The Impact of Historical Geography and Agricultural Land Development Processes on Wetland Restoration Methods Used to Create Ecological Networks:
A Comparison of Japan and the Netherlands

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ABSTRACT

In the Osaka area in the 1880s, rice was grown mostly in dry fields in upland areas, and a few paddy fi elds were situated on the natural wet landforms along the major rivers and streams on the Osaka Plain. As the area developed, dry fi elds became irrigated, and the lowland fields were filled and converted to urban land uses. For the Osaka city region, developed in this historical context, an ecological network has been proposed by the national government in 2006. The proposal was partially influenced by ecological network planning in the Netherlands, and it focuses on spatial patterns and wetland restoration measures at a limited number of sites. However, its historical geography is not taken into consideration. Therefore we examined historical land-use changes in the Osaka area and then compared restoration projects in both countries. On the one hand, we found some similarities in wetland restoration processes and measures at unused industrial sites in reclaimed coastal areas in Japan (the Osaka Nankou Bird Sanctuary) and the Netherlands (the Oostvaardersplassen). There are, on the other hand, notable differences in appropriate wetland restoration measures in farmland areas. Some potential wetland restoration candidates in Japan require either winter fl ooding or the resumption of labor-intensive agricultural practices in abandoned paddy fi elds, because many of these sites were naturally dry before the introduction of irrigation. In the Netherlands (e.g., at Tiengemeten), however, this was not a problem because areas are being converted from drained fi elds to natural wetlands. To conclude, regional considerations are therefore important when ecological networks are planned, and the perspective of historical geography is essential when networks are planned with wetland restoration as a core element.

Keywords: *ecological network, wetland restoration, rice field, delta, land reclamation, historical geography*

INTRODUCTION

The concept of an ecological network, which describes the biotic interactions in an ecosystem, has increasingly drawn worldwide public attention. As wetlands provide a wide range of ecosystem services, including water purification, floodwater storage, and biodiversity promotion, they are considered to be a core element in ecological networks (Musacchio and Coulson 2001). Therefore, wetland restoration has become an important topic in densely populated delta regions, where it is difficult to estimate and integrate pre-existing natural wetland conditions into ecological network planning and restoration methods. Agricultural land development processes that occurred before urbanization also must be considered in wetland restoration projects (Bellio et al. 2009).

In Japan, wet rice cultivation was a major agricultural land use in low-lying areas before urbanization. These rice fields functioned as alternatives to natural wetlands in low-lying alluvial plains (e.g., Natsuhara 2013).Paddy farmers can support the environment by minimizing the use of pesticides and inorganic fertilizers and by maximizing the fields' ecosystem services, such as biodiversity promotion (Amano et al. 2008), water purification, and floodwater storage. These goals can be achieved by replacing concrete structures with those made of natural materials, by giving incentives to farmers to conduct winter flooding, and by recultivating abandoned fields, all of which would contribute to creating sustainable ecological networks. But as little attention has been paid to the original pre-agricultural condition of these rice fields, it is difficult to evaluate whether restoring rice fields would be consistent with the undisturbed natural system in a given area.

Japanese national and local governments have referred to the ecological network concept and framework developed in the Netherlands as an ideal model, especially in its implementation, to use in the development of ecological networks in Japan. Matsuyuki and Kinoshita (2012) present the development and implementation processes and case studies of restoration sites under the ecological network framework in the Netherlands. They focus mainly on the institutional framework and pointed out some problems in its implementation, but give less attention to historical geography, which strongly affects the concept, implementation, and restoration of the ecological network. For example, they mention the use of only current landforms and land uses to develop the ecological network concept in the Netherlands, but there is almost no discussion of the Netherlands' long history of land reclamation (Lambert 1985). This intensive and cooperative land development process has clear urban–rural boundaries and is supported by long-standing zoning-based spatial planning. These clustered dry lands that have long used dykes and water drainage systems are now considered candidates for wetland restoration under the current ecological network plan of the Netherlands. Clearly, the context of wetland restoration in the Netherlands is different from that of Japan and its rice-based landscapes. Therefore, it is important to review an introduction process of the ecological network concept with wetland restoration as a core element from the Netherlands into Japan in order to identify influential points by indigenous water drainage (the Netherlands) and irrigation (Japan) histories in the contemporary planning system, thereby making better contributions to the process of the future spatial planning in consideration of water management.

