

Impact of Distance on Farming: A Test of Von Thunen's Model¹

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Abstract

This study attempts to test the applicability of Von-Thunen's model of agricultural land use in Nepal. Three villages namely Sakhi, Banjhadi and Nayagaon from the hill, inner Tarai and Tarai respectively are selected to test the model. The study finds that impact of distance on agricultural inputs such as labour, fertilizer and intensity of ploughing is evident and the use of these inputs decreases with distance from home. It also finds that the amount of labour inputs both human and animal is higher in the hills compared with inner tarai and tarai region.

Key Words: *Von Thunen's Model, crop location, cropping intensity, modern technology.*

Introduction

Agricultural activity is highly dispersed in space, mainly because the elements of physical environment such as precipitation, temperature, and soil fertility are really extensive. Therefore, distance relationships are more important for agriculture than for any other activities. In order to increase production, environmental conditions need to be satisfied. However, modern innovations in irrigation, fertilization, and other agricultural technologies allow the expansion of physical limits to formerly unfavorable areas.

Moreover, it has long been realized that physical concept alone cannot answer the question as to why there is difference in cropping paradigm between the areas having similar physical environment. The crop location, to a large extent, is shaped by the motive of the farmers to maximize the production.

Farmers tend to utilize their land in such a way that the value of gross produce exceeds the cost of production. If in fact the cost of production starts to exceed the value of gross produce as the distance increases, then the farmers tend to curtail the value of input. It is therefore, the landholdings located at a distance that are operated less intensively. According to Von Thunen's theory each crop or pattern of agriculture is ultimately assigned to that location where its total costs are minimized and the benefit maximized.

The present study has sought to use von Thunen's principle of agricultural location to micro level study. He had conceived a vast and uniform plain with a single city at the center as an "Isolated State". Unlike his original theory, in the present study a village or a house with agricultural land around it has been considered as the "Isolated State". The village or house is the point of origin for all the inputs, which have to be applied to the landholdings around it. Farmers leave the house each morning for the fields and return to it in the evening and possibly at interval during the day. Distance, thus, plays a crucial role in the manner in which a farmland is operated. As the distance of landholding increases from the house, the movement of both goods and persons becomes tedious and more expensive. Reducing von Thunen macro model to micro level is justified, as there are many studies which have applied von Thunen model to micro level study. Von Thunen influences are observed to shape farming at local level.

Objectives

The present article aims at achieving two objectives. First, this study depicts location pattern of crop in the land around villages. Second, it intends to disclose intensity of cultivation in relation to distance from the homestead. For the study of intensity only two crops viz, paddy, and wheat are selected. The study attempts mainly to discern how crop location and intensity of farming vary with an increase in distance.

Methodology

This study builds on the information collected through extensive field survey. Farmers were solicited to elicit information needed in accordance with the objectives. The basic ideas developed by von Thunen regarding agricultural location are the guiding principles of the present study. However, as the study descends to micro level, the studies carried out by a number of scholars on the villages of Europe and Africa have given insight into using the original model for micro level study (Horvath, 1969; Chisolm, 1979).

For the investigation into the pattern of crop location in the land around village the study rests on the response of the farmers to the question as to what type of crops they grow at particular location. For convenience, the land surrounding the villages is divided into five zones on the basis of distance from the homes of the farmers. The land that is located within the distance of 0.25 km. is the first zone. The second zone spreads between 0.25 and 0.5 km. the third zone between 0.5 and 1 km, and the fourth zone lies between 1 and 2 km. The fifth zone extends beyond 2 km. Information obtained for the amount of various types of inputs such as labour, pair of bullocks, fertilizers/manure and seeds are analyzed to reveal the existing situation of intensity of cultivation in relation to distance from the house. The basic parameter of inputs obtained in kind is converted into money costs. Whoever, it was quite difficult to obtain reliable and reasonable money costs equivalent to labour, manure, pair of bullocks and agriculture produce. It entailed a lot of efforts to compute equivalent money costs and to minimize errors. Some other errors also have arisen mainly out of much reliance on memory of the farmers.

Villages under Study

One village each from three ecological regions namely the Hill, inner Tarai and Tarai have been selected for the study. Sakhi village was purposively from Rolpa, a hill district. Similarly, Banjhadi village from inner tarai of Dang district and Nayagaon village was picked

from Bardiya (Tarai). The purpose behind selecting villages to represent three ecological regions is to portray how crop location and intensity of farming vary according to distance and differ from region to region. Sakhi village, a typical mountain settlement, is characterized by primitive mode of farming operation. One more feature to be considered in case of Sakhi village is that owners themselves operate the land. Use of modern technology like fertilizers and improved seeds does not exist at all there. Farming depends entirely on the mercy of monsoon.

Banjhadi village (Dang) has for some years started using chemical fertilizers and improved seeds. The practice of sharecropping is ubiquitous here. The village lies near a market centre. Agriculture suffers from inadequate irrigation facility in Banjhadi.

Nayagaon village of Bardiya resembles a typical tarai village in settlement, housing pattern and in agricultural activities. Equipped with perennial irrigation facility, Nayagaon village is resisting the use of chemical fertilizers especially for paddy cultivation. Like Sakhi, this village is located at a considerable distance from market centre. It is learnt that floods usually disrupt irrigation network. Absentee landowners and sharecropping are general features.

Pattern of Crop Location

According to von Thunen's principle, the crops which outbid the other crops or which bring highest net return occupy the location adjacent to the market center. The crops, therefore, adjust themselves to the land that surrounds an urban center.

