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Paper:

A Proposal of Multi-Scale Urban Disaster Mitigation Planning that Takes Regional Issues into Consideration

U Hiroi*, Akito Murayama, Yoshihiro Chiba*, Hisashi Komatsu*, Masafumi Mori*, Keiichi Yamada***, Masato Yamazaki*, and Nobuo Fukuwa***

*Disaster Mitigation Research Center, Nagoya University
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan
E-mail: hiroi@nagoya-u.jp
**Department of Urban Engineering, School of Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656 Japan
***Nagoya Urban Development Public Corporation
1-1-1 Kanayama-cho, Naka-ku, Nagoya 460-0023, Japan
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This case study proposes a new approach to community-based disaster mitigation in which regional issues are resolved and the features of local areas are concurrently addressed. This paper proposes a method of multi-scale community-based disaster-mitigation planning based on the results of workshops on regional community-based disaster mitigation conducted by the authors and targeted at city planning professionals, and describes the results obtained from a case study targeting the greater Nagoya region. Several issues were indicated, including the absence of institutional mechanisms to support the relocation of residential functions and the need for such mechanisms to support the adoption of active disaster-mitigation measures, density reduction, and withdrawal of industry from high-risk areas.

Keywords: community-based disaster mitigation, regional issues, workshop

1. Introduction

This study proposes a method to examine multi-scale community-based disaster mitigation that allows consideration of both region-wide issues and those at the area and district levels. Many efforts regarding community-based planning for disaster prevention have been undertaken in Japan, a widely known example being the community-based disaster-prevention planning in the Ichitera-kototoi District [1] aimed at creating a "town from which one does not have to escape when a disaster occurs." Many programs have been undertaken, particularly since the Han-Shin Awaji Earthquake disaster, and they vary widely, including Disaster Imagination Games (DIGs) that are aimed at promoting proper risk awareness in urban districts, programs that facilitate speedy emergency evacuations, those that create a community resilient against urban fires, shelteroperating drills ("hinanjo unei game" [HUG]) in which methods of shelter operation are discussed, and post-disaster town reconstruction. The implementing parties also vary, including voluntary organizations for disaster prevention, residents, and corporations, while the undertakings deal with various hazard types and assume different time spans and geographical extents. Indeed, it can be stated that such diversity is a feature of community-based disaster-mitigation programs. While there is a high degree of flexibility, on the one hand, because of this diversity among community-based disaster-mitigation programs, the participants are frequently confronted by situations in which they "have no idea where to begin" without expert advice. In the present situation, where there is only a limited number of channels to access disaster data, we feel that there is a need for technology to support residents in becoming aware of their local areas in their undertakings regarding community-based disaster mitigation. Because of the projected occurrence of the Nankai megathrust earthquake in the near future, which is expected to be severe and cause extensive damage, the development of a regional disaster-mitigation plan that includes plans on land use and facility development over a wide area is considered essential. Furthermore, as it is no longer considered possible to achieve balanced development among all regions of Japan, with its declining, aging population and dwindling birthrate, there is clearly a need for a policy of community development based on a regional perspective. Yet, existing general urban and community-based disaster mitigation programs have been limited to the municipality level, and there are no community-based disaster mitigation programs that target a wide geographical area. Based on the recognition of these issues, this study proposes a method of "multi-scale community-based disaster mitigation" that allows regional issues to be taken into account.[1] In the proposed "multi-scale community-based disaster mitigation," it is assumed that the phase of examining the

1. In this paper, the term "multi-scale" is used in a spatial sense and signifies that a comparison is done between the regional (30-50 km wide area) and district-level (town district level) issues of undertaking community-based disaster-mitigation planning.

regional issues is carried out by city planners, government workers, and those active in business, while the phase of examining local issues involves the general residents who make use of the process to discuss the issues.

2. Methodology Proposed in This Study

2.1. Historical Development of Regional Disaster-Mitigation Plans

Before discussing the approach to multi-scale community-based disaster mitigation, we briefly review the past development of efforts to examine regional issues related to safety and security. In Japan, we have disaster-prevention plans based on existing laws, such as the Disaster Countermeasures Basic Act and Area Plans for Disaster Prevention. Yet, they are essentially response-based plans, and, in particular, the latter is targeted at the municipality level, rendering it is difficult to resolve region-wide issues (particularly measures for preparedness). Admittedly, the Disaster Countermeasures Basic Act allows for inter-regional disaster-prevention plans, while various programs such as the "regional disaster prevention plans," as proposed by the Guidelines for Emergency Activities and Measures and special local public entities, do exist. Yet, most of these plans only go so far as to clarify protocols during emergencies or the division of roles in the event of a disaster, while discussions between municipalities can come to a halt in situations where consensus formation does not take place smoothly. More importantly, they are not intended to serve as preventive plans to begin with. Meanwhile, the frameworks of regional programs undertaken by the Fire and Disaster Management Agency and other ministries and agencies are based on hazard types or jurisdictions, and they do not ensure that a comprehensive response will be carried out.