In this study, we first reviewed the proposed Japanese ecological network, with a special focus on the Osaka city region. We then examined rice-based wetlands in this region and compared the government's ecological network proposal, geomorphologic conditions, current land-use patterns, and land-use patterns in the 1880s in a geographic information system. Next we focused on ongoing and potential field-level wetland restoration projects. Using all of this information, we identified the gaps between actual methods of wetland restoration in the field and the concepts presented in the guideline for the Osaka city region.

Following these investigations, we compared the wetland restoration concept and practices in Japan and the Netherlands. We referred to maps and documents related to ecological networks in the Netherlands, as well as ongoing wetland restoration projects. We then identified which parts of the ecological networks in the Netherlands that is relevant to the ecological network scheme for the Osaka city region and which parts are not. This

approach can help to improve the next process, that of planning ecological networks in Osaka with better spatial and institutional linkages between the total framework imported from the Netherlands, and the currently isolated field practices based on the natural land conditions and agricultural development history. With globally applicable institutional relationships between planning and practice this approach can also be helpful in figuring out the hierarchical spatial structure of indigenous (irrigation based) ecological network for future development of ecological networks in the Netherlands which is facing rising flood risk due to global warming.

DEVELOPMENT OF THE ECOLOGICAL NETWORK CONCEPT IN JAPAN

Traditionally, ecological networks in Japan existed in people's daily living spaces in conjunction with their agricultural activities. For example, in rural areas, rice fields, irrigation ditches, canals, channels, and rivers formed a water network in which many types of fish and other aquatic species lived. Similarly, there were green corridor structures in village areas, such as rice field ridge grasses and the so-called Satoyama forest network (Moriyama 1997). Even in large cities such as Edo (the former name of Tokyo), there was a wide range of urban green spaces, including dry field patches, temple and castle gardens, and small green pots along the streets, all of which were spatially connected (Katagiri et al. 2008).

However, in terms of planning, the Greenbelt Ring Plan of the Tokyo Park System was one of the first to officially consider a network of green spaces (Sanada 2003). This plan was initiated in 1932 by the Committee for the Tokyo Park System and developed a greenbelt at what was then the outer edge of the Tokyo Metropolitan Area. The purpose of the greenbelt was to minimize future urban sprawl, and it consisted of existing and proposed parks, agricultural fields, and wide roads with pedestrian green spaces. During World War II, these areas were also used as evacuation locations during bombing. As a result of land tenure reform after the war, these green spaces were distributed to former sharecroppers. Because of this reform and increasing urbanization, these lands were fragmented and the greenbelt almost disappeared, although some parks built under this plan still exist as an important green legacy for Tokyo residents.

A similar plan was created by the Osaka Park System. Although it is not as well-known as the Tokyo Park System, it was created in 1928, 4 years before the Tokyo plan (Ishikawa 2014). The greenbelt in the Osaka Park System has also become fragmented and has almost disappeared for the same reasons as in Tokyo. Again, some parks still remain as a legacy of this plan in the Osaka urban area.

These examples of greenbelt planning are remarkable examples of Japan's first concepts of regional planning, but they were concerned with physical structures only and did not include the concepts of ecosystems and biodiversity. After the early postwar planning experiences, green network planning was applied in a limited number of areas at the district scale at the metropolitan fringes. For example, the Kohoku New Town land readjustment development project (with an initial area of about 13 km^2) began during the 1960s in Yokohama City at the fringe of the Tokyo Metropolitan Area. In this project, the planners installed the so-called Green Matrix System, which consisted of new public parks; private green spaces held by shrines, temples, and home owners; and farmland (Housing and Urban Development Corporation 1997).

They also focused on the local ecosystem and biodiversity, with the goal of trying to preserve the pre-existing Satoyama ecosystem by physically networking the remaining ecosystem patches. The creation of the new stream system was a core element in it. First they assessed geomorphologic conditions and groundwater levels, and then developed the stream network in consideration of rainwater discharges. In the construction stage, natural local building materials were partially utilized for their structures by civil engineers. This was a pioneering project in terms of preservation of an ecosystem network, but the biodiversity assessment at that time was insufficient and the green network was limited to the area inside the land readjustment project site. Currently, some of the private green patches, particularly private farmlands, have been further fragmented and encroached upon by small housing developments (Harada et al. 2012), probably as a result of weaker zoning regulations for private land parcels.

