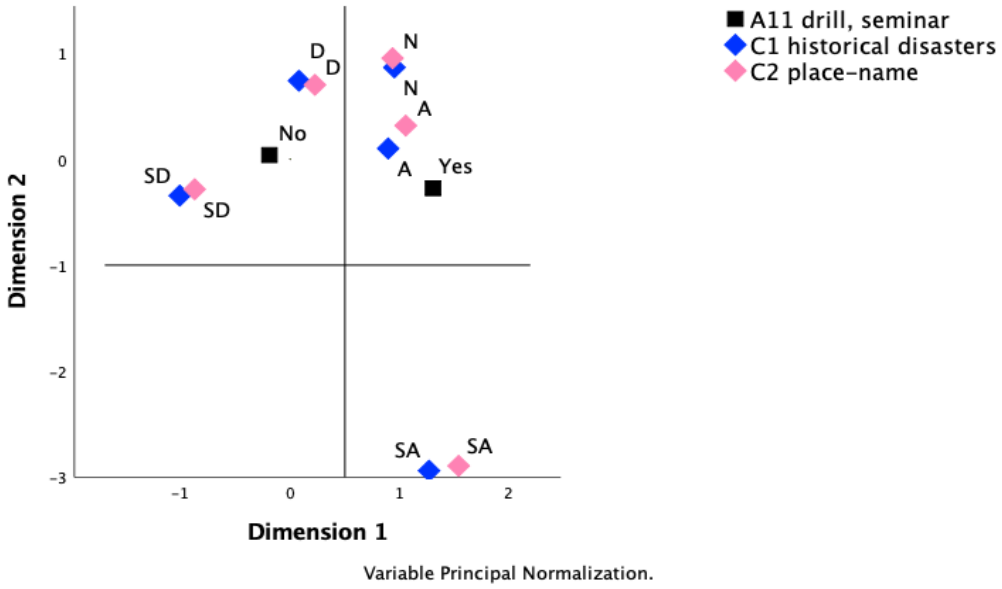

Joint Plot of Category Points
A7 stock (life goods)
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
N
D
D
N
A
No
Yes
SD
SD
A
SA
SA
1
0
−1
−2
−3
−4
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Variable Principal Normalization.


Joint Plot of Category Points
A8 bosai guide (hazard map)
C1 historical disasters
C2 place-name
Dimension 2
Dimension 1
N
D
D
N
A
No
Yes
SD
SD
A
SA
SA
1
0
−1
−2
−3
−4
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Variable Principal Normalization.


Joint Plot of Category Points
A9 shelter (location)
C1 historical disasters
C2 place-name
N
D
N
A
A
No
D
Yes
SD
SD
SA
SA
Dimension 2
Dimension 1
1
0
−1
−2
−3
−4
−1
0
1
2
Variable Principal Normalization.

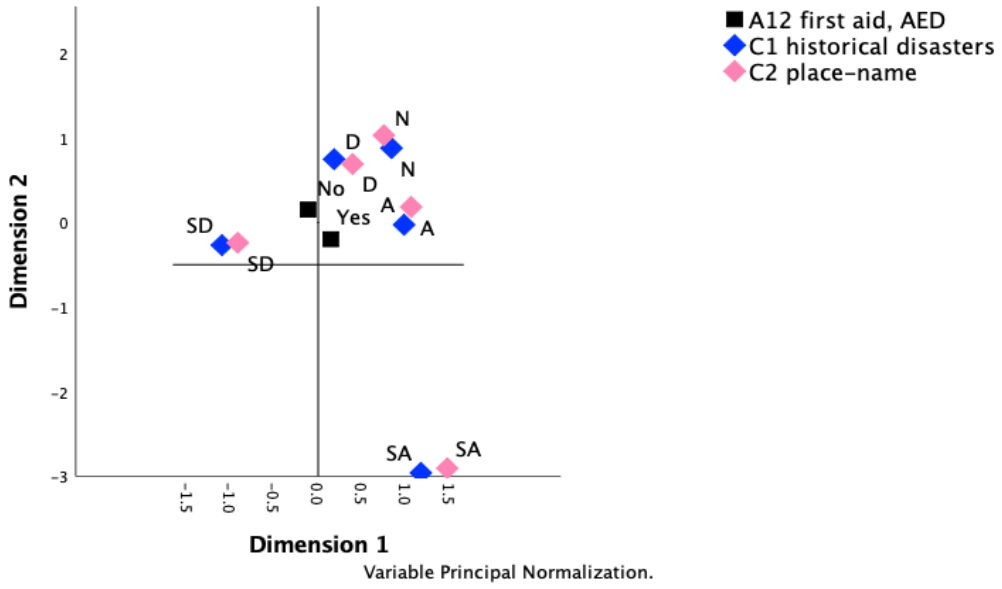

Joint Plot of Category Points
A10 shelter (routes)
C1 historical disasters
C2 place-name
N
D
N
A
A
No
D
Yes
SD
SD
SA
SA
Dimension 2
Dimension 1
1
0
−1
−2
−3
−4
−1
0
1
2
Variable Principal Normalization.

Joint Plot of Category Points

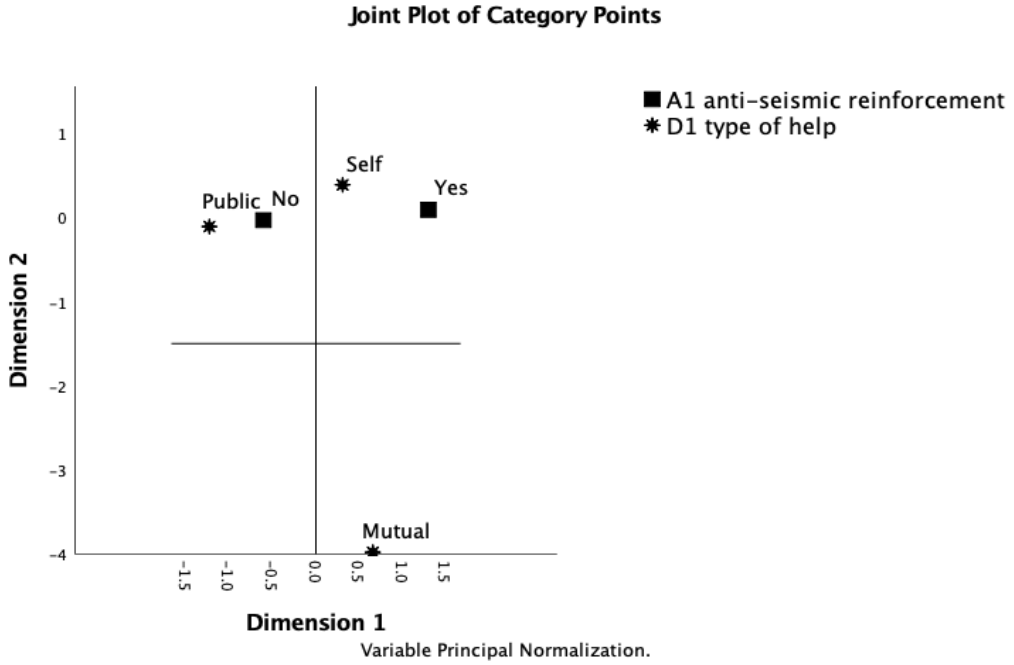


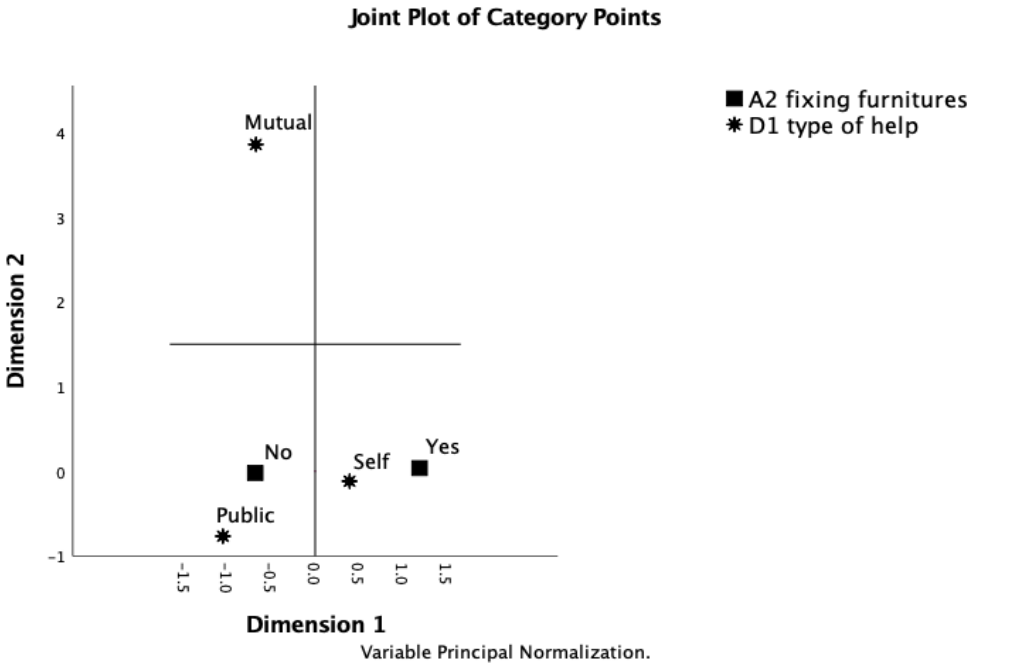
Variable Principal Normalization.