In Japan, five National General Plans have been formulated so far. In particular, the Grand Design for the 21st Century (the fifth Plan), adopted by the cabinet, refers to maintaining essential functions in the event of a large-scale disaster and is centered on multiplexing network facilities and securing substitute functionalities under the keyword "redundancy;" meanwhile, the National Spatial Planning Act, enacted in 2005, adopted a decentralized, two-tiered planning system consisting of the national plan, which provides guidelines for long-term land development, and regional plans, where Japan is divided into ten regional blocks. However, this has failed to provide a forum for discussing regional disaster-mitigation planning (particularly from the standpoint of community development and prevention) due to various issues, such as the following:

1) It tends to be a potpourri of plans adopted by various local governments because communication among them mainly revolves around coordination and cooperation.
2) The planning system lacks interlocking between the national, regional (Master Plans for Regional City Planning), and greater metropolitan scales (Master Plans for City Planning).
3) It is not sufficiently linked to the National Land Use Plan or Land Use Basic Plan.
4) It lacks enforcing power because there are no provisions for setting up a "regional authority" that can formulate and implement regional plans.
5) It is difficult to create a common understanding among prefectures to reach a consensus because their administrative objectives are different.

Based on the history described thus far, it was decided to propose a method of formulating regional community-based disaster mitigation plans in this study.

2.2. Methodology of Multi-Scale Community-Based Disaster-Mitigation Planning

2.2.1. Preparations for Multi-Scale Community-Based Disaster-Mitigation Planning

In this section, we propose a method of investigating "multi-scale community-based disaster-mitigation" (**Fig. 1**) that allows consideration of regional issues based on education gained from the workshops that will be described later. In this paper, "regional" shall be used to refer broadly to an area extending 30–50 km. Before undertaking multi-scale community-based disaster-mitigation planning, it is necessary to draw up the possible scenarios and prepare data. Therefore, at the preparatory stage, we must carry out "Step 1: Drawing up disaster scenarios," and "Step 2: Preparation of data on disaster and land use." In Step 1, an image of the disaster expected to occur within the target period is drawn up, and various possible scenarios are listed. In the present case study, a scenario covering a fifty-year period was considered in which a Nankai megathrust earthquake occurs thirty years from the present, followed by mid- to small-scale flooding at five-year intervals. The data prepared in Step 2 involves population and companies, such as population trends (national census), estimate of future population (National Institute of Population and Security Research), number of businesses and employees (Statistics on Business), data on the risks of earthquakes, tsunami-caused flooding, earthquake-caused fires, liquefaction, mudslides, inundation by river water, inundation inside levees, flood tides, and development capacities (Land Use Fragmented Mesh for urban areas); the data were organized in mesh format. This is followed by "Step 3: Preparation of the tool to visualize the collected data." Since the proposed method involves the examination of many elements, voluminous data, and targets an extensive area, it was considered unrealistic to carry out work and visualization through the medium of paper; thus, it was deemed necessary to employ an alternative method of organizing and visualizing information. Therefore, we employed a giant projector and ultrashort focus projector, which are shown below, to display a large volume of data on a wide area, which made

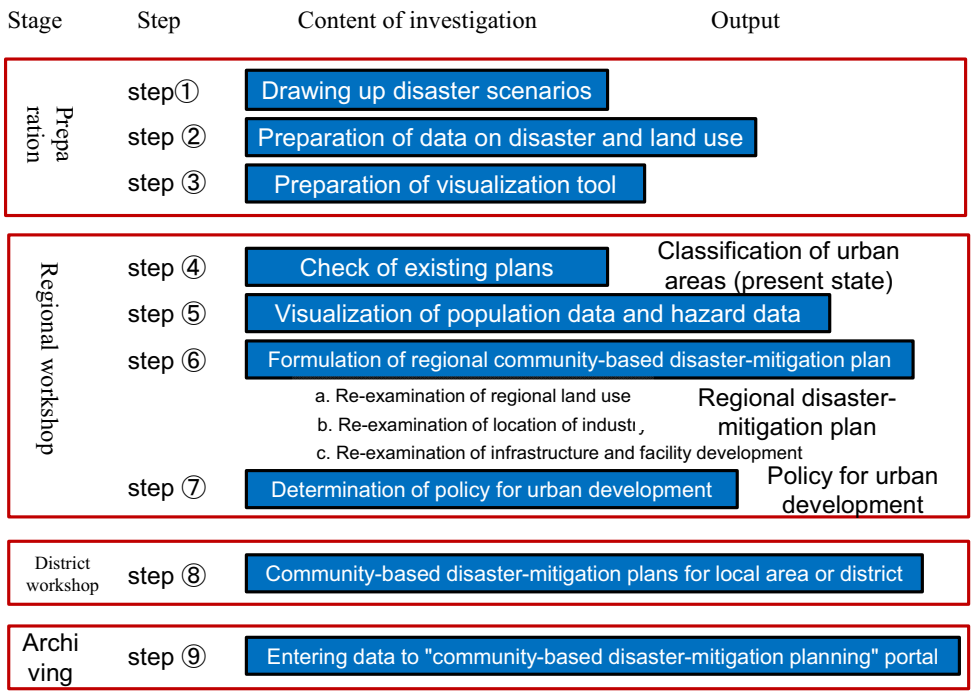

Fig. 1. Method of investigating multi-scale community-based disaster mitigation.

it possible to conduct workshops with many participants. The giant projector (**Fig. 2**) was used to project multiple layers of information, including the expected extent of various disasters and regional infrastructures (present and planned), onto a giant screen, which was produced by pasting paper sheets on the floor of the stairwell of the first-floor gallery at the Disaster Mitigation Research Building, Nagoya University. This made it possible for a relatively large number of people to participate and engage in planning-related discussions while concurrently sharing information. However, it is not a suitable tool for horizontal networking of the developed method because the venue is limited by its fixed equipment. Therefore, we also conducted workshops employing an ultrashort focus projector, which made it possible to project magnified images onto a screen at a short distance. In these workshops, the discussion was carried out while projecting various map information onto the floor, as shown in **Fig. 3**. Although the display size is not as large as the giant screen, it has the potential to expand the base of discussion via traveling workshops because the projector is portable and does not require a large venue. The preparations consisted of the above steps.