REFLECTION OF DUTCH ECOLOGICAL NETWORKS IN JAPAN

The development of regional-scale planning to integrate the ecosystem concept into green network planning emerged gradually in Japan along with the previously mentioned land development projects. Around the late 1980s to early 1990s, a group of Japanese researchers, engineers, government officials, and politicians studied nature restoration methods and nature-friendly civil engineering in Europe, especially in Germany and Switzerland. They wrote a book entitled *More Nature in Towns and Waterfronts*, explaining nature restoration sites and planning in Zurich (Technology Research Center for Riverfront Development 1990). The book influenced reforms in the River Act in Japan in 1997 towards more environmentally friendly ways of integrating the concept of ecosystem services into planning. However, these reforms emphasized engineering and technological aspects and placed less emphasis on planning, networking, and institutional dimensions, perhaps because of the historical importance of civil engineering in Japan.

In 1995, the Ecosystem Conservation Society of Japan published a Japanese translation of *Towards a European Ecological Network*, which was first published in 1991 by the Institute for European Environmental Policy in the Netherlands. This book significantly influenced the establishment of Japan's 5th Comprehensive National Development Plan, entitled "Grand Design for the 21st Century—Promotion of Regional Independence and Creation of Beautiful National Lands," in 1998 (MLIT 1998), which included the concept of ecological networks at the national scale, and other national and municipal scale land-use planning related to ecological networks. A considerable number of references were made to Dutch examples during this institutional decision-making process because of the influence of this book. Indeed, the Japanese edition included more than 10 pages of examples from the Netherlands. There was a particular focus on the ecological network of the Netherlands that included detailed maps (Fig. 1) and explanations about the structure of the network, cases of nature restorations, and related planning measures.

In 2006, a report entitled "Grand Design of Urban Environmental Infrastructures for the Kinki [Osaka City] Region—A Proposal Toward Human and Nature Network Connecting Mountain, Village and Sea" was published by a national governmental committee

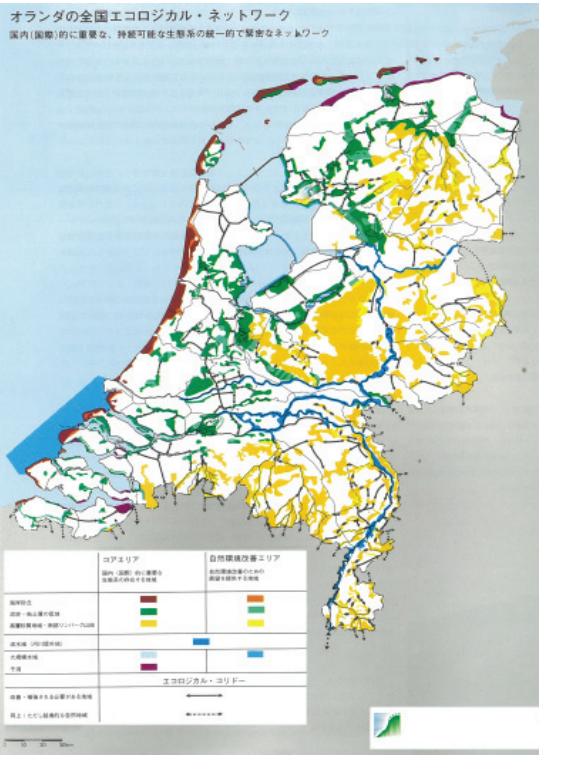

Figure 1:
Ecological network of the Netherlands (from the first Japanese translation; Conservation Society of Japan 1995)

(MLIT 2006). Figure 2 shows potential green (land) and blue (water) networks from the surrounding mountains to the low-lying urban center and coastal area. The proposal also recommended future prioritized zones, as outlined by thick green lines in Fig. 2, as core areas for ecosystem conservation in the ecological networks. These proposed networks and core zones basically overlapped the remaining natural elements of rivers and surrounding forests. Other areas were designated as "areas where nature restoration and creation are needed" (in dark pink in the figure) but without any suggested practical methods of doing so. Thus, the map was essentially based on the current land-use conditions with an emphasis on existing ecosystems.