Joint Plot of Category Points

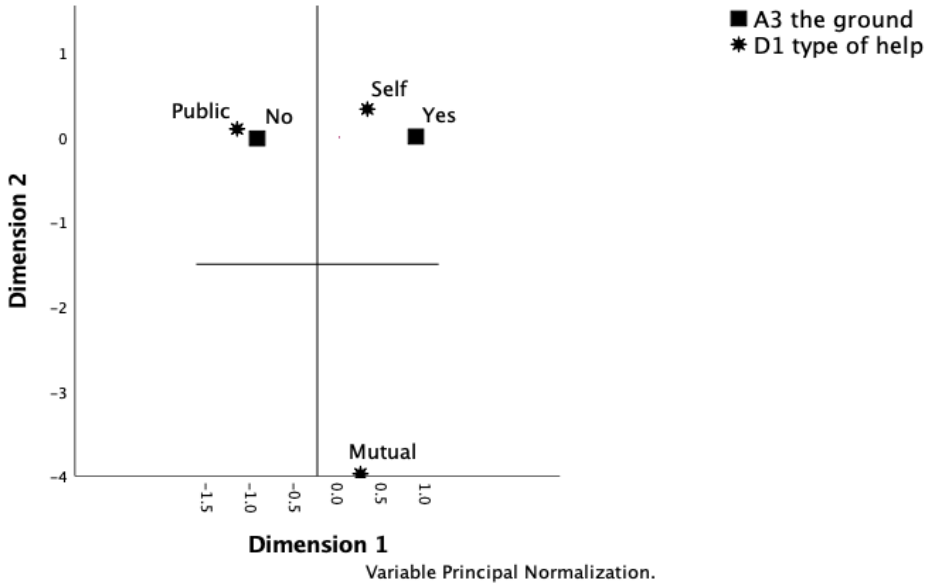


Variable Principal Normalization.


Joint Plot of Category Points
A1 anti-seismic reinforcement
D1 type of help
Self
Yes
Public
No
Mutual
Dimension 2
Dimension 1
Variable Principal Normalization.

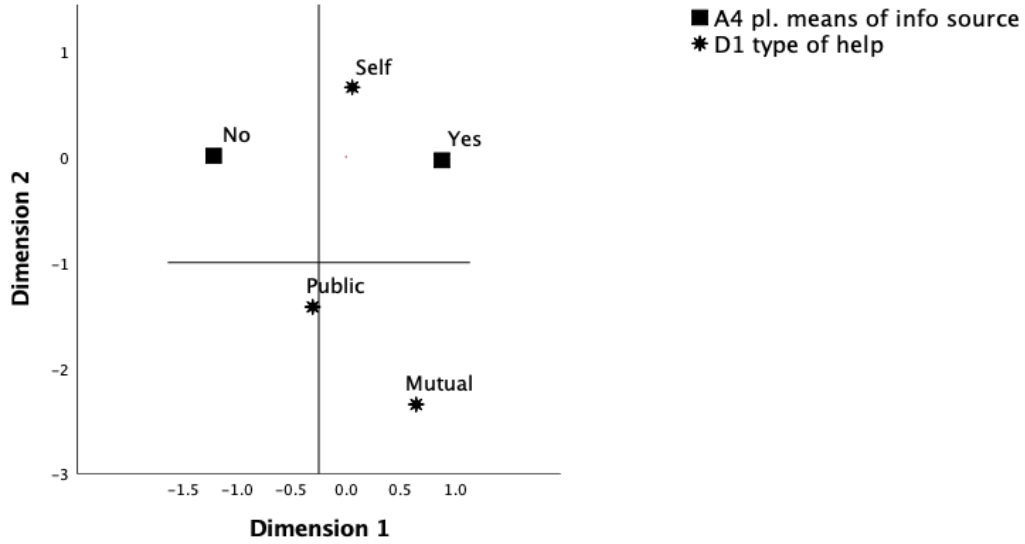

Joint Plot of Category Points
A2 fixing furnitures
D1 type of help
Mutual
No
Self
Yes
Public
Dimension 2
Dimension 1
Variable Principal Normalization.

Joint Plot of Category Points

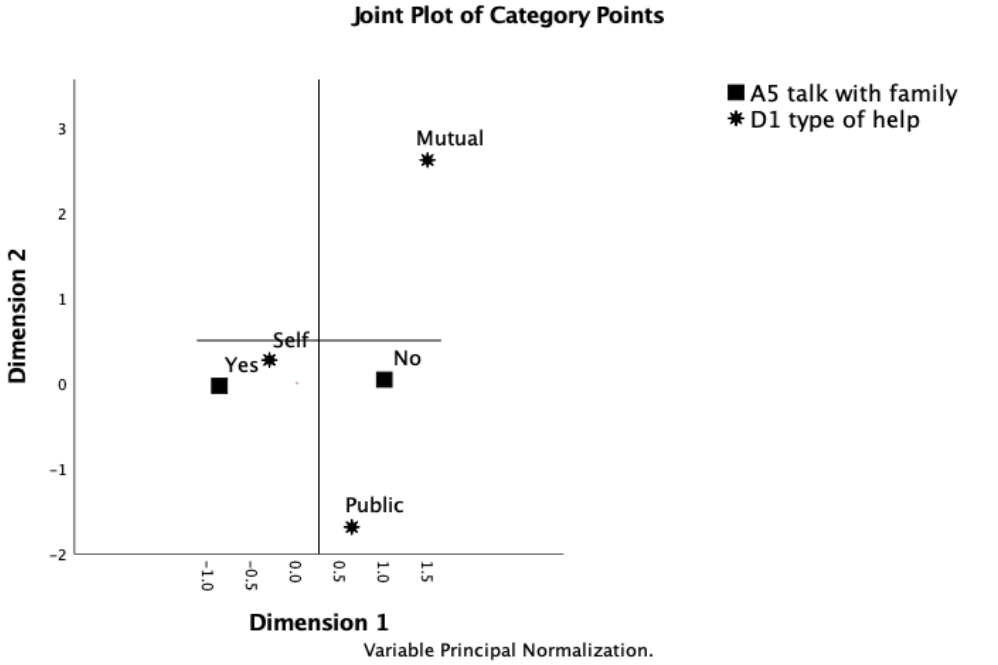


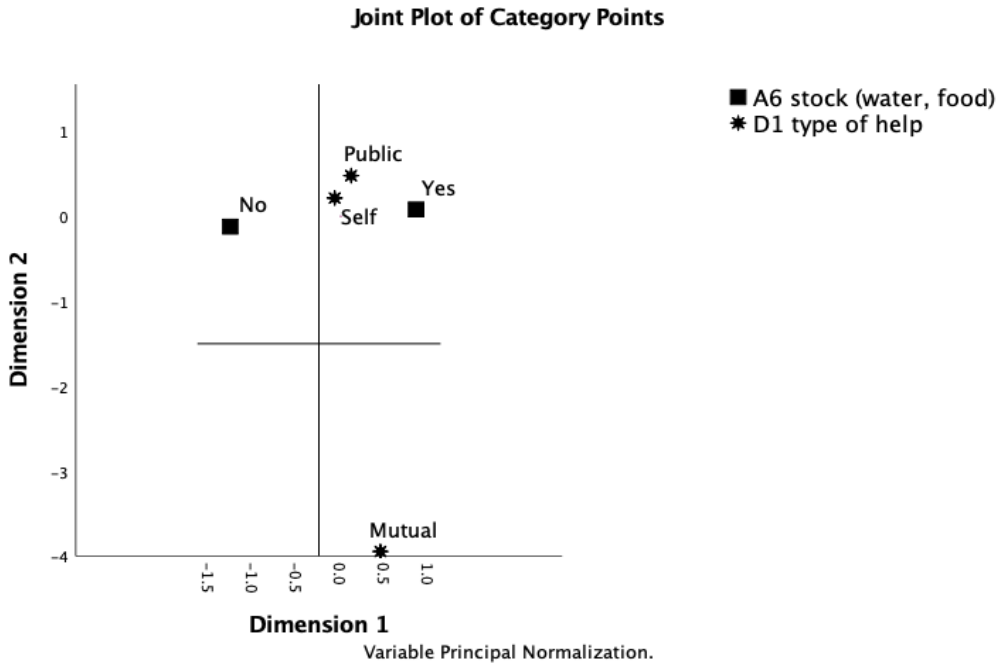
Variable Principal Normalization.