Fig. 2. Giant projector.

Fig. 3. Ultrashort focus projector.

2.2.2. Workshop on Regional Community-Based Disaster-Mitigation Planning

Next, based on the collected data, workshops on regional community-based disaster-mitigation planning are conducted. The workshops involve Steps 4–7, which are shown in **Fig. 1**: "Step 4: Check existing plans," "Step 5: Visualization of population data and hazard data," "Step 6: Formulation of the regional community-based disaster-mitigation plan," and "Step 7: Determination of policy for urban development."

In "Step 4: Check existing plans," the existing laws and plans that have so far been formulated or proposed are ex-

Table 1. Classification of urban development policy (classification examples in workshop conducted by present writers).

Residential	Industrial	Commercial	Other
Multi-unit housing area	Industrial center	Commercial cluster district	Administrative function cluster district
Single-unit housing area	Port function cluster district	Roadside commercial district	Terminal station area
Highland mixed housing area		Large-scale commercial facility	Station-area neighborhood
Historic highway urban area			

amined. Various plans for the target area, such as city master plans, regional open space planning, land use subdivision, designated land use districts, living areas near railroad stations, Plan for National Resilience [2], and Grand Design 2050 [3], are examined[2], and the urban areas targeted for investigation are classified. In broad terms, the classification consists of designating the areas as commercial, residential, or industrial districts. **Table 1** presents specific examples of the urban development policy for the greater Nagoya region that was examined in the workshop, which will be described later, although the classifications may differ somewhat depending on the target areas.

This is followed by "Step 5: Visualization of population data and hazard data." Using the data collected in Step 2, population trends, company clusters, disaster risks, and development capacities are overlaid on top of each other. Next comes "Step 6: Formulation of the regional community-based disaster-mitigation plan," where the existing plans are re-examined using the population and hazard data layers described above; it can be broken down into re-examinations of (a) regional land use, (b) location of industry, and (c) infrastructure and facility development. Regional land use and industry location are re-examined by taking note of the existing regional open space plans and the plans for station-area neighborhoods and industry clusters and examining the municipal master plans for their consistency. Then population trends and hazard risks are taken into account to formulate a general framework of urban development (at a basic level). This step involves (1) extracting areas with population or industry clusters and attaching tags (hereafter called "tiles") to those areas on the screen map; (2) identifying those population/industry clusters that have a relatively high disaster risk; (3) examining the possibility of withdrawal (i.e., relocation) from high-risk areas based on population trends or the specific features of the location (adopt active disaster mitigation measures for those areas not designated for withdrawal); and (4) moving the "tiles" to relocation candidate sites (areas with low hazard risk and high development capacity). The redistribution of population and industry is then simulated by taking into account the land areas before and after relocation. Furthermore, if it is deemed necessary, a re-examination of the facilities' development and/or the transportation infrastructure is carried out at this stage.

The final step in the workshop on regional community-based disaster-mitigation planning is "Step 7: Determination of policy for urban development." Here, based on the results of the overall framework for redistribution formulated in the previous step, the urban areas in the target area classified earlier are sorted into the categories of "active disaster-mitigation urban areas," "urban areas targeted for density reduction," "reserve urban areas for reconstruction," and "urban areas targeted for withdrawal" by taking into account the disaster risk, future population trends, presence or absence of company clusters, development capacity, features of the location, and so on. For instance, those areas where a disaster is expected to occur, the population is expected to grow into the future, and which possess special features such as being the location of an industry cluster or a major terminal station, are designated as "active disaster-mitigation urban areas;" those areas where no disaster is expected to occur, the population is falling, and which have a large development capacity are designated as "reserve urban areas for reconstruction" and serve as either candidate sites for reconstruction housing during the disaster reconstruction process or cluster areas for new industries. Clearly, areas that have been designated in existing plans for preservation of green zones or areas that have preserved historic townscapes are excluded from this and designated as "green zone preservation areas" or "historic townscapes," respectively, which must be considered individually when deciding whether to reduce the population/industry density or adopt measures specific to the historic areas. Step 7 concludes the workshop on regional community-based disaster-mitigation planning.