Although they had some significance in sharing a future ecological network master plan among stakeholders, the map and the affiliated report were still only conceptual in nature. There was no integration with past or ongoing actual restoration projects such as the one conducted at the Osaka Nankou Bird Sanctuary wetland restoration site completed 23 years prior. In terms of wetlands,

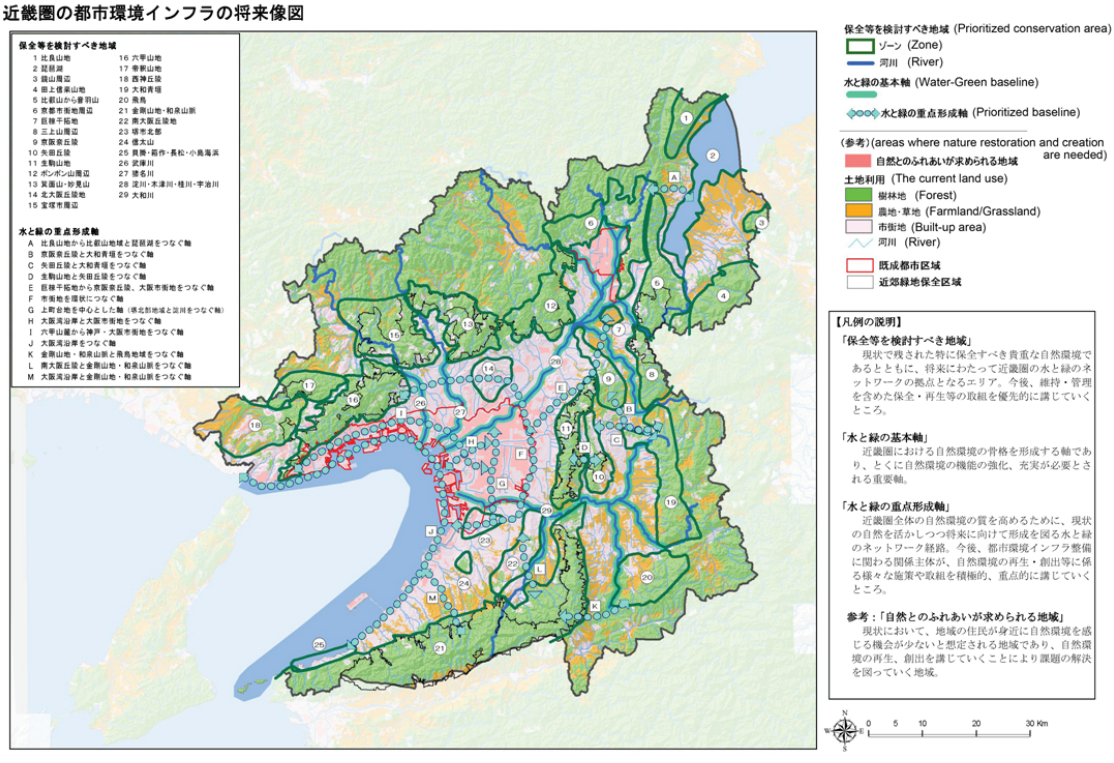

Figure 2:
Ecological network proposal for the Osaka city region in 2006. (modified from MLIT 2006)

the proposal noted the need to restore Osaka Bay mudflats as well as inner paddy fields to enhance the ecological network and maximize ecosystem services, but again, no tangible processes were suggested. In addition, the proposal lacked any legal enforcement measures. The map itself shows the influence of the Dutch ecological network in its shape and pattern, but the report was abstract and offered limited explanations about the required restoration methods in each zone.

TRANSITIONS AND RESTORATION

After the 2011 Tohoku earthquake, the Geospatial Information Authority of Japan (GSI; formerly called the Geographical Survey Institute of Japan) re-emphasized the importance of natural land conditions such as geology, soil, and micro-landforms in land-use planning for preventing and minimizing disaster risks. As part of their efforts, they produced a set a data known as “1880s low-lying wetlands data in digital vector format” and released the data to the public through their website (GSI 2013). These data were produced from original paper topographic maps created during this period at a scale of 1:20 000, which was Japan’s first topographic map created using Western survey methods.

These data can be useful in identifying low-lying urban areas that were originally not suited for human uses, but that had been completely filled and artificially developed during the late 19th and 20th centuries. For example, many of these areas were fully urbanized, and the original landforms were no longer visible; however, in the disaster area, these types of former wetlands were damaged by liquefaction and suffered other foundation impacts (Aoyama et al. 2014). These data can also be put to use in other research areas such as landscape ecology and historical geography, where more efficient visualizations, comparisons, and quantifications are possible than with the older paper maps. From the original vector format shape files, we mapped the 1880s wetlands in the Osaka city region (Fig. 3). We also produced a corresponding contemporary wetland/water-related

land-use distribution map (Fig. 4) that was extracted from 2008 land-use vector data at a scale of 1:5000 (GSI 2011) to make comparisons between these two periods.

