TOPOGRAPHIC WATERSHEDS AS A FRAMEWORK FOR THE NEW JAPANESE REGIONAL ADMINISTRATIVE UNITS FOR ECOSYSTEM MANAGEMENT

CHEN, Siew Fong 1), MORIMOTO, Yukihiro 2)

1) Graduate School of Global Environmental Studies, Kyoto University
   siewfong.chen@gmail.com
2) Graduate School of Global Environmental Studies, Kyoto University
   ymo@kais.kyoto-u.ac.jp

Abstract: "Japan Regional System Debate" (日本の道州制論議) is a discussion regarding the consolidation of the present Japanese regional administrative structure of prefectures, cities, towns and villages into larger administrative units: a 'state and country' system. One of the main reasons for the abolishment of the current prefectural administration systems into larger administration units are public economics and governmental finance problems. Japan, the postwar economic miracle, is on a fundamental slide. In 1992, Japan ranked fourth in the world in terms of gross domestic product per person, but has slipped to 20th by year 1997. With escalating tax rates, decline of public services and the rise of national and prefectural governmental debts, budget volume and creditworthiness of prefectural governments are declining with the current Tokyo-centric approach in administration. "Broad-scale Regional Plan" (広域地方計画) is a suggestion that consolidates existing prefectures into integrative administrative zones to reinforce authoritative independence and economic competency of the proposed new administrative regions. The Japan Regional System discussion by the Ministry of Environment mentioned that in order to combat global warming, efficient management of industrial waste, management of air pollution, water and soil contamination, we need a nationwide countermeasure system that responds to actual circumstances of regional environmental problems across administrative borders. This paper explores the idea of re-discussing the framework of Broad-scale Regional Plan towards a more ecologically-relevant planning unit tool for nationwide conservation planning, ecosystem management and conservation of biodiversity. It is important as a decision making aid to solve Japan's socioeconomic constraints parallel with environmental and conservation concerns.

1.1 Background

"Japan Regional System Debate" (日本の道州制論議) is a discussion regarding the consolidation of the present Japanese regional administrative structure of prefectures, cities, towns and villages into larger administrative units: a 'state and country' system. One of the main reasons for the abolishment of the current prefectural administration systems into larger administration units are public economics and governmental finance problems. Japan, the postwar economic miracle, is on a fundamental slide. In 1992, Japan ranked fourth in the world in terms of gross domestic product per person, but has slipped to 20th by year 1997. With escalating tax rates, decline of public services and the rise of national and prefectural governmental debts, budget volume and creditworthiness of prefectural governments are declining with the current Tokyo-centric approach in administration. "Broad-scale Regional Plan" (広域地方計画) is a suggestion that consolidates existing prefectures into integrative administrative zones to reinforce authoritative independence and economic competency of the proposed new administrative regions. The Japan Regional System discussion by the Ministry of Environment mentioned that in order to combat global warming, efficient management of industrial waste, management of air pollution, water and soil contamination, we need a nationwide countermeasure system that responds to actual circumstances of regional environmental problems across administrative borders. This paper explores the idea of re-discussing the framework of Broad-scale Regional Plan towards a more ecologically-relevant planning unit tool for nationwide conservation planning, ecosystem management and conservation of biodiversity. It is important as a decision making aid to solve Japan's socioeconomic constraints parallel with environmental and conservation concerns.

1.2 Ecoregion delineation and significance in ecosystem management

The federal government and many states of the United States have been using a framework of ecoregions and watersheds in an effort to adopt a more holistic approach to ecosystem and natural resource management at a broader regional context (Omernik and Bailey, 1997). From a nature restoration point of view, delineation of ecoregions is important as guideline in restoring ecosystems indigenous to each region, to prevent disasters and sustain local to global environments (Miyawaki, 1999) beyond regional and political boundaries. In this paper, the authors explore the idea of adopting the Topographic Watershed Map of Japan (Chen S.F., Ise H., Masuzawa T. 2007) and ecoregion classification as a framework to spatially organize ecosystem management and to suggest demarcation of new political and administrative regions of Japan in a
Fig. 1 Topographic Watershed Map of Japan with main watershed divide (Chen, S.F., Ise, H., Masuzawa, T. 2007).

to geographical and ecological perspective. Ecosystem classification methods used for delineating ecoregions should be adjusted to Japan’s unique geological formation, natural history and rich biodiversity.