2.2.3. Extension to District Level and Archiving

The next step is "Step 8: Extending the community-based disaster-mitigation plans to local areas or districts." Based on the urban redevelopment policy formulated above, the local areas or districts engage in community-based disaster-mitigation planning. As stated earlier, community-based disaster-mitigation programs often encounter obstacles because the participants "have no idea where to begin" or "do not know where to obtain data" when there is no expert to provide guidance. To address this issue, we have developed a "community-based disaster-mitigation planning portal" site (**Fig. 4**), where participants can obtain hazard data, refine planning by incorporating the community-based disastermitigation sce-

2. As a case study of community-based disaster-mitigation planning, we have narrowed down the used data and existing plans to population concentrations, future population trends, preservation of green zones, concentration of industries, etc.; however, in order for this method to possess a higher reality as a method of city planning, we believe that it will be necessary to include a diversity of viewpoints such as the promotion of the regional economy, social welfare, and community.

Fig. 4. Community-based disaster-mitigation planning portal site (provisional title).

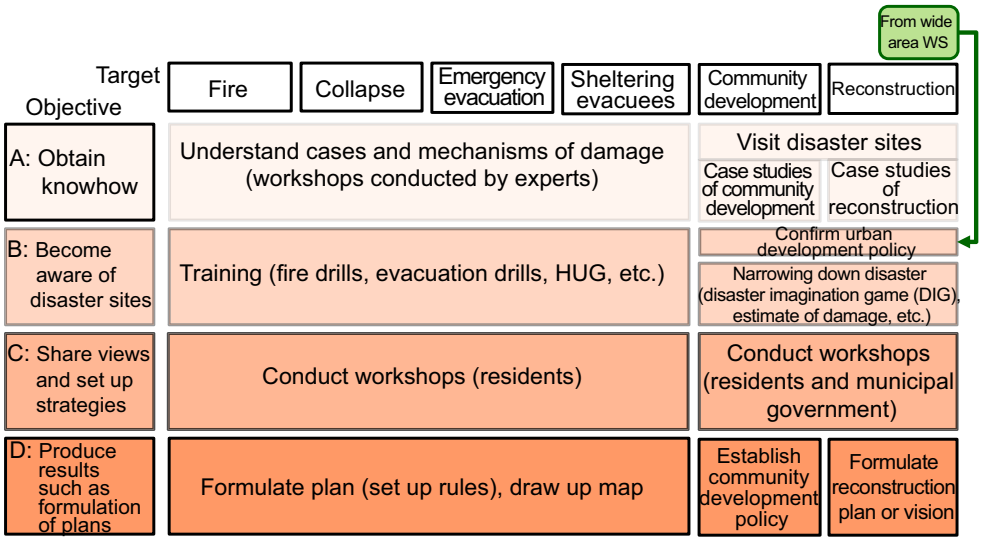

Fig. 5. Example of community-based disaster-mitigation scenario (for an urban area with a concentration of wood-construction houses).

narios suited to the local features, and archive the results. The site is currently being used by relevant parties on a trial basis. As shown in **Fig. 5**, the community-based disastermitigation scenarios, which are referred to by the residents, are designed to guide them to become aware of risks, draw up concrete plans for community development, and establish rules in an orderly sequence depending on the respective planning stages, and they should vary widely between areas (Note that it is assumed here that the overall framework for urban development is provided by the regional community-based disaster-mitigation plan). The results are uploaded to the portal site using a common format (Step 9: Entering data into the "community-based disaster-mitigation planning" portal), and are archived, allowing the disaster-mitigation plan to be shared among various participating parties and levels (or geographical scales) and serve as the basic plan for reconstruction of local areas after a disaster has struck.

3. Case Study of the Greater Nagoya Region

The process of "multi-scale community-based disaster-mitigation planning" proposed in this study consists of extending the results obtained in the regional community-based disaster-mitigation workshops (the regional community-based disaster mitigation plan) to community-based disaster-mitigation planning in local areas and districts, carrying on discussions following the scenario for the particular urban-area type, and archiving the results, as we have outlined above. In this section, we describe the workshops that we conducted, which targeted

Fig. 6. Workshop on commercial and residential areas (discussion carried out by laying disaster risk information on top of that on population and designated preservation areas).

Fig. 7. Results of the above workshop.

the greater Nagoya region. Note that only the earlier part (i.e., up to Step 7) of the proposed method was carried out.

3.1. "Workshop for Regional Community-Based Disaster Mitigation Planning for Commercial and Residential Areas" with City Planning Professionals as the Main Participants (August 2014)

The first case study is a workshop for regional community-based disaster mitigation planning conducted on August 23, 2014 at Nagoya University, targeting a 30 km-radius area centered on Nagoya city and attended by 18 people consisting mainly of experts in city planning (municipal and private city planners, academic researchers of city planning, etc.). The participants were divided into three groups (also present were four observers and a staff of 12). Using an ultrashort focus projector, Steps 1–7 (**Fig. 1**) were carried out; meanwhile, there was no deliberation regarding relocation candidate areas or industries (**Figs. 6** and **7**).

3.2. "Workshop on Regional Community-Based Disastermitigation Planning for Industrial Location" with Participation by Industry (March 2015)

Based on the above workshop, a second workshop on regional community-based disastermitigation planning was conducted on March 21, 2015 at Nagoya University, focusing on industrial location within the context of community-based disastermitigation planning for the greater Nagoya region. The targeted area was extended to a 50 km zone centered on Nagoya city in order to examine industry location. The workshop was attended by 28 people, consisting of city planning experts as well as members of industry, divided into two groups (it was also attended by ten observers and a staff of 12). The participants reviewed the plans and the reality of industrial clusters, the current status of and plans for regional infrastructures, the projected damage extent of various types of disasters, actual cases of plant relocations, etc. on the map, and they discussed disaster-prevention investments in and industry relocation from industrial cluster areas. Views of the workshop and its results are shown in **Figs. 8** and

Fig. 8. Workshop on industry location (projected damage of various disasters was overlaid on reality of and plans for industry and regional infrastructures [current status and plans] to discuss the issues of and possibilities for industrial location).