Figure 3 shows that natural wetlands and flooded paddy fields in the 1880s were situated in the lowest topographic parts of the area and along the Yodo River on the alluvial plain (the Osaka Plain), and dry rice fields were widely distributed along the rim of the plain. The river meandered and there were many small streams, natural wetlands, and annual wet rice fields on the lower plain. The map indicates that river course management, riparian works, and flood control engineering for the major river course had not yet been intensively executed. In some higher parts of the plain, however, particularly in the south, riparian works (including the construction of floodways and gravity irrigation channels) had been constructed, most likely during the Edo Period (1603–1868), by hand without the use of heavy equipment (Nishida et al. 2008).

By 2008, almost all of the natural wetlands and wet paddy fields had disappeared (Fig. 4), and the dry rice fields of the 1880s had been converted into irrigated fields. The main course of the Yodo River became straight as a result of river course management and flood control works originally planned and initiated by the Dutch engineer Johannis De Rijke (1842–1913; called the "father of modern civil engineering" in Japan) during the early Meiji Period (1868–1912) (Kamibayashi 1999). These works allowed people to inhabit former wetland areas along the river by using fill; that is, the areas that were close to the urban center of Osaka were urbanized (Takahashi 1999). The former dry rice fields along the rim of the plain had been largely converted into irrigated fields through land, canal, and stream improvement projects supported by modern civil engineering equipment and by institutional frameworks such as the Arable Land Readjustment Law (enforced in 1889) and the Land Improvement Act (enforced in 1949).

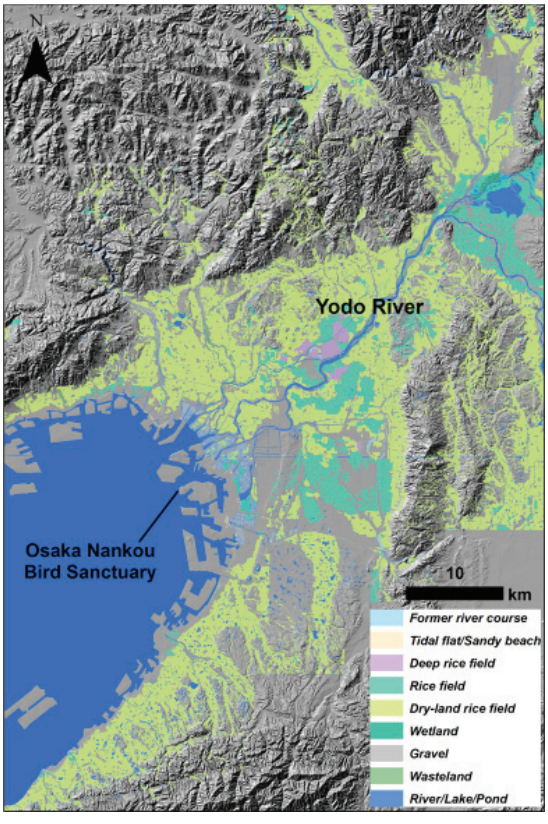

Figure 3:
Wet and dry farmlands and natural wetlands in the Osaka area in the 1880s

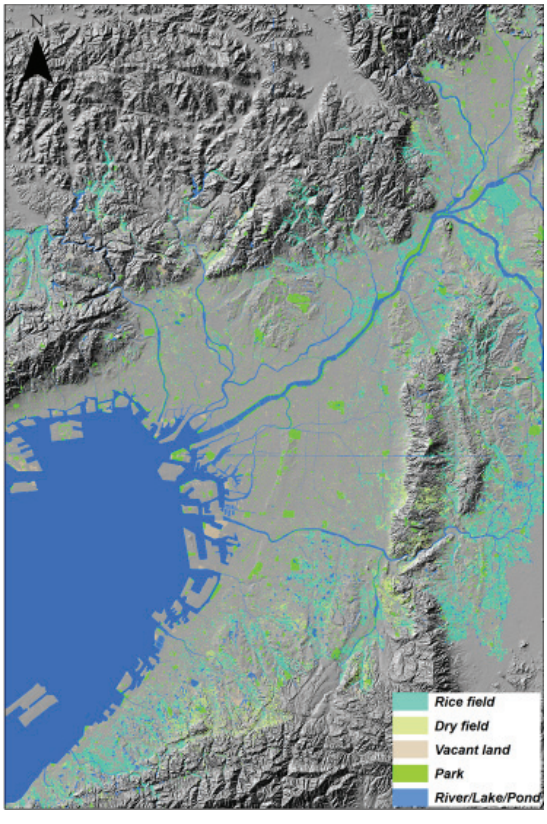

Figure 4:
Wet and dry farmlands and natural wetlands in the Osaka area in 2008

Figure 4 also shows a limited number of parks in the lowest urban center, some of which were constructed as part of the Osaka Park System described in Chapter 2. These parks are not wetlands, they are modern urban parks.