Joint Plot of Category Points

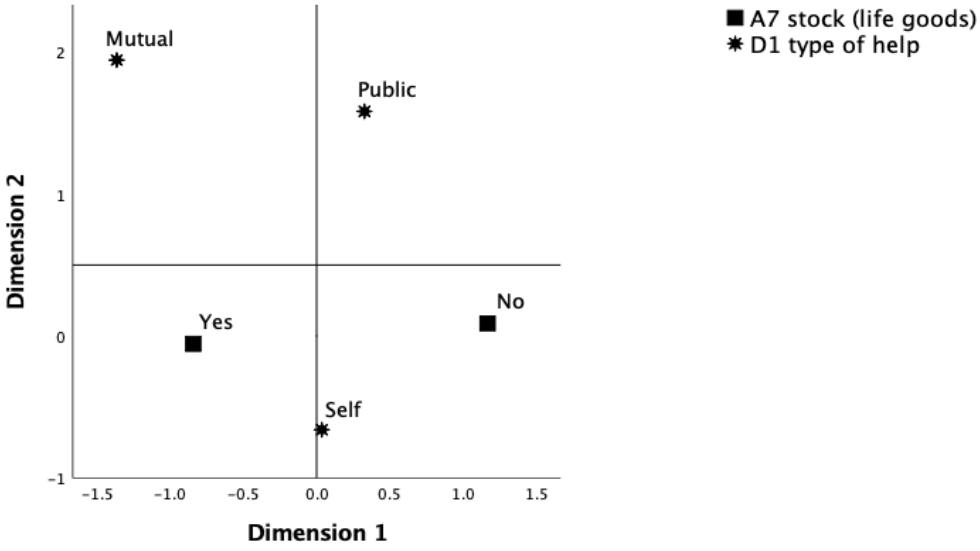


Variable Principal Normalization.


Joint Plot of Category Points
A5 talk with family
D1 type of help
Mutual
Self
Yes
No
Public
Dimension 2
Dimension 1
Variable Principal Normalization.

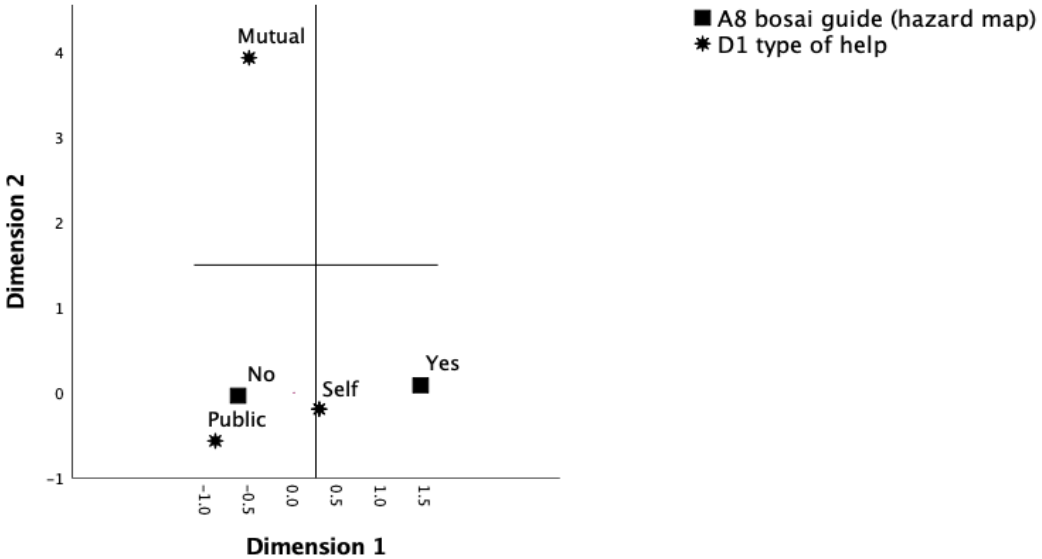

Joint Plot of Category Points
A6 stock (water, food)
D1 type of help
Public
Yes
No
Self
Mutual
Dimension 2
Dimension 1
Variable Principal Normalization.

Joint Plot of Category Points



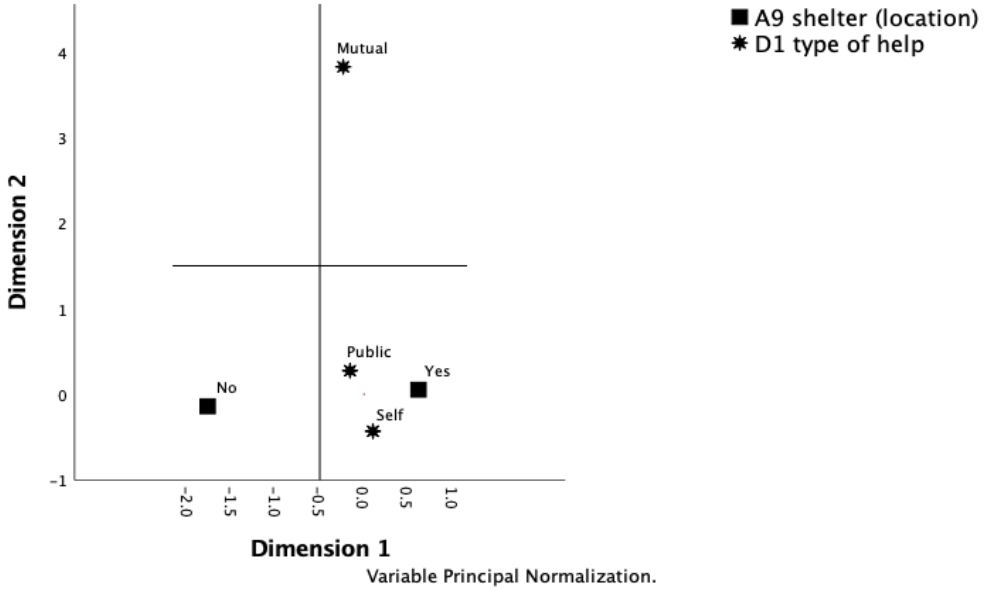
Variable Principal Normalization.

Joint Plot of Category Points



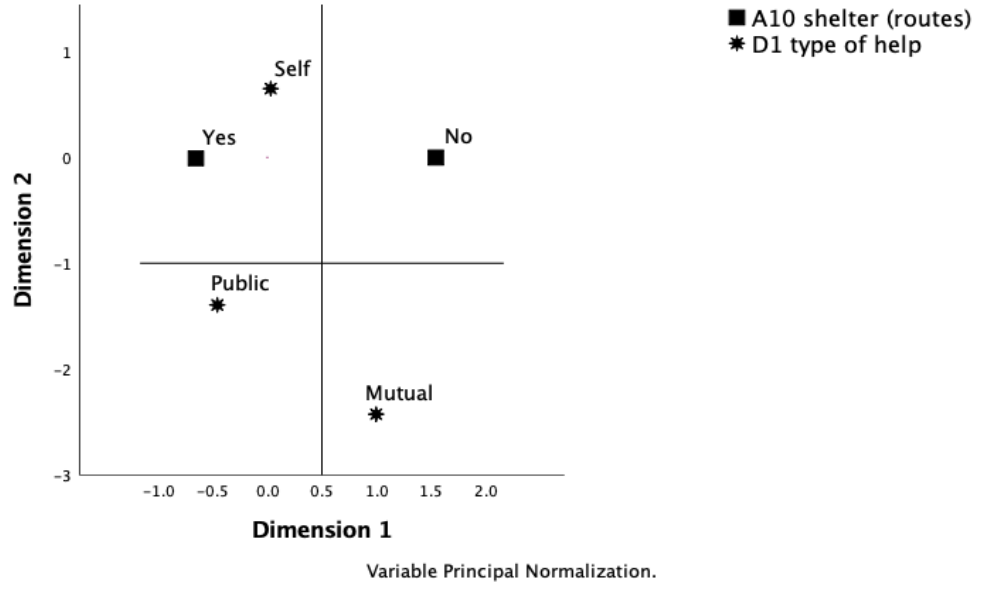
Variable Principal Normalization.