Fig. 9. Results of the above workshop (left: group 1; right: group 2).

9, respectively. Unlike the previous workshop, Steps 1–7 (**Fig. 1**) were all carried out in detail, including identifying the area development policy as well as the use of tiles to examine the relocation of industry clusters.

3.3. Results Obtained from Two Workshops on Regional Community-Based Disastermitigation Planning

In this section, we describe the results of the regional community-based disastermitigation planning (output of Step 6 in **Fig. 1**) obtained in the workshops described above and discuss the issues in city and regional planning that were made clear during the workshops.

3.3.1. Results of Workshops and Discussion of Regional Community-Based Disastermitigation Planning Issues

Various views were obtained in the workshops, in which the participants examined the 50 km zone centered on Nagoya city from the standpoint of safety and security (**Table 2**). Those views are sorted according to different areas below and presented along with our discussion of the planning issues.

a. Southwest Section

Main Views and Expressed Statements Obtained During Workshops

The southwest section contains an extensive area with a high risk of disasters, such as earthquakes, liquefaction, tsunami, flooding, and earthquake-caused fires, and contains many areas with high risk of multiple disasters. Thus, it is necessary to examine the possible relocation of population and industry from this section. While it may be possible to relocate manufacturing bases while considering the delivery and shipping of materials or products, the securing of water supplies, and housing for employees, it would be difficult to relocate import-export bases, thermal power plants, and import/storage bases for petroleum, LNG, and coal owing to the great merits of being closely located to ports. For this reason, active disaster-mitigation measures should be adopted in small zones, such as station areas in the latter, taking into consideration such precedents as the case of Wajuh while concentrating selected industries and the population in safe locations.

Table 2. Results of case studies of two workshops on regional planning (main views that were obtained).

Section	Workshop on commercial and residential districts	Workshop on industry location
Northern	• Contains a wide unused zone, which is safe and can be used following a disaster. • Consolidate urban districts to areas surrounding base stations such as Ichinomiya and Komaki stations.	• Receptacle of logistics and manufacturing companies (prepare infrastructure development environment to encourage industry relocation) • With the opening of the Tokai loop expressway, areas near interchanges can provide relocation candidate areas. • The southern part of Gifu prefecture has a well-developed infrastructure, and can serve as a candidate area for industrial sites.
Western	• Includes an extensive zero-meter urban area, with a high disaster risk. • Using precedents such as the Wajuh district as references, create safe areas within local districts such as station areas, and consolidate resources there.	• Although there is no concentration of industry, there is a high risk of tsunami and liquefaction (some industry concentration seen in southwestern part). • New rice field developments and reclaimed lands have high risks.
Southern	• Has a high risk but is the location of industries that cannot be replaced. Consolidate the industrial district extending to Nishi-mikawa into a narrower zone and improve resilience. • Relocate residences to safe locations using various methods at the earliest possible date.	• Has a concentration of industries, need to clearly demarcate areas to be made more resilient and areas to be relocated elsewhere (retain port functions and relocate manufacturing) • Petrochemical complex, chemical industry plants, LNG plants, and power stations must be protected by liquefaction countermeasures and strengthening of seawalls. • Reclaimed lands are safe but can become isolated, leaving the possibility of cutting off supply channel to automotive industries. • Port facilities serve as import-export base for automotive industry as well as logistics base for other industries, and so must be given high priority to make them more resilient. • Adopt countermeasures for liquefaction and flooding in the southern part of Nishi-mikawa, and relocate seaboard industries to inland areas if possible.
Eastern	• Has a low risk with a rising population, which should be consolidated to new urban districts. • However, attention must be paid to avoid planning conflicts with green zone preservation schemes. • There are districts where the population is falling, which can serve as “second towns.”	• Areas near interchanges of National Route 23 and Shin-Tomei Expressway can be suitable for relocation (machine and distribution industries) • Investigate possibility as relocation candidate area while taking measures against mudslides (making use of expressway interchanges) –>measures must be taken against separation of workplace and residence • Important as base of Toyota Motor Corp., a world-class corporation
Central	• Nagoya station area cannot be replaced and must be given top priority to make it more resilient. • Since the Sakae area has a low risk and a falling population, it can serve as a backup base for the Nagoya station area.	• Degree of importance will increase with the opening of the maglev Chuo Shinkansen, but there are many small businesses so a regional BCP should be considered. • One possible approach is to enforce measures to place a high priority on human lives rather than BCPs while shifting the weight of industry and commerce to the east.