ONGOING AND POTENTIAL NATURE RESTORATION SITES

Several wetland restoration practices and projects are emerging in the fields of the Osaka city region. One of the most successful projects is the Osaka Nankou Bird Sanctuary (ONBS)(Fig. 5), which was created largely using a bottom-up approach. (Natsuhara et al. 2005). ONBS is a part of a landfill area near the Osaka Port, which was the one of the first ports to open to foreign countries in 1868. On the basis of port planning in 1894, the area near the port was gradually landfilled and developed as an important trade center before World War II. Landfilling was halted during the war but it resumed in 1958. By then, some unused areas had already become submerged and were returning to wetlands that provided habitat for birds. Some local residents were opposed to further development on this emerging wetland, and formed an organization in 1968 to petition for the establishment of a park here. In 1971, the decision to create the ONBS was made, and the sanctuary was opened in 1983. Originally, the Port and Harbor Bureau of the Osaka City Government managed the park; however, the Nankou Wetland Conservation Group, which includes several professional bird ecologists, was designated as the management organization in 2006. The park was selected as one of Japan's 500 important wetlands by the Ministry of the Environment Japan in 2001 and as an important flyway network core by the Partnership for the East Asian Australasian Flyway in 2003 (ONBS 2013).

A similar type of wetland restoration practice occurred in the Netherlands. The Oostvaardersplassen (Fig. 6) is a nature reserve that is described in "Conservation Society of Japan" (1995). It is situated on the lowest part of the Southern Flevoland polder (Fig. 7) a land reclamation from 1968. Originally a large industrial area was planned there, but because of the oil crisis of 1973 and the ensuing economic recession, no further development took place and the area became a vast wilderness.

An action group consisting of biologists and local residents formed in 1973 to preserve this emerging natural area. In 1976, a decision was made to install pumps to supply water to the area. Since then, the water level has been monitored consistently and frequently to provide high water levels in the winter and low levels in the summer imitating the natural water cycle of this area, which is the opposite sequence functionally in the most surrounding agricultural fields. For every period, the optimum water level was determined and prescribed for those groups of birds that were deemed important. In addition, some cattle were introduced to promote surface disturbance and induce micro-scale mosaic habitats including grassland, marsh vegetation and open water.

At the end of 1995, the responsibility for the area was transferred from the Ijsselmeer Area Water Authority to the Dutch Forestry Commission. The Oostvaardersplassen is thus one of the largest

Figure 5:
Osaka Nankou Bird Sanctuary, a restored unused industrial coastal site in Japan

Figure 6:
Oostvaardersplassen,a restored unused industrial site in the Netherlands

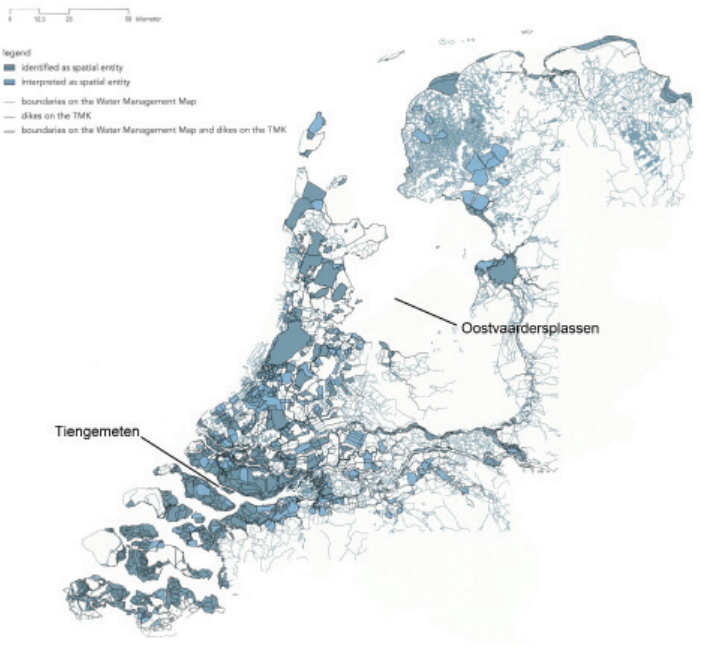

Figure 7:
Polder-based and wetland restoration sites in the Netherlands (modified from Steenbergen et al. 2009)

experimental sites for adaptive management of the wetland in Europe, and still considered to be a wetland of international importance with many breeding marsh birds, migrating waders, and waterfowl, including rare species such as the great egret, spoonbill, and sea eagle (Wigbels 2000). People are able to enjoy this beautiful natural area year-round. The ONBS and Oostvaardersplassen share similarities in their construction process and the bottom-up approach from the local community for establishing public wetlands on unused reclaimed industrial lands.