Joint Plot of Category Points



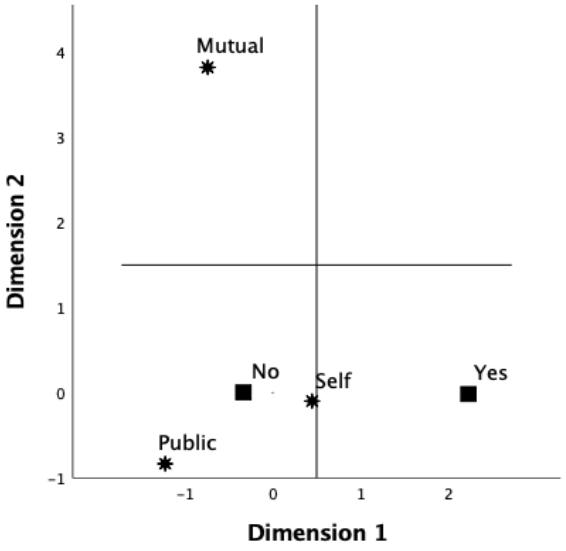
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

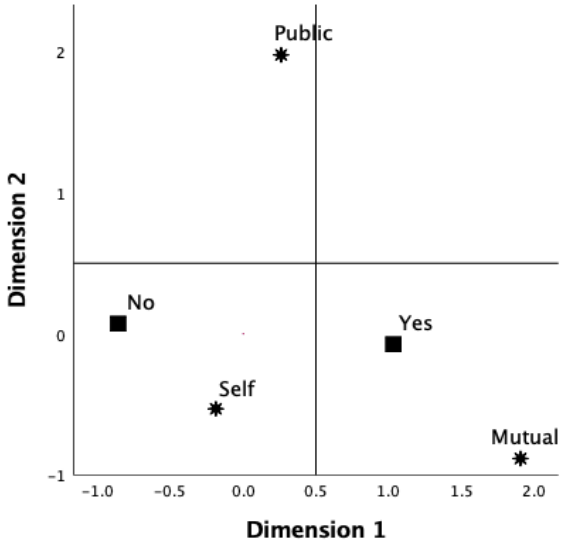
Joint Plot of Category Points



■ A11 drill, seminar
✱ D1 type of help

Variable Principal Normalization.

Joint Plot of Category Points



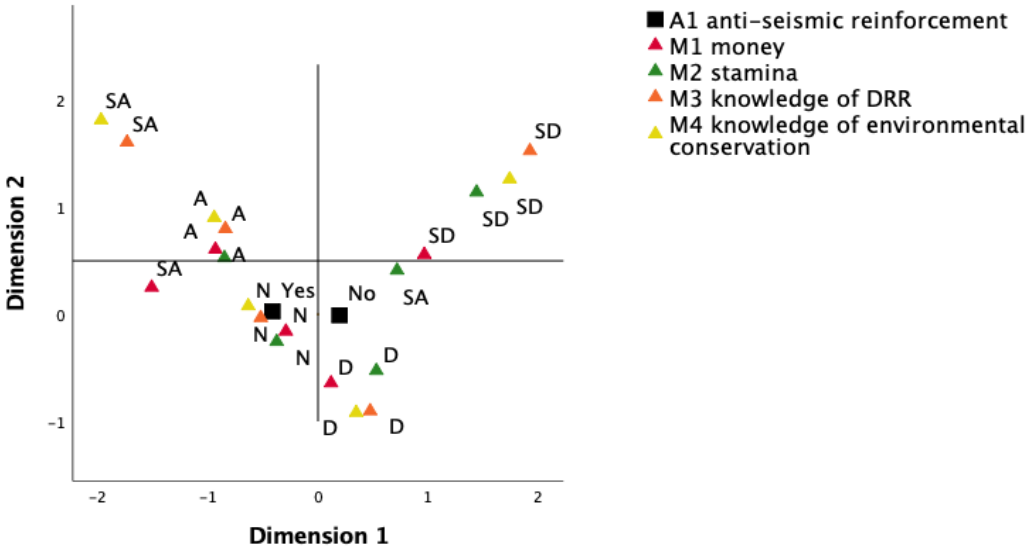
■ A12 first aid, AED
✱ D1 type of help

Variable Principal Normalization.

APPENDIX C: Chapter 5 Results of Multi Correspondence Analysis

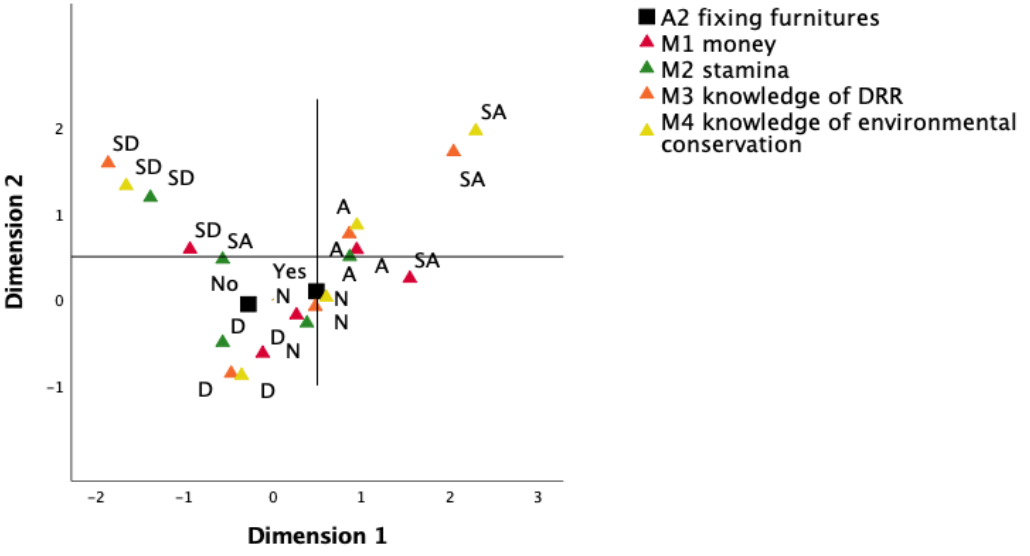
Analysis (3)

Joint Plot of Category Points



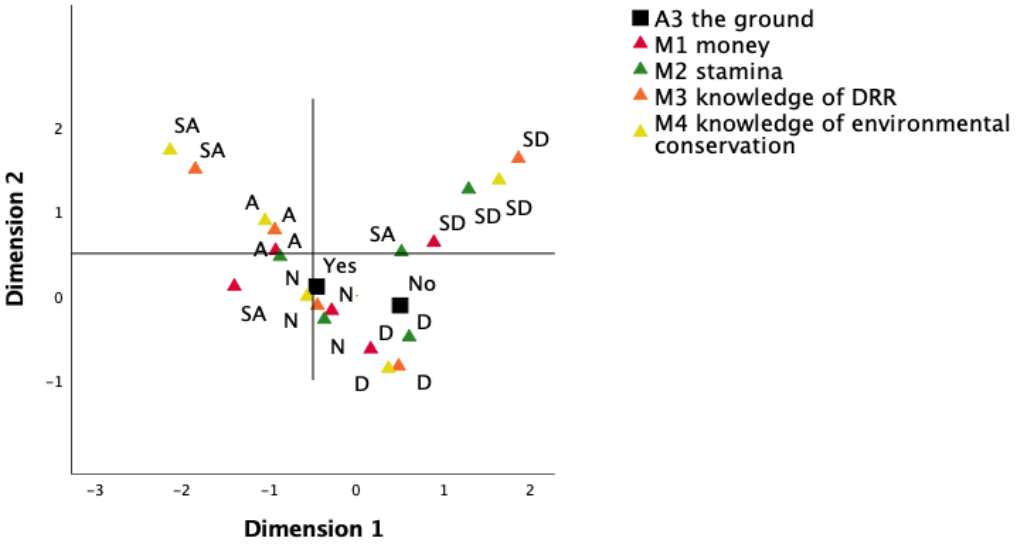
Variable Principal Normalization.

Joint Plot of Category Points



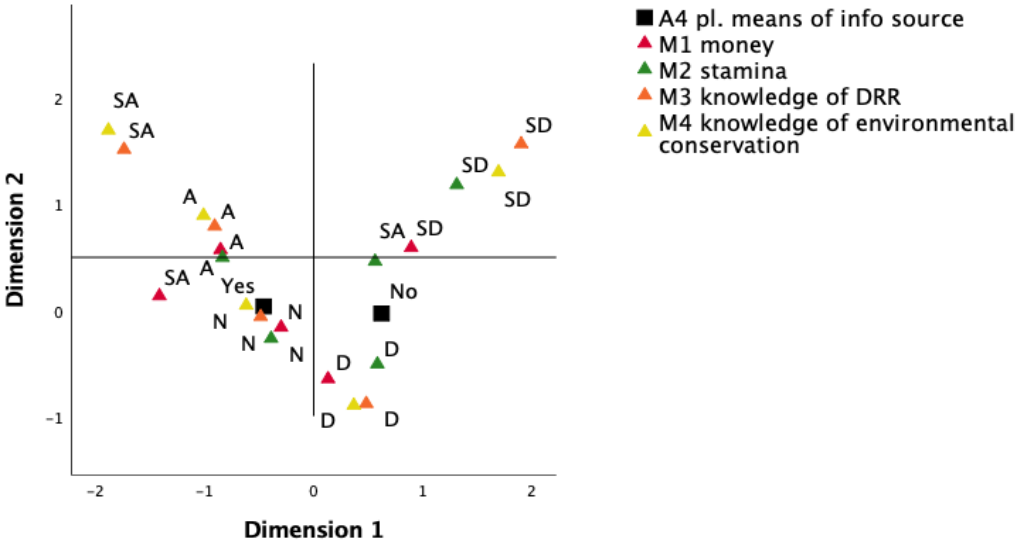
Variable Principal Normalization.