Discussion of Planning Issues

In principle, this is an area where relocation of industry or the population should be considered. The urban areas targeted for reduction of density or relocation would be converted into natural land-use areas. However, important city bases, port facilities, and industrial bases should be partially retained and protected since they cannot be replaced.

b. Northeast Section

Main Views and Expressed Statements Obtained During Workshops

Based on the data on hazards, population, and industry clusters, the northeast section has a relatively low disaster risk and extra development capacity. Thus, excepting certain areas where the risks of mudslides and flooding exist, the area appears to have room for new urban development. The northeast also provides candidate sites for industry relocation, but it will be necessary to secure accessibility and convenience in order to encourage industries to actively relocate; therefore, areas close to highway interchanges or areas in which new infrastructure development is planned (preferably a regional infrastructure network linking the bases in the northeast section) should be considered candidates for relocation. With respect to preparedness against large-scale disasters, this area also has possibilities for providing land for "second towns" (reserved areas for reconstruction) because of its remaining development capacity. The eastern section, however, has been designated as a green zone preservation area in the current regional open space plan, so any plans for development must recognize the possibility of conflicts with these plans.

Discussion of Planning Issues

From a regional standpoint, this area can be considered a candidate site for relocation of population or industry, although the relocation should be to locations where transportation or other infrastructure is well developed. However, indiscriminate development must be avoided, particularly in view of the declining population in Japan, and new development should be limited to areas near railroad stations as well as from the standpoint of reducing motor traffic. Thus, station areas that are safe and have a large development capacity should be given high priority for inducement of residences while also observing open space planning. Meanwhile, some areas can be secured as planned construction sites for temporary housing within the wider context of a reconstruction plan, in which disaster victims can be transported quickly to reconstructed public housing or newly developed urban areas near railroad stations.

c. Central Section

Main Views and Expressed Statements Obtained During Workshops

Since the central section constitutes the nucleus of the greater Nagoya region, this entire area cannot be replaced. Thus, the highest priority should be given to implementing active disaster mitigation measures for the Nagoya station area and the administrative district. Since this section also contains many small businesses, it may be effective to formulate a joint regional Business Continuity Plan (BCP). Although the area around Sakae is relatively safe according to hazard data, future population estimates indicate that the population is falling, so it can be considered a backup base for the Nagoya station area.

Discussion of Planning Issues

The Nagoya station area is a particularly important urban and industrial base, and the area north of it is an administrative base; therefore, thorough measures must be adopted to protect this area. While the area around Sakae can be considered a backup base for the Nagoya station area, the commercial districts in this area should be used to consolidate urban functions.

Figure 10 is a diagram that summarizes the above findings, particularly the planning issues we arrived at by discussing the views obtained from the workshops. From an overall standpoint, active disaster mitigation measures must be adopted in the central section, which has a high concentration of population, while relocation of the population and industry should be considered for the southwest section. Meanwhile, the northeast section should be developed as a candidate area for such relocation. A closer examination, however, reveals that each section contains districts that are locally safe or high in risk, indicating that the adoption of active disaster mitigation measures in urban districts, lowering the density, and withdrawing (relocation) should be investigated for each area individually rather than indiscriminately relocating urban functions and residential districts from the southwest section to the northeast section.

We described the case studies of two workshops conducted according to the proposed method and the results that were obtained. Since not all of the proposed steps were carried out, we were unable to verify the validity of the proposed method. Yet, we believe that the workshops yielded useful suggestions for future urban planning policy and community-based disastermitigation planning for the greater Nagoya region.

3.3.2. Issues of Regional and City Planning Identified by The Present Method

In this section, we discuss the issues of regional and city planning that became apparent through the present method. We arrived at these issues based on views and issues that were identified during the workshops and that also constitute the practical issues that must be addressed in this study. The first item is the absence of an institutional framework to support the relocation of residential functions. Unless suitable policies are adopted to create regulations or inducements to support relocation to safe locations, the tax system is re-examined (including increasing or decreasing municipal finances to meet industry relocations), and the use and ownership of land

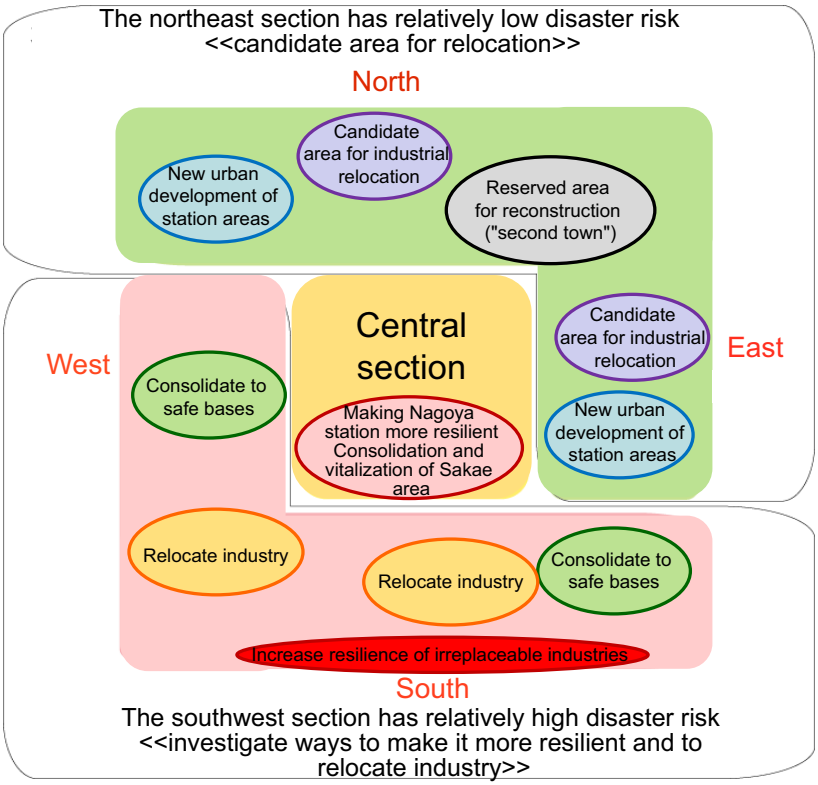

Fig. 10. Policy guidelines for regional community-based disaster-mitigation planning for the greater Nagoya region based on a discussion of the views during workshops.