Another type of emerging wetland restoration practice in the Osaka city region is the restoration of rice fields, particularly abandoned fields. Throughout Japan, abandoned paddies are frequently reported as a serious issue nationwide. Historically and geographically, Japanese paddy fields were developed in small parcels and required labor-intensive practices; therefore, production costs were high and not competitive with imported products. To protect small-scale rice farmers, the national government had a standard domestic rice price policy with a high protective tariff. However, this agricultural policy came to be criticized because it minimized farmers' competition in the market, which served to further reduce productivity. Therefore, the central government began a direct payment policy for farmers in 2000 (similar to the EU's decoupling policy) in place of the long-standing price maintenance policy.

The concept of "multi-functional agriculture" began to emerge in support of this new policy (Yonezawa et al. 2002). Enhancement of wetland ecosystem services in rice-producing areas is central to multi-functionality. Following these trends, the practice of winter flooding has drawn wide public attention in relation to nature restoration and the creation of ecological networks. Winter pooling in rice paddies is considered an important measure to maximize the year-round wetland functions of rice paddies in Japan.

Mineta et al. (2004) identified at least 66 cases in Japan in 2004. In the past, the practice was regarded as competitive in terms of labor efficiency and productivity of rice cultivation. Recent movements toward the use of winter flooding in rice paddies act as a counterbalance to large modern mechanized farms that are dependent on machinery and inorganic fertilizers and that reduce the level of biodiversity (Washitani 2007).

Mineta et al. (2004) identified the major incentives for farmers to start using winter flooding. The major one was not to conserve biodiversity, but rather to maximize productivity through its function of improving organic soil quality without the use of factory fertilizers and pesticides and minimizing

wild grasses and other weeds. In essence, these are straightforward economic reasons for using this practice. For organizations, the major reason was to enhance biodiversity, in particular for winter migratory birds. Washitani (2007) presented cases of winter-flooded fields in Japan (Fig. 8). These areas were usually located in remote low-lying rural areas or on the fringe of regional cities, where large-scale rice plots still existed. These large rectangular irrigated rice fields were originally reclaimed from natural wetlands, as discussed in Chapter 4 (Fig. 3). However, as time progressed, many of these rice fields were converted into urban uses in large cities such as Osaka (Fig. 4), whereas they still exist in rural areas and have therefore become a target for winter flooding projects (Mineta et al. 2004). In the case of metropolitan regions such as Osaka, there are few places available to practice winter flooding in low-lying areas.

Instead, in the Osaka city region, rice fields suitable for wetland restoration were identified on the rim of the plain, which was previously used as a dry rice area. One such case involves the restoration of abandoned rice fields into biotope ponds to promote biodiversity without rice production (Fig. 9). These biotope sites are managed by non-profit organizations; they are mainly located in the foothills of the urban fringe (Fig. 4) and distributed as small fragmented landscape patches (Motoyasu and Hara 2011). Hence, they cannot function as core wetlands in the ecological network. Furthermore many of the abandoned rice fields are located in dry areas that are not wet under natural conditions. Once abandoned, they revert to grasslands and eventually forests in as little as 10 years (Fig. 10). Thus, practical measures applicable to the restoration of wetland functions in rice fields vary by location, and there is less potential to practice restoration in and near large metropolitan areas. Given these problems, it is challenging to integrate wetland restoration measures into newly created ecological networks.