Joint Plot of Category Points



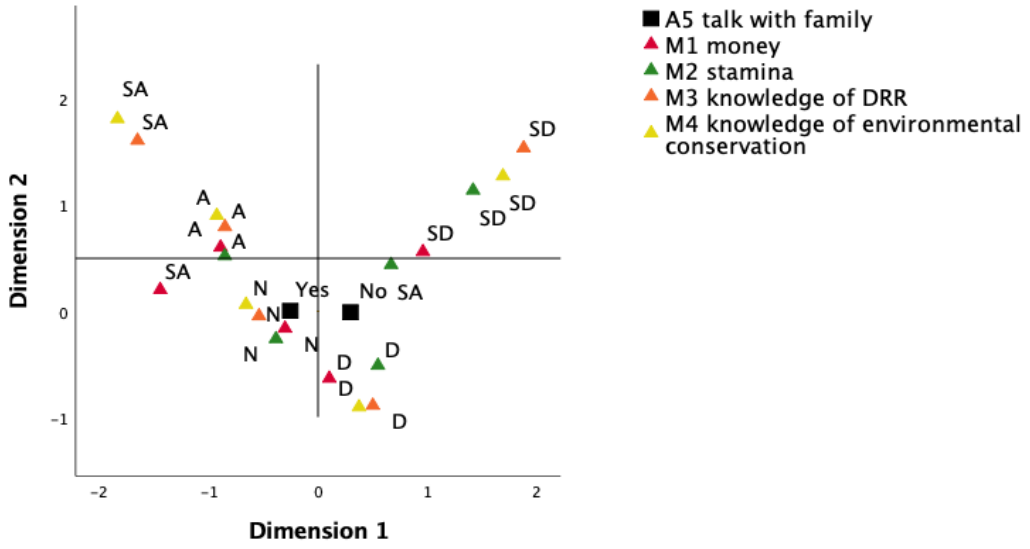
Variable Principal Normalization.

Joint Plot of Category Points



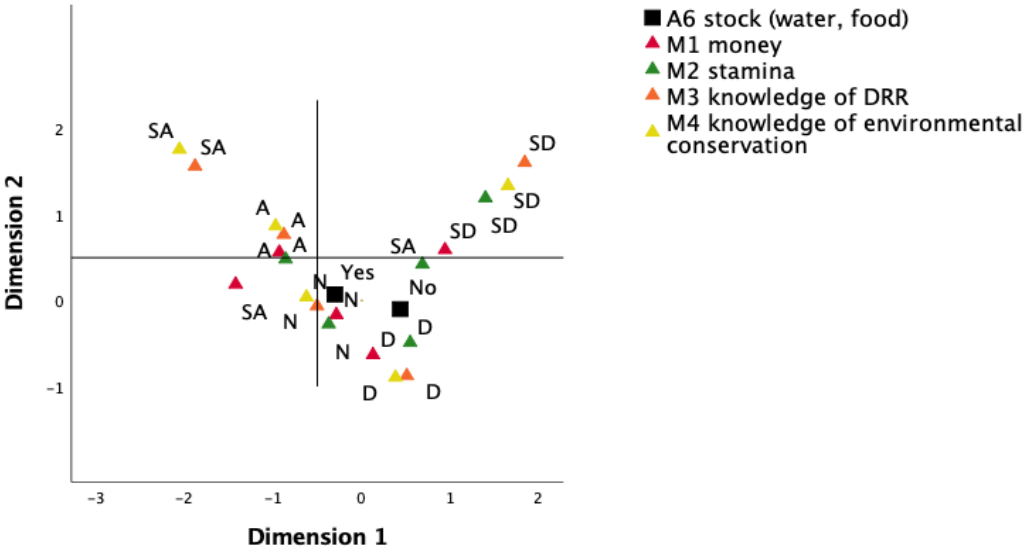
Variable Principal Normalization.

Joint Plot of Category Points



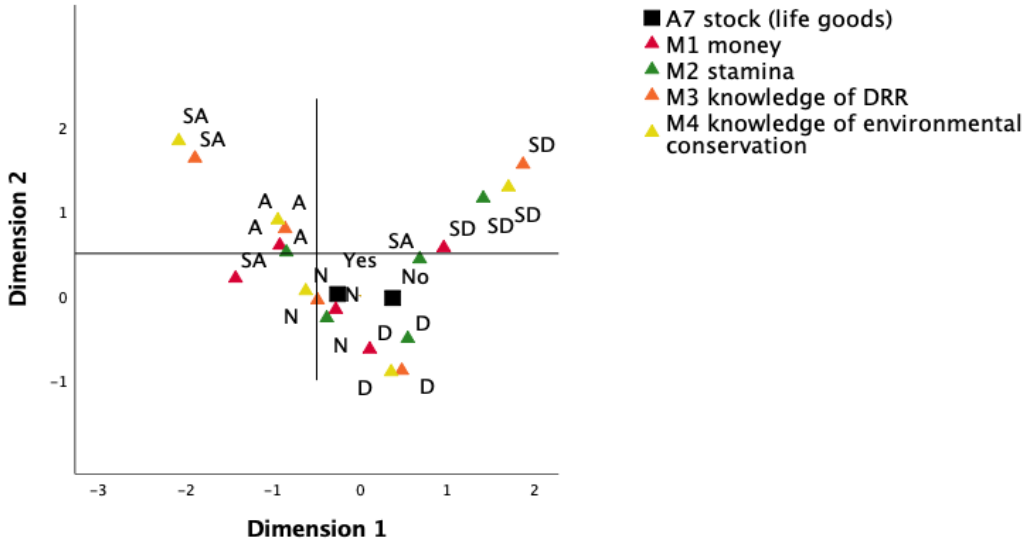
Variable Principal Normalization.

Joint Plot of Category Points



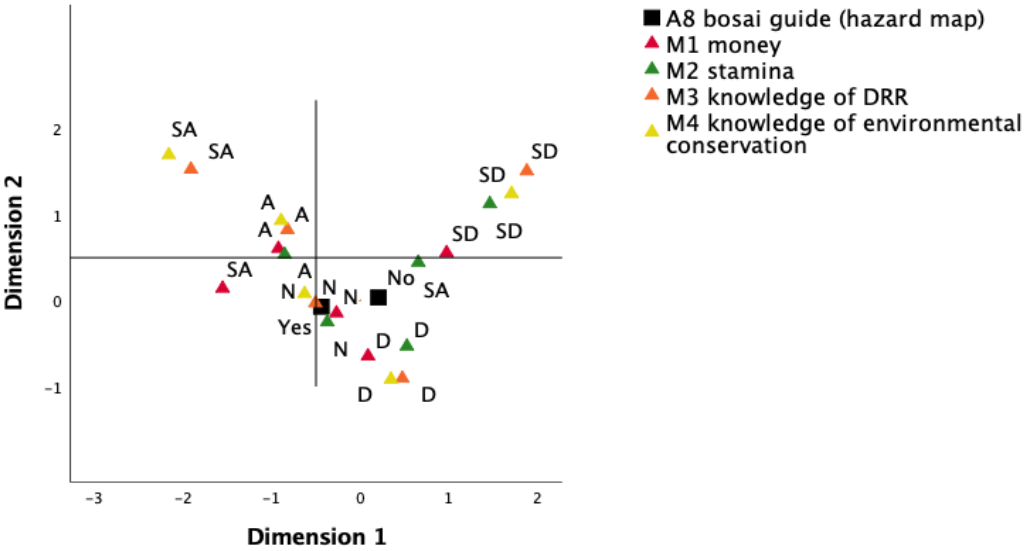
Variable Principal Normalization.

Joint Plot of Category Points



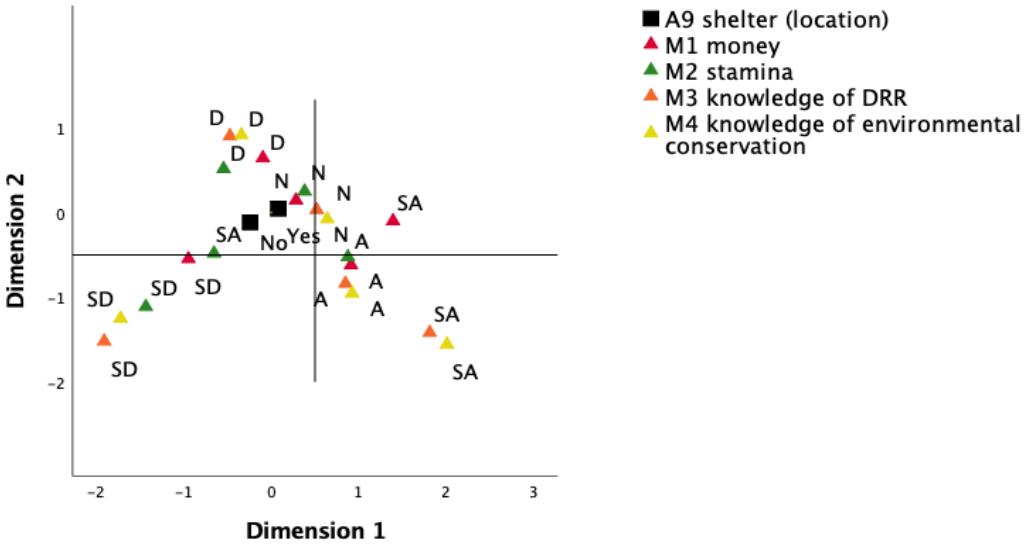
Variable Principal Normalization.