Notwithstanding the original model, the present study tries to discern the pattern of crop location in the land surrounding the villages. An effort has been made to see whether von Thunian influences have really acted to shape farming at local level in Nepal. The analysis builds on an assumption that the crops that are bulky and highest in value are located

closest to the villages (houses) and less bulky and low priced ones are cultivated farther away. The present study has revealed that impact of distance on the location of crop is not very strong. However, the information exhibits that there is a significant change in crop pattern with increasing distance.

In the land around Banjhadi village, there is no great variation in pattern of crop location with distance. However, the variation that is apparent cannot be overlooked. Maize crop is produced only from the land adjacent to the house and beyond this distance there is virtually no maize production. Mustard is produced solely from the field given over to maize crop. Maize is bulky which needs constant attention whereas mustard is high priced crop. Paddy dominates all the zones including the first one. More than 70 percent of the land even in the first zone is given over to paddy. During winter, wheat becomes dominant crop at all locations. However, wheat is replaced by *arsli* and low priced pulses in the landholdings that are away from homestead. The farmers sow these crops without ploughing up the land. Some of the farmers reported that they leave much of the farther field fallow.

The pattern of crop location found in the land around Nayagaon village displays certain changes in crop location with distance especially during winter. Paddy appears to be dominant at all locations in terms both of area and amount of production. Wheat forms the dominant winter crop in the zone closer to the house. In the holding at further remove *arsli* and low priced pulses are produced during winter. Wheat cultivation in farther plots is quite negligible. Many of the farmers allow the farther holdings to remain fallow, whereas they never allow closer plots to remain the same. The crops like maize, mustard and vegetables are grown only in the first zone.

In Sakhi village maize dominates all other crops in the first three zones during summer. In the winter mustard cultivation is confined solely to the first zone. But wheat appears as major winter crop at all locations. Barley forms the second winter crop. Farmers produce vegetables from the first zone and market some of the production. Potato, tomato, beans

and been seeds are the crops that are taken to market in Dang. The land beyond 1 km is utilized solely over to rice during summer and to wheat during winter. But wheat is produced in a very small proportion of land and the large part is left fallow.

The present study shows that the pattern of crop location within the physical limitation is governed partly by necessity and partly by economic factors. Farmers either produce less demanding crops from the farther plots or leave them fallow. The change in crop variety with distance is more apparent especially during winter. Farmers are seen to have made alternative adjustment i.e., substitution by *arsisi* and lentils, which require less input at further locations.

Intensity of Cultivation According to Distance

It is believed that once the settlement is established farmers operate their land that surrounds the settlement in varying intensity. Human labour is scarce because human energy may be bent upon several alternative ends. However, some people argue that such assumption ceases to be valid in circumstances where labour is unemployed or underemployed. But it should also be considered that the farming activity is governed more by availability of labourers during peak period of seeding and harvesting. The disposition of land use will be adjusted to this situation and not to the situation in which labour is surplus. Moreover, since most of the farmers in Nepal are very poor, they are unable to invest on inputs, which are not compulsory. The farming activity is greatly influenced by economically active family members. However, the farmers with large landholdings need to employ hired labourers at peak periods.

This study finds that farmers pay more attention to the holdings located nearer the house. They visit nearer plot more frequently and farther plot only occasionally. It is, therefore, they tend to spend more for the input to closer holding than farther ones.

It is but natural that all types of input go on decreasing with distance. The farmers do not supply fertilizers and manure/decomposed plant leaves to the holding at farther location and they generally apply less number of labourers and pair of bullocks to the distant holding. The farmers even plough up nearer plots more extensively than farther ones. As crops at the further location do not grow well, the farmers do not need many labourers to harvest the crops. The study may, thus, seem to exhibit a vicious circle of investment as regards relation between investment and distance.

Intensity of Paddy Cultivation

The inputs of fertilizers, manure, pair of bullocks and labour applied to rice crop per unit of land go on decreasing with distance. The information on the investment on paddy cultivation in the land around Banjhadi village shows a diminishing intensity with an increase in distance. However, the decrease in average value of chemical fertilizers with distance is quite small. Other inputs such as labour and pair of bullocks decline showing some significance. Generally, the decrease beyond one km is significant.

The average value of input used to paddy cultivation in the land around Nayagaon village resembles that of Banjhadi village in many respects. The inputs such as fertilizers, pair of bullocks and labour goes on decreasing with distance from the house. The use of chemical fertilizers to rice crop in the village is virtually nil. However, farmers supply manure and waste materials to nearer holdings before preparing the field for paddy plantation.

Table 1
Average Value of Input to Paddy Crop According to Distance
(Input value Rs./bigha)

Distance from home (in Km)	Banjhadi	Nayagaon	Sakhi
Less than 0.25	4,928	3,508	-
0.25 - 0.5	4,861 (2.4)	2,919 (16.8)	6,370
0.5 - 01	4,699 (3.3)	2,877 (1.4)	5,850 (8.2)
01 - 02	4,540 (3.4)	2,829 (1.7)	5,980 (-2.2)
More than 02	-	2,740 (3.1)	5,265 (8.9)

Note: The figure in parenthesis show percentage decline.

1 bigha equals to approximately 0.676 ha.

Source: Field Surcey, 1992.

Table 1 shows that total amount of input diminishes with distance. Farmers reported that they do not visit distant plots as frequently as they visit the near ones. As transplantation, weeding and harvesting should be done instantly to avoid loss; distant plots receive fewer amounts of inputs and pair of bullocks in the form of labour especially during transplantation and weeding period.

The intensity of paddy cultivation in the land around Sakhi village shows more or less a pattern similar to that of Nayagaon and Banjhadi villages. The total amount of input per unit of land is considerably greater than that of other two villages. Rugged topography, small and narrow plots or terraces, low yield, smallholdings can be attributed for higher value of input. Farmers put colossal labour for field preparation, for weeding and