Table 1 Map scale and polygon size of ecological units (Cleland et al., 1997)

<table>
<thead>
<tr>
<th>Ecological unit</th>
<th>Map scale range</th>
<th>General polygon size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>1:30,000,000 or smaller</td>
<td>1,000,000s of square miles</td>
</tr>
<tr>
<td>Province</td>
<td>1:15,000,000 to 1:5,000,000</td>
<td>100,000s of square miles</td>
</tr>
<tr>
<td>Section</td>
<td>1:7,000,000 to 1:5,000,000</td>
<td>1,000s of square miles</td>
</tr>
<tr>
<td>Subdivision</td>
<td>1:3,000,000 to 1:2,000,000</td>
<td>100s to 1,000s of square miles</td>
</tr>
<tr>
<td>Landtype association</td>
<td>1:250,000 to 1:500,000</td>
<td>1,000s to 10,000s of acres</td>
</tr>
<tr>
<td>Landtype</td>
<td>1:50,000 to 1:24,000</td>
<td>100s to 1,000s of acres</td>
</tr>
<tr>
<td>Landtype phase</td>
<td>1:24,000 or larger</td>
<td>&lt;100 acres</td>
</tr>
</tbody>
</table>

2. Materials and methods

2.1 Study site

We have chosen Japan as a whole for our nationwide analysis of the Japan Topographic Watershed Map (Fig. 1) as the framework for the application of hierarchical regional ecoregion classification.

Ecoregions are large ecosystems of regional extent that contain a group of geographical zones that represent geographical groups of similarly functioning ecosystems. Ecoregions naturally exist in different sizes and can be identified at various scales or levels of detail in a hierarchical manner. As climate determines natural ecosystem boundaries at all scales, it is basically assumed that climate, as a source of energy and moisture, acts as the primary control for the ecosystem. All ecosystems either macro and micro-scaled, are responding to climate influences at different scales. As a result, kinds and patterns of dominant life-forms of plants and animals change, as do all kinds of soils. Hydrologic and erosion cycles plus the life cycles of biota also changes, therefore ecoregions should reflect significant
difference in climate as the most important factor in setting ecoregion boundaries (Bailey 2005). The different climatic regions of Japan can be the first step in delineating Japan’s ecoregions.

2.2 Ecoregion mapping as a tool for ecosystem management

In this paper, we have decided to study about the National Hierarchy of Ecological Units (Fig. 2) developed for the USDA Forest Service as a reference for further developing the ecological units that are unique to Japan’s much narrower spatial scale, unique geographical characteristics and rich biodiversity. We used map scale polygon size of ecological units (Table 1) as a base to compare the scale of Japan’s topographic watersheds. And then we used principle map design criteria and hierarchy of ecological units (Fig. 2) to compare with the characteristics of Japan’s climate regions to find out the largest ecological unit in Japan in relation to USDA Forest Service’s ecological unit map design. We used Japan’s climate region map as a surrogate for Japan’s ecoregion, assuming climate region as the main delineator for ecoregion mapping. By such comparison, we discovered if the ecological unit delineation by Cleland et. al. is feasible to be adopted as guideline for the delineation of Japan’s ecoregions. We are also able to know the scale of Japan in terms of ecoregion mapping as compared to United States which is much vaster in area and has a continental character as opposed to Japan, a narrow island country. This can be helpful in aiding us in our future plans to further detail the ecoregion classification of Japan.