Joint Plot of Category Points



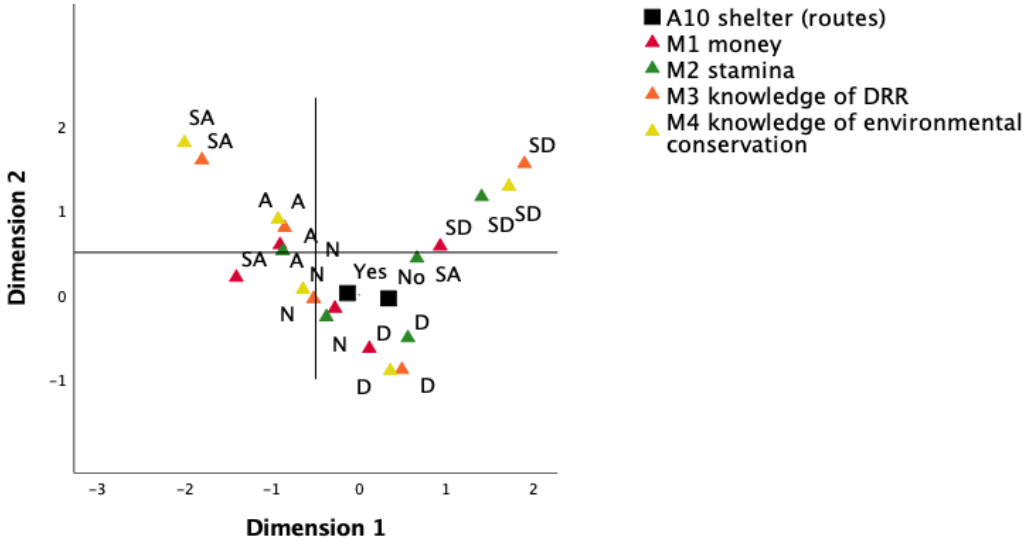
Variable Principal Normalization.

Joint Plot of Category Points



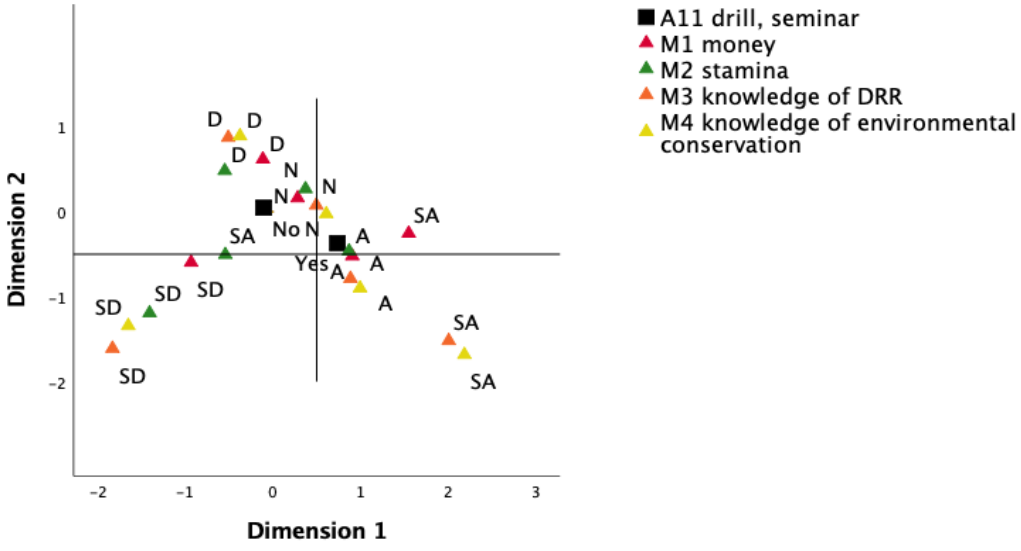
Variable Principal Normalization.

Joint Plot of Category Points



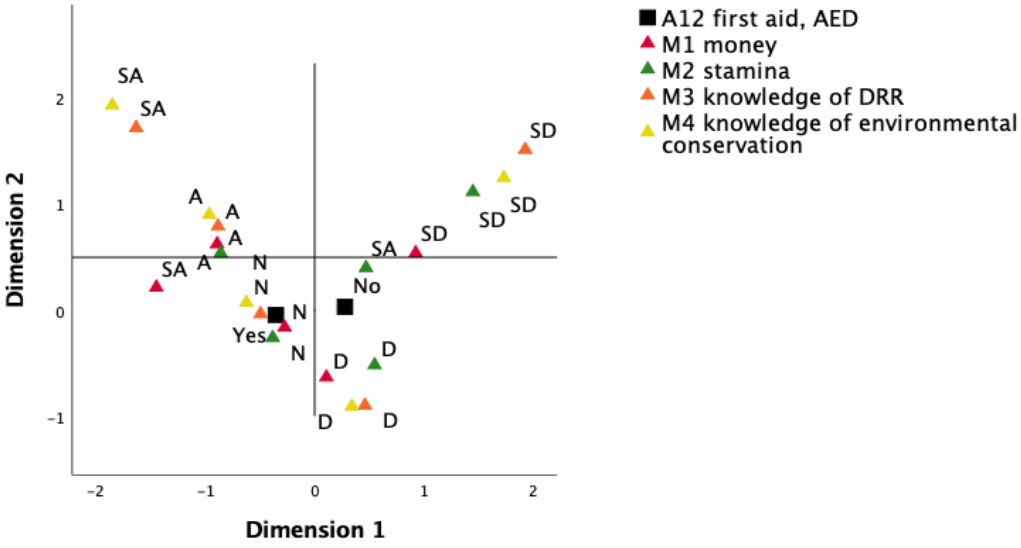
Variable Principal Normalization.

Joint Plot of Category Points



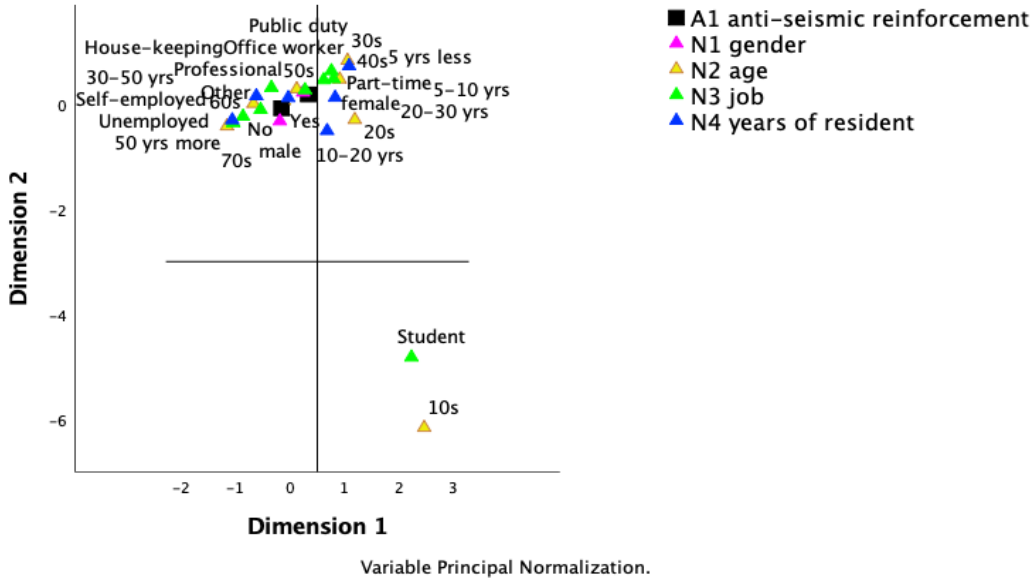
Variable Principal Normalization.

