

Urbanization, Resource Management and the Environment: Historical Perspective from Vegetable Production in Early-Modern Japan

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Introduction

The concentration of populations in urban centers inevitably creates problems of excessive wastes and pollution. Throughout history the development of advanced production and market exchange has typically stimulated urbanization. This also has been accompanied by material concentration in urban centers. Such patterns of economic development often leads to overuse of energy, thus depleting natural resources.

In contrast, Japan's urbanization was unique because it occurred before industrialization and in an essentially closed economy. Large-scale cities emerged in Japan during the Tokugawa period (1603-1867), well before the period of industrialization. Most notably, Edo (present Tokyo) was one of the first few cities in the world that had more than one million people by the beginning of the eighteenth century. In addition, the Tokugawa government banned international exchange, except strictly restricted trade with Holland and China, for more than two centuries. Early-modern Japan thus faced long-term resource constraints more severe than any urban society in history, while it still accumulated capital and technology that laid a basis for successful economic development in the later period.

Historical literatures suggest that early-modern Japanese society developed an extensive system to recycle urban waste as fertilizers. Such recycling practices were operated by private services, not by government. Particularly, ash and human night soil were traded as indispensable resources with positive price. This means that farmers went door to door to pick up wastes, and, rather than being paid for collecting, they paid the households for the resources. *Examining conditions of such an economic system will give us significant insights for public policy design to address today's global challenge of sanitation in developing countries and natural resource management.*

Research

In this research, I focus on the interdependence between cities and agricultural villages. The hypothesis is that the profit-maximizing behavior of farmers actually created a condition to promote the market-based recycling, which alleviated problems caused by excess energy use and waste generation. The research draws upon an interdisciplinary approach: based on the knowledge provided in literatures in economic history of Japan, I will build an original economic model utilizing the capability of Geographic Information Systems (GIS). Prof. Gary Leupp (History), Prof. Matthew Kahn (Fletcher School), Prof. Frank Ackerman (UEP and GDAE), Prof. Chris Swan (Civil and Environmental Engineering) and Prof. Rhonda Ryznar (UEP and GIS Center) are the key faculty members who have been helping me to conduct this project with their expertise.

The profit maximization of farmers was dependent on their proximity to the consumers of

their produce. Population densification created immense demand for foodstuffs. Farmers near the city of Edo quickly shifted their production from grains to fresh vegetables in response to these market changes. While grains could be stored for a long period, fresh vegetables needed to be consumed as soon as harvested. This made the farmers take advantage of low transports costs. Urban proximity also presented the benefit of easier access to urban wastes. Used as nutrient rich fertilizers, they were vital ingredients for maintaining productivity under conditions of intensive farming.

Based on these premises, I will apply a theory that Thunen (1826) originally sought to explain the pattern of agricultural activities surrounding cities in preindustrial Germany.¹ The essence of his theory is that, in a given location and its associated transport costs, a farmer will choose to produce a crop that will give him the maximum profit among choices available to him. If the transport costs are uniform across space, according to his theory, "rings" of crops in order of the importance of transport costs from the marketplace (i.e., the city) should be observed. I will examine if we can observe such "rings" in agricultural villages around Edo. In reality, goods can travel more easily (thus transport costs are lower) if water canal or roads are provided. GIS allows us to incorporate such conditions in the analysis. In Fall 2002, I conducted a preliminary study using data from published sources as a term project for a course (ENV193R: Advanced GIS). The result showed that the "vegetable rings" were formulated around the city of Edo. I will present a paper on this study at the meeting of the International Society for Industrial Ecology in July 2003.

In order to make this model credible and show the mechanism of this recycling system, however, it is critical to build an original database based on historic information. Components of the information include: locations of different crops, prices of vegetables, night soil and ash, production practices, actual transport costs, and other surrounding conditions such as how these goods were traded. Such information is available through local histories and historic tax records, etc., most of which are only available in Japan. Therefore, it will be necessary for me to conduct archival research in Tokyo. The University of Tokyo's Agriculture Library and the National Diet Library are the two most reliable sources, although local libraries and museums should have valuable sources about the area's early modern agriculture as well. Funding from the TIE Environmental Graduate Fellowship will allow me to conduct this field study.

Relevance of Project

My career goal is to educate young professionals in urban planning and environmental policy, and contribute to public policy design through academic researches in Japan. While illuminating an unusual and innovative period of environmental stewardship in Japanese history, this project will result in my Ph.D. dissertation for the Interdisciplinary Doctorate Program at Tufts Graduate School of Arts and Sciences.

¹ Johann H. von Thunen. *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationaleconomie*. English translation is *Isolated State*. 1966. Oxford and New York: Pergamon Press.