3. Anticipated results

3.1 Comparison of National Hierarchical Framework of Ecological Units (Fig. 2) with Japan’s climate regions

We started our analysis by studying map unit design criteria of the National Hierarchical Framework of Ecological Units (Fig. 3) to the highest ecological unit suited to ecoregion delineation of Japan’s suited to its spatial scale. As climate influence was the main determining factor, a study into Japan’s climatic characteristic revealed that Japan is divided into distinct climate subzones that had different weather patterns, different length of dry season or duration of cold temperature and as a result of all these, different resulting natural vegetation. These characteristics matched the characteristics of ecological unit at province level, so we decided to assign province as the largest ecological unit for ecoregions. Figure 3 shows the climatic regions of Japan. Each of the climatic regions was assumed to be a representation of ecoregions at a province ecological unit. It is representative because although climate is the main determinant in ecoregions boundary, other determinants using map design criteria such as geological, vegetational and other indicators in National Hierarchical Framework of Ecological Units has not been considered. Furthermore, we need to customize designation of ecological units and its indicators unique to Japan’s spatial scale and characteristics. Once we have designated principle map units design criteria unique to Japan’s province level / section level we will be able to explore grouping of watersheds/ basins into broad-scale administration regions for government-wide environmental management and nature restoration.

Fig. 3 Revised from Climate regions of Japan (Wadachi, 1974)

Fig. 4 National Land Division for Biodiversity Conservation (Environmental Agency, 1997)
4. Further research

4.1 Discussing administration region using National Land Division for Biodiversity Conservation map

We are currently exploring the idea of using the Japan Environment Agency-published National Land Division for Biodiversity Conservation map (Fig. 4) as an ecoregion substitute for province level / section level broad-scale administration unit. This scheme was divided into ten districts from a biota point of view. This land division scheme is an important measure to protect and conserve biodiversity according to their appropriate regions. This map identified the extent of plants' internal migration patterns and therefore is important for monitoring movements of native species within and beyond their natural extents and the inverse impacts. Using this map as another framework for determining broad-scale administration regions is an interesting prospect.

5. Discussion

The combination of both ecoregion mapping and topographic watersheds can form a system of administration from an ecologically point of view. This is because topographic watersheds are natural boundaries and can be used as group of geographical zones with similar functioning ecosystems as ecosystem boundaries. Ecoregion borders can be used as a provincial administration border, and watersheds as the components that make up parts of a certain ecoregion. Therefore we will be able to make holistic/government-wide ecosystem-level decisions across the current administrative boundaries. Because topographical watersheds are the true pathways for interactions of ecosystem components and are critical linkages between upstream and downstream effects, this framework is beneficial for soil and water conservation and riparian system management.

However, there are several limitations to using topographic watersheds as administrative units for ecosystem management. Unlike the discussions by Ministry of Environment about using the Broad-scale Regional Plan as a broad administrative unit and its potential to solve air pollution/contamination and global warming, watershed is too small a unit in managing these issues. This framework is not effective in the management of fauna with big habitat range that are not constrained by topographical boundaries but this can be solved by managing the environment at an ecological unit higher than ecoregion level e. g. division level or domain level. Therefore, we need to have a specific classification for environmental parameters and biological parameters to efficiently delineate ecoregions unique to Japan's spatial scale, natural history and so on. Japan is much narrower in size and shape, isolated from other countries and has a rich biogeographical history compared to ecological unit map design criterias of the United States.

About Japan Regional System Debate, the main concern is about chronic financial situation of the current prefectural system, so there should a compromise to balance the socioeconomic side and also the environmental aspects when devising the new administration units. At the moment, there are some prefectures that have agreed but there is still a lot of protest on the dismantlement of the prefectural system.

6. Conclusion

Discussions of the Japan Regional System and the Broad-scale Regional Plan in the government are suggestions to consolidate the present prefectural administrative structure into larger administrative blocks to help alleviate financial problems of poorer prefectures as a result of a Tokyo-centric policy. This suggestion apparently is also aimed to improve decision making in environmental management but the potential of these spatial arrangements is unknown. We explored the idea of adopting an ecoregion approach to re-discuss the spatial arrangement of Broad-scale Regional Plan for nationwide-scaled ecosystem management. As climate acts as the main determinant in ecoregion delineation, we assigned the scale of ecological units unique to Japan based on the National Hierarchical Framework of Ecological Units (Cleland et al. 1997) to see the potential resulting ecoregion to be used as a broad administration unit, and to adopt the Topographic Watershed Map of Japan (Chen, S. F., Ise, H., Masuzawa, T. 2007) as individual management units for ecosystem management.

References