Joint Plot of Category Points



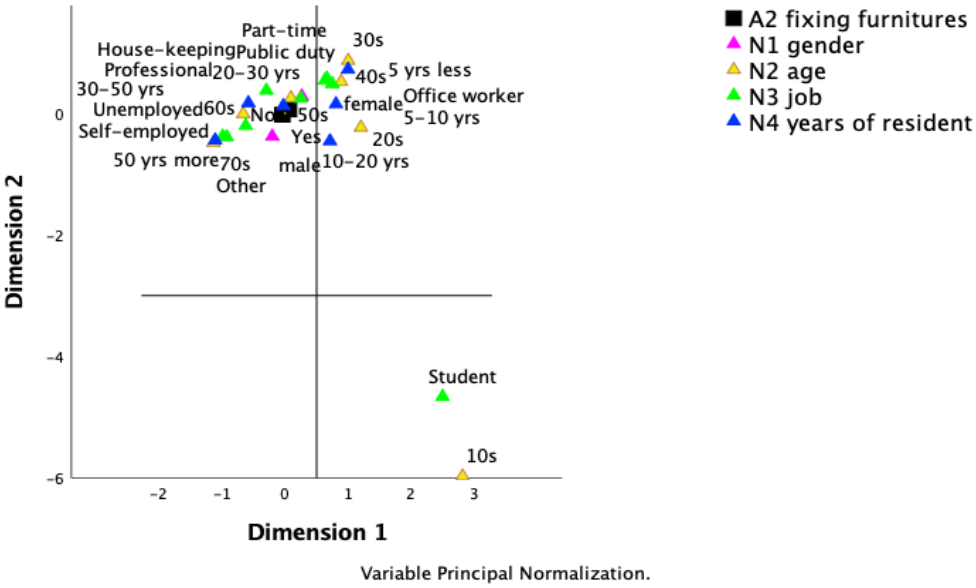
Variable Principal Normalization.

Joint Plot of Category Points



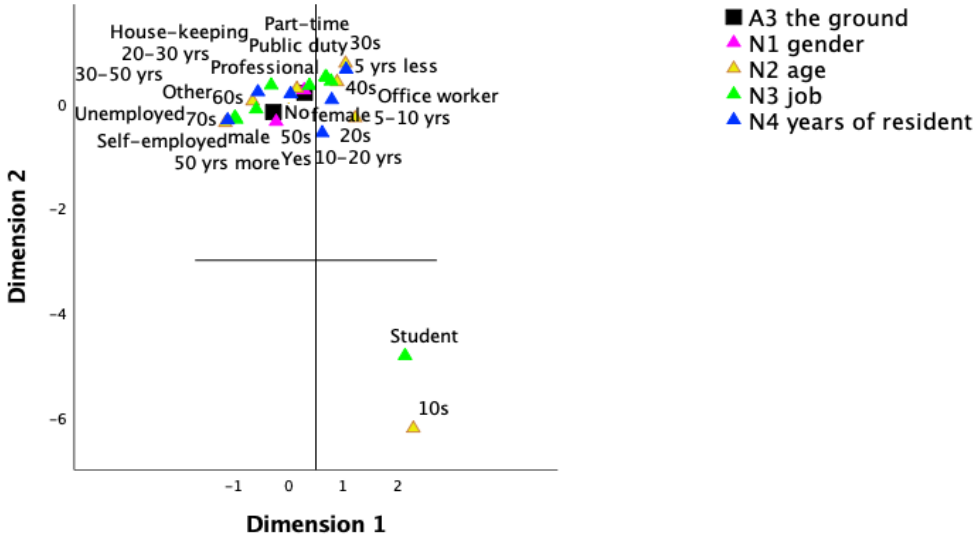
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

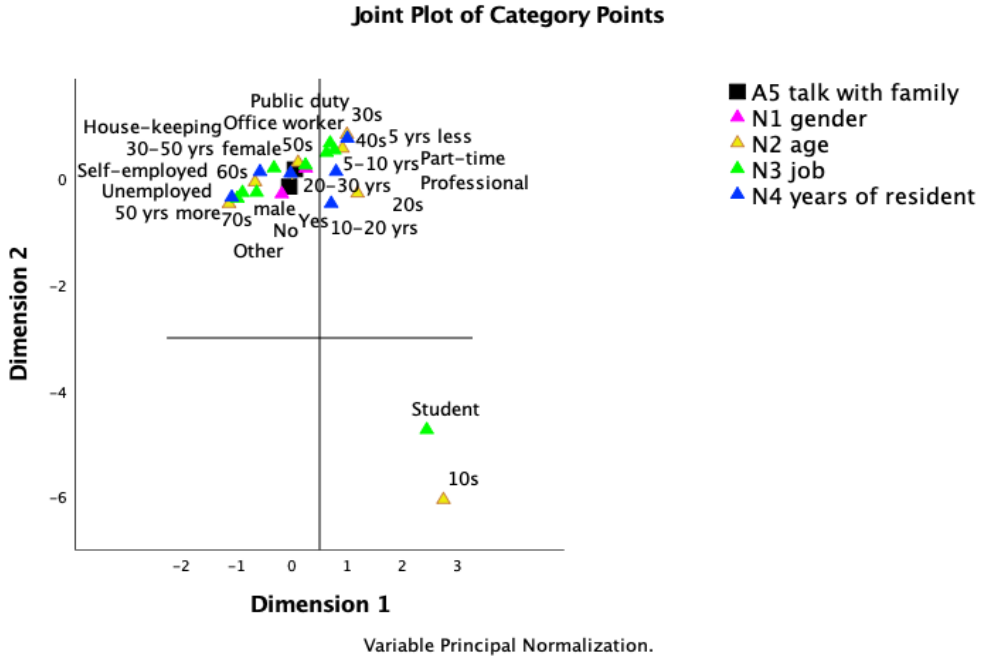
Joint Plot of Category Points

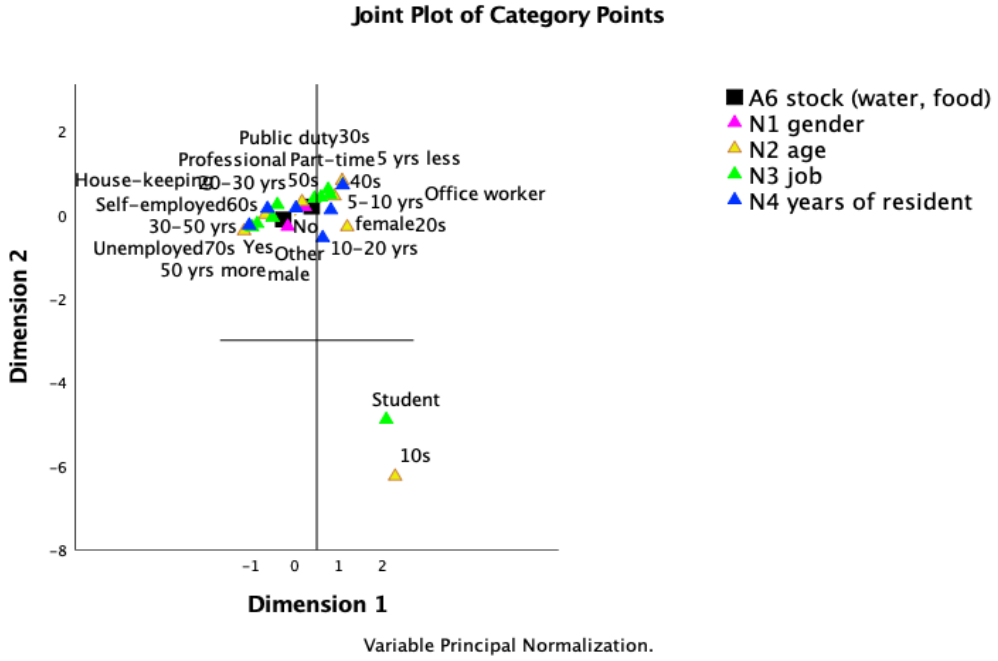


Variable Principal Normalization.

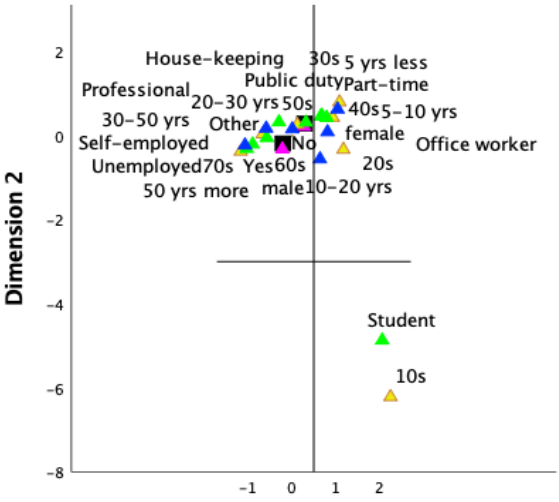
Joint Plot of Category Points

Variable Principal Normalization.


Joint Plot of Category Points
Public duty
30s
House-keeping
Office worker
40s
5 yrs less
30-50 yrs
female
50s
5-10 yrs
Part-time
Self-employed
60s
20-30 yrs
Professional
Unemployed
20s
50 yrs more
70s
male
Yes
10-20 yrs
No
Other
Student
10s
Dimension 1
Dimension 2
A5 talk with family
N1 gender
N2 age
N3 job
N4 years of resident
Variable Principal Normalization.


Joint Plot of Category Points
Public duty
30s
Professional
Part-time
5 yrs less
House-keeping
20-30 yrs
50s
40s
Office worker
Self-employed
60s
5-10 yrs
30-50 yrs
No
female
20s
Unemployed
70s
Yes
Other
10-20 yrs
50 yrs more
male
Student
10s
Dimension 1
Dimension 2
A6 stock (water, food)
N1 gender
N2 age
N3 job
N4 years of resident
Variable Principal Normalization.