are clearly separated, the proposed regional community-based disastermitigation planning will not become practicable. Furthermore, in this study, the workshops for community-based disastermitigation planning for local areas and districts are to be conducted based on the urban redevelopment policies, but this requires institutional mechanisms to support the active adoption of disaster mitigation measures, the reduction of density, or plant withdrawals. Although we presented a policy guideline for adopting active disastermitigation measures in locations that serve special functions and have a high disaster risk, such as port facilities, the practical contribution of this study will be limited unless we can present in concrete terms how to implement such measures, manage the use of open areas or green zones under a policy of reducing the density, encourage companies to withdraw or relocate, or strike a balance in the distance between workplace and residence. The way to achieve a formed consensus is also an important issue. How can we achieve consensus in urban areas that have been designated for withdrawal? In other words, we will need a method to coordinate the respective discussions at the district and regional scales. There will also be a need to set up a forum to discuss the regional planning issues proposed in this study. In the United States, the Metropolitan Planning Organization (MPO) [4] possesses a strong authority to which the municipalities have the obligation to yield; so, that MPO serves to provide a forum for discussion and at the same time ensure enforcement of the plans. In contrast, in Japan, there have been very few undertakings or organizations that are not based on administrative jurisdictions, excepting common daily procedures such as firefighting operations or application procedures for a driver's license. The final issue is that, while this study adopted the classifications of "urban area targeted for withdrawal," "urban area targeted for density reduction," "active disaster-mitigation urban area," and "reserve urban area for reconstruction" in the policy guidelines for urban redevelopment, some areas may require a more detailed classification; this is something that must be investigated through workshops for regional community-based disastermitigation planning addressing a wide range of subjects and hosted in various locations.

4. Conclusion

In this study, we proposed multi-scale community-based disastermitigation planning based on recognition of the diversity of community-based disastermitigation plans and the need for region-wide investigations, and we conducted workshops on regional community-based disastermitigation planning in which the earlier part of the proposed process was carried out. We presented the results of the investigation, targeting a 50 km zone centered on Nagoya, and then described the issues of the obtained regional and city plans. Although we were unable to verify Step 8 and the subsequent processes, due to the

limited number of case studies examined, or the validity and effect of the workshops in a quantitative manner, the uniqueness of this study lies in its original proposal of a new method of investigating community-based disastermitigation planning that takes into account the need for and diversity of region-wide discussions, based on the current backdrop of the decline and aging of Japan's population and the likelihood of major extensive disasters. In particular, the manner in which area residents perceive the regional plan created by the process leading up to Step 7, and use it in their district-level planning in Step 8, or the manner in which district-level planning is fed back to regional planning, including the methods of communication and creation of forums for consensus forming, are major issues. Although the community-based disaster mitigation planning portal site shown in Step 9 was designed to link the process up to Step 7, conducted mainly by experts and municipal workers, and Step 8, which is to be carried out mainly by the area residents, this part has been left unverified in this paper. In addition to the issues presented in section 2, subsection 3, a future issue is the continuation of discussions about and investigations into the entire process. To raise the degree of completion of the proposed method, we believe that, in addition to the data used and existing plans referenced in this case study, it will be necessary to incorporate diverse viewpoints, such as the promotion of the regional economy, social welfare, and community, under a comprehensive undertaking. This is another issue that must be verified in future investigations.

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Name:
U Hiroi

Affiliation:
Associate Professor, Disaster Mitigation Research Center, Nagoya University

Address:
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan

Brief Career:
2007 Assistant Professor, School of Engineering, the University of Tokyo
2012 Associate Professor, Disaster Mitigation Research Center, Nagoya University

Selected Publications:
• "Questionnaire Survey about the Great East-Japan Earthquake and Estimation Method concern on Tsunami-Fire," Jornal of Social Safty Science, No.24, pp. 111-122, 2014.

Academic Societies & Scientific Organizations:
• City Planning Institute of Japan (CPIJ)
• Architectural Institute of Japan (AIJ)

Name:
Akito Murayama

Affiliation:
Associate Professor, Department of Urban Engineering, School of Engineering, The University of Tokyo

Address:
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

Brief Career:
2004 Project Researcher, Center for Sustainable Urban Regeneration, School of Engineering, The University of Tokyo
2006 Associate Professor, Department of Environmental Engineering and Architecture, Graduate School of Environmental Studies, Nagoya University
2014 Associate Professor, Department of Urban Engineering, School of Engineering, The University of Tokyo

Selected Publications:
• H. Shimizu and A. Murayama (Eds.), "Basic and Clinical Environmental Approaches in Landscape Planning," Springer, 2014.
• A. Sharifi and A. Murayama, "Neighborhood Sustainability Assessment in Action: Cross-Evaluation of Three Assessment Systems and Their Cases from the US, the UK, and Japan," Building and Environment, Vol.72, pp. 243-258, 2014.