Wetland restoration on farmland has also been recorded in the Netherlands, but in a completely different form. The Tiengemeten project is a good example. Tiengemeten is an island in the Rhine–Meuse–Scheldt delta in the province of South Holland (Fig. 7). The name refers to an old measurement of area (one *gemet* is comparable with one acre), and the name means "ten-*gemet*" island. Ten *gemets* is about 100 m × 400 m, whereas the island is actually about 7 km × 2 km. Before 1750, it was an unstable small muddy island where local farmers and hunters traditionally gathered reeds, fish, and ducks. Like many other areas in the Netherlands, it was reclaimed as a polder after 1750 to create inhabitable dry farmlands (Landbouwmuseum Tiengemeten 2013). After the middle of the 20th century and the continued expansion of the Rotterdam area, the island was the focus of several different types of planning, including being used as an industrial park and the location of a power plant. However, these plans never materialized, primarily for economic reasons. In 1994, plans began to emerge to restore the island to its natural state. Over the next few years, Natuurmonumenten started to acquire land on the island for a wetland restoration project (Natuurmonumenten Tiengemeten 2013). On 10 May 2007, the island was officially "given back to nature"; all of its farming inhabitants had been relocated and the island has since been undisturbed by human activity. New nature reserves are rare in the Netherlands, and Tiengemeten has become a wilderness with a trackless terrain, flowing creeks and gullies, meadows full of flowers, and huge populations of migrating birds, including ospreys and egrets (Fig. 11). Some of the marshy pastures are grazed by Highland cattle and other hardy animals.

The Tiengemeten case provides an example of land-use change from widespread dry polder (Fig. 7) to natural wetland (Fig. 11). This is in sharp contrast to much of the Japanese farmland (especially the formerly dry rice fields), where restoration requires continuous intensive human management. Many parts of the Dutch territory used to be under water (Fig. 7), so it is natural that they become wet in the absence of intensive drainage management. Hence, even the concept of pre-existing wild nature itself was not yet fixed in the Netherlands (Van den Berg and Koole 2006; van der Windt et al. 2007). Such a significant difference in pre-existing land conditions and agricultural development history should be considered whenever planners, policymakers, and other stakeholders plan or implement restoration measures. As we have noted, however, the perspective of historical geography has been largely ignored in the ecological network concept in Japan.

The Tiengemeten case is not a typical example. The project required difficult negotiations and a long process of consensus building among stakeholders, including land owners (farmers), planners, government officials at different administrative scales, and the Natuurmonumenten (Kuster and Kuster-Bellmann 2011). Moreover, it probably represents one of the easiest cases of wetland restoration with the aim enhancing ecological networks in the Netherlands in terms of availability of land (Jongman and Bogers 2008). Given these difficulties in the Netherlands, where long-standing

Figure 8:
An example of a flooded winter paddy field in Miyagi Prefecture, northern Japan (photo provided by Dr. Mayura Takada, University of Tokyo)

Figure 9:
An example of a newly created biotope pond in an abandoned paddy field

Figure 10:
An example of short-term vegetation succession in the absence of human intervention in a rice-growing area on the plain rim in the Osaka area. The lot in the foreground has been abandoned for 1 year and already has wild grasses growing on it. The lot in the background has been abandoned for several years and has trees growing on it (experimental paddy plots monitored by Wakayama University)

Figure 11:
Tiengemeten, a restored wetland area that had formerly been drained dry fields

spatial planning authorities exist (van Dijk and van der Wulp 2010), it is likely that in more populous Japanese low-lying areas with weaker land-use control measures, such as in Osaka (Kawai 1959), available land for wetland restoration will be highly limited, except for coastal post-industrial reclaimed areas such as at ONBS. In addition, the rice fields at the urban fringe are not naturally suited for wetland restoration, so creating ecological networks will remain a challenge in large Japanese cities.

WORKING TO CREATE ECOLOGICAL NETWORKS IN THE CONTEXT OF RESILIENT LANDSCAPES

In this paper, we describe the ecological network concept and plan for the Osaka city region in relation to similar concepts and plans in the Netherlands. Through our investigation, the importance of

considering the historical geography perspective in the creation of reliable hierarchical relationship between restoration spatial plan and field practice in each part of ecological network has emerged. The word "resilience" is widely used but does not yet appear to have a clear definition. The example shown in Figure 10 can be regarded as one aspect of a resilient landscape, one that is transformed from intensively managed wet rice fields to natural grasslands and forests on a plain rim landform in a humid warm climate in Japan. The example in Figure 11 could be regarded as another type of resilient landscape, as the area is transformed from dry polder fields into its original natural wetland state in the Netherlands. These examples should be considered as normal predominant land uses in these areas and not overly site specific. The restoration examples shown in Figure 5 (Japan) and Figure 6 (the Netherlands) are more limited and may apply only to reclaimed coastal areas. Good planning strategies and concepts can be shared internationally, but regional perspectives are also important in the creation of a practical framework of ecological networks in landscape planning. Such comparative studies should be continued for elaborating ecological network plan with reliable practical restoration measurements in each zoning of the network based upon historical geography perspectives.

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