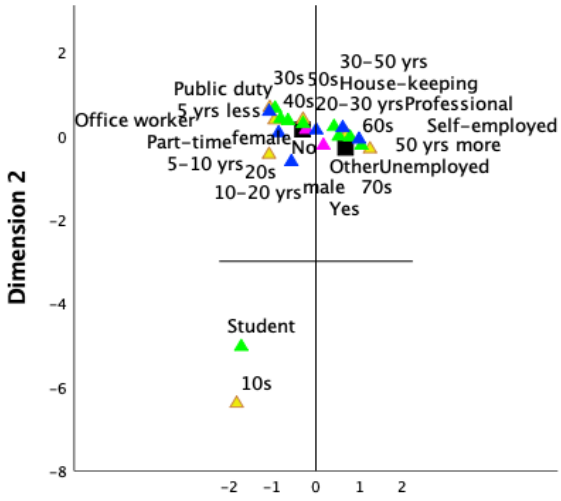
Joint Plot of Category Points



A7 stock (life goods)
N1 gender
N2 age
N3 job
N4 years of resident

Variable Principal Normalization.

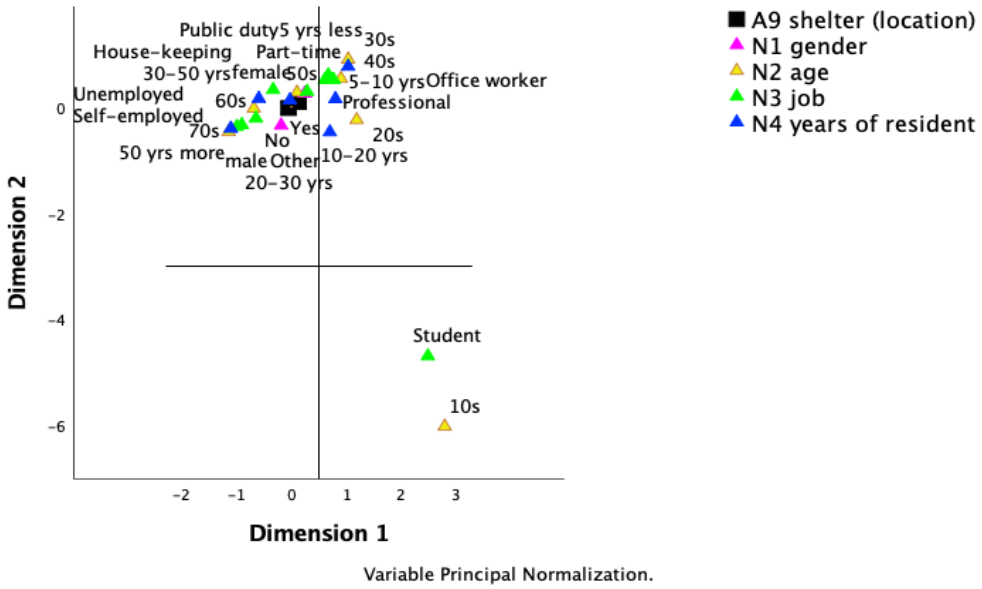
Joint Plot of Category Points



A8 bosai guide (hazard map)
N1 gender
N2 age
N3 job
N4 years of resident

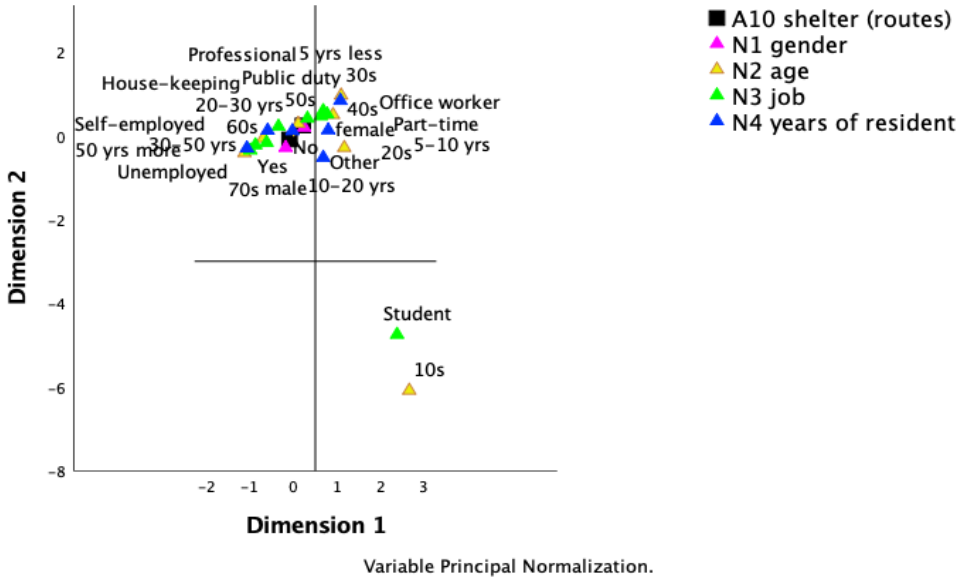
Variable Principal Normalization.

Joint Plot of Category Points



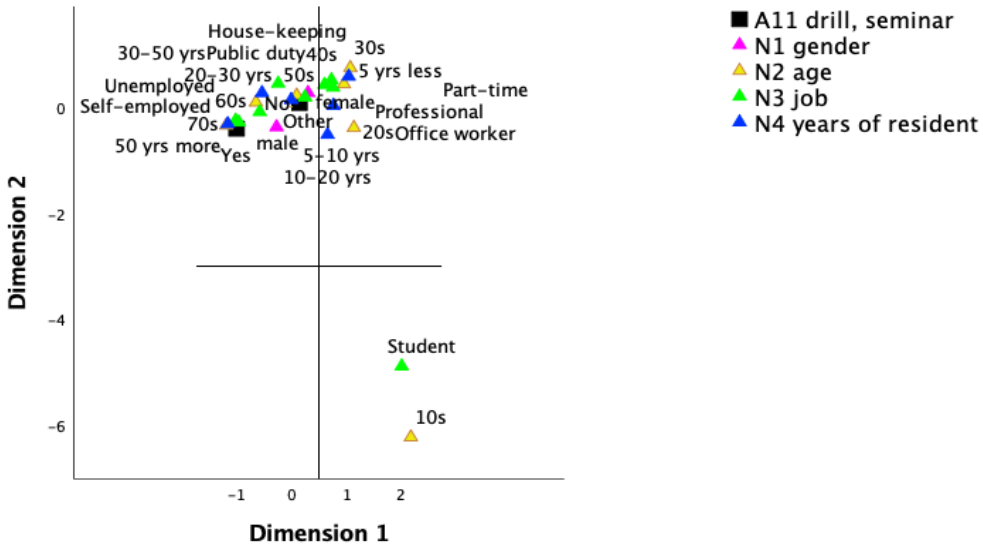
Variable Principal Normalization.

Joint Plot of Category Points



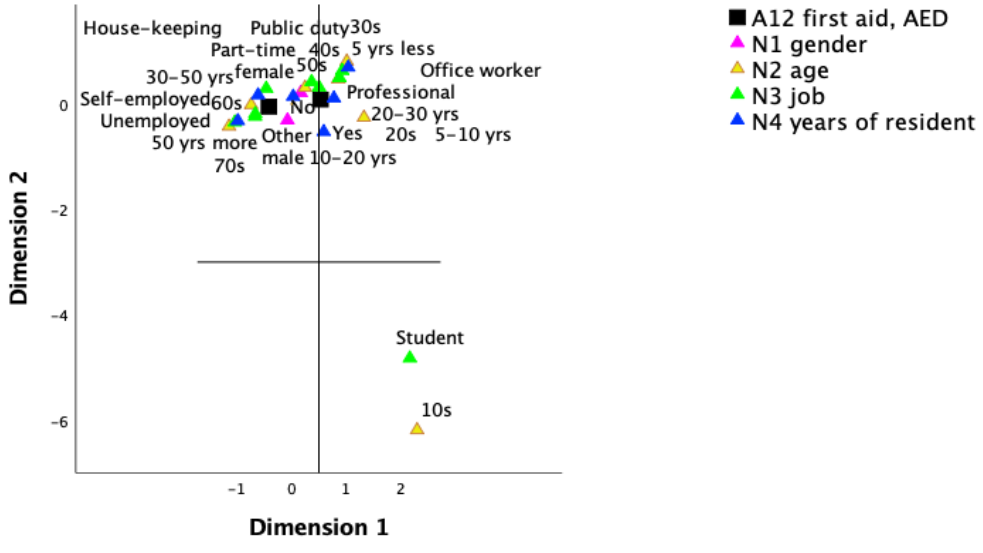
Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.

Joint Plot of Category Points



Variable Principal Normalization.