Academic Societies & Scientific Organizations:
• City Planning Institute of Japan (CPIJ)
• Architectural Institute of Japan (AIJ)
• Association of Urban Housing Sciences (AUHS)
• Japan Urban Design Institute (JUDI)
• International Alliance for Sustainable Urbanization and Regeneration (IASUR)

Name:
Yoshihiro Chiba

Affiliation:
Researcher, Disaster Mitigation Research Center, Nagoya University
Address:
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan
Brief Career:
2014 Researcher, Disaster Mitigation Research Center, Nagoya University
Selected Publications:
• K. Okamoto, A. Sharifi, and Y. Chiba, "The Impact of Urbanization on Land Use and the Changing Role of Forests in Vientiane," Integrated Studies of Social and Natural Environmental Transition in Laos, Springer, pp. 29-38, 2014.
Academic Societies & Scientific Organizations:
• City Planning Institute of Japan (CPIJ)
• Architectural Institute of Japan (AIJ)

Name:
Hisashi Komatsu

Affiliation:
Associate Professor, Graduate School of Environmental Studies, Nagoya University

Address:
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan
Brief Career:
1992 Research Assistant, School of Engineering, Nagoya University
2001 Associate Professor, Graduate School of Environmental Studies, Nagoya University
Selected Publications:
• N. Kurata, T. Ozasa, T. Ueno, and H. Komatsu, "Campus Planning for Promoting Quality of Life in the Community," Regenerative Sustainable Development of Universities and Cities, Edward Elgar, 2013.
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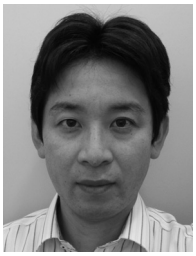
Academic Societies & Scientific Organizations:
• Architectural Institute of Japan (AIJ)
• Man-Environment Research Association, Japan (MERA)
• Association of Urban Housing Sciences, Japan (AUHS)

Name:
Masafumi Mori

Affiliation:
Disaster Mitigation Research Center, Nagoya University

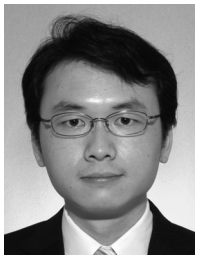
Address:
Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan
Brief Career:
1991-2006 Technology Research Institute of a construction ompany in Japan
2006-2011 Associate Professor, Graduate School of Environmental Studies, Nagoya Univ.
2011-2013 Associate Professor, Disaster Mitigation Research Center, Nagoya Univ.
2014- Designated Professor, Disaster Mitigation Research Center, Nagoya Univ.
Selected Publications:
• "Seismic Response Analysis and Design of Buildings Considering Dynamic Soil-Structure Interaction," AIJ, 2006.
Academic Societies & Scientific Organizations:
• Architectural Institute of Japan (AIJ)
• Japan Association for Earthquake Engineering (JAEE)
• Japanese Geotechnical Society (JGS)
• Japan Society of Seismic Isolation (JSSI)



Name:
Keiichi Yamada

Affiliation:
Research Division Chief, Nagoya Urban Institute, Nagoya Urban Development Public Corporation

Address:
1-1-1 Kanayama-cho, Naka-ku, Nagoya 460-0023, Japan
Brief Career:
2014 Research Division Chief, Nagoya Urban Institute, Nagoya Urban Development Public Corporation



Name:
Masato Yamazaki

Affiliation:
Assistant Professor, Disaster Mitigation Research Center, Nagoya University

Address:
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan

Brief Career:
2010 Postdoctoral Fellow of National Institute of Advanced Industrial Science and Technology (AIST)
2011 Postdoctoral Fellow of Ritsumeikan University
2012 Assistant Professor, Disaster Mitigation Research Center, Nagoya University

Selected Publications:
• "An assessment of nuclear power shutdown in Japan using the computable general equilibrium model," Journal of Integrated Disaster Risk Management, Vol.3, No.1 pp. 36-55, 2013.

Academic Societies & Scientific Organizations:
• Committee of Instructure Planning and Management, Japan

Name:
Nobuo Fukuwa

Affiliation:
Professor, Disaster Mitigation Research Center, Nagoya University

Address:
Furo-Cho, Chikusa-ku, Nagoya 464-8603, Japan

Brief Career:
1991 Associate Professor, School of Engineering, Nagoya University
1997 Professor, Center for Cooperative Research in Advanced Science and Technology, Nagoya University
2001 Professor, Graduate School of Environmental Studies, Nagoya University
2012 Professor, Disaster Mitigation Research Center, Nagoya University

Selected Publications:
• N. Fukuwa and J. Tobita, "Key Parameters Governing the Dynamic Response of Long-Period Structures," Journal of Seismology, Vol.12, No.2, pp. 295-306, 2008.

Academic Societies & Scientific Organizations:
• Architectural Institute of Japan (AIJ)
• Japan Association for Earthquake Engineering (JAEE)