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Johann-Heinrich von Thünen: Balancing Land-Use Allocation with Transport Cost

By Scott Crosier

Background

In the early 1800s a North German estate owner, Johann-Heinrich von Thünen (1738–1850), sought to determine the most profitable land use for his estate. He collected information that would later be published in *Der isolierte Staat* (1826 "The Isolated State"). In this work, von Thünen developed one of the first models to describe the land use practices radiating out from a central market location.



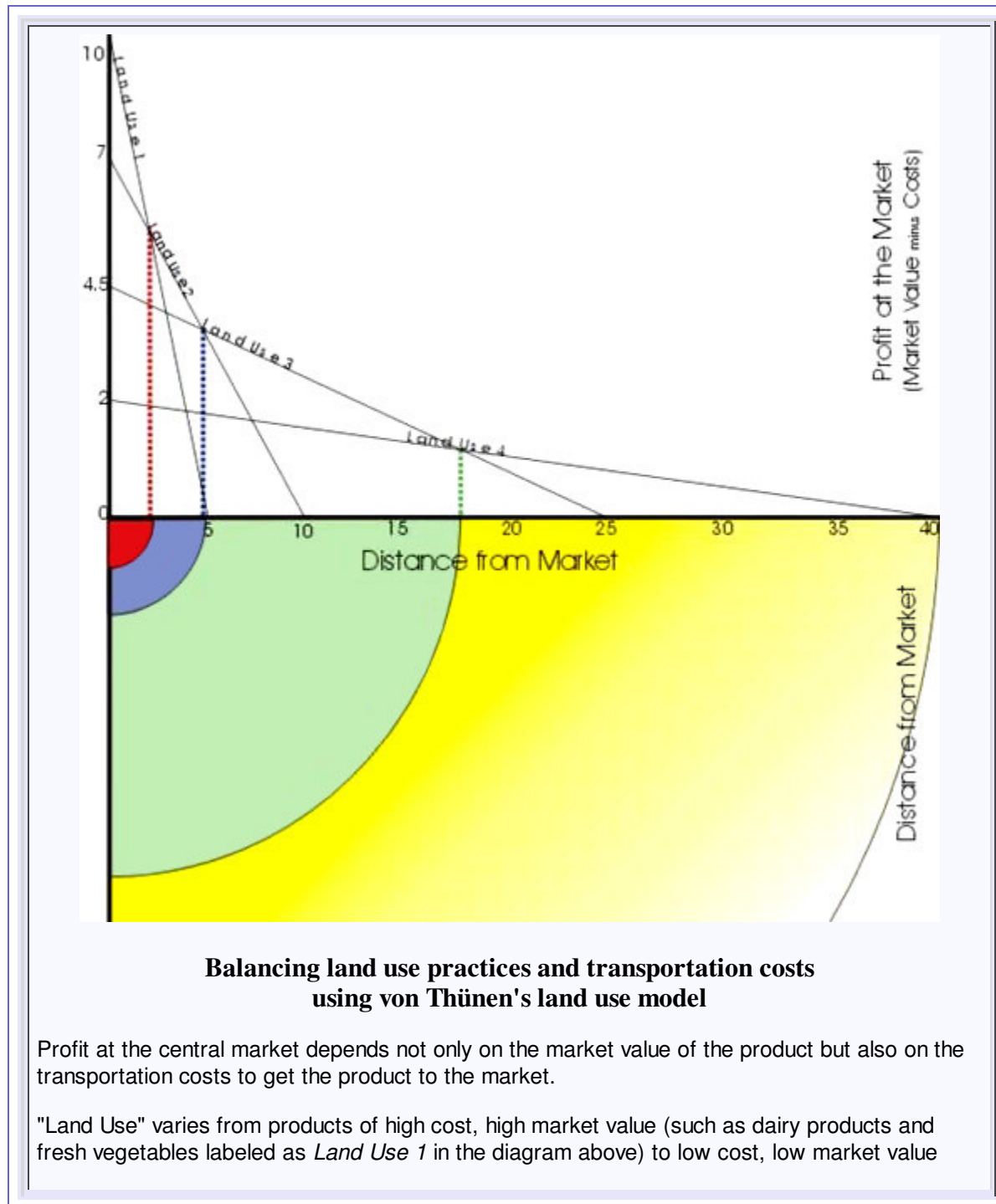
Innovation

Von Thünen developed a model of agricultural land use. His model was created before industrialization and is based on the following limiting assumptions:

1. The central market place is located within what is referred to as an "Isolated State," suggesting a community that is self sufficient and has no external influences.
2. This "Isolated State" is surrounded by an unoccupied, unused land.
3. The land of the State is completely homogenous, having no rivers, mountains or other obstructions. Furthermore, the soil, climate and all other factors on agriculture are the same.
4. In the "Isolated State" there are no major veins of transportation. That is to say that the farmers in the State transport their own products to the market via oxcart, over land, directly to the central marketplace.
5. Farmers in the state do what they need to earn the greatest profit in the marketplace.

In an "Isolated State" with these conditions, von Thünen theorized that several rings of agricultural land use practices would surround the central market place (see illustration). The land within the closest ring around the market will produce products that are profitable in the market, yet are perishable or difficult to transport. As the distance from the central market increases, the land use shifts to producing products that are less profitable in the market, yet are much easier to transport.

Although the idea of an "isolated state" is archaic in today's world, the agricultural patterns in Europe and the United States still reflect the economic considerations that influenced von Thünen. This approach has also been central to modern applications of understanding urban land use patterns (Alonso, 1964), urban sprawl (Sinclair, 1967) and other spatial studies where transportation costs have an influence over decisions on land use. The general approach of von Thünen illustrated the use of distance-based gradient analysis (e.g., the change in value for a variable such as land rent with increasing distance from the city center). His work also foreshadowed research on optimization in land allocation to maximize the net return associated with land use activities.



products (such as grain or livestock labeled as *Land Use 4* in the diagram above).

As the distance from the central market increases, the profit that would be gained from a product decreases. In the diagram above, if the producer of "land use 1" (tomatoes, for example) needed to transport the product 5 miles, there would be no profit made at the market. This rate of depreciation in market value varies with different land use types. Using the same example, if the farmer had land 4 miles from the market it would be more profitable to produce "land Use 2." An equilibrium is met where the profit of one land use outweighs the profit of another (signified above by the dotted lines). At this point, the land use changes.

Publications

Hall, Peter, Ed. *Von Thünen's Isolated State* (English translation by Carla M. Wartenberg, with an introduction by the editor), Pergamon Press. 1966.

The Isolated State, Volumes I, II and III (1826, 1850, 1867).

Related Works

Alonso, W. *Location and Land Use*. Cambridge, Mass.: Harvard University Press. 1964.

Beckmann, Martin. Von Thünen Revisited: A Neo-Classical Land Use Model *Swedish Journal of Economics* 74: 1–7, 1972.

Clark, Colin. *Von Thünen*

Sinclair, R. Von Thünen and Urban Sprawl *Annals of the Association of American Geographers* XLVII: 72–87, 1967.

Links [Johann-Heinrich von Thünen Resources](#)
[Philip Steadman's von Thünen Animation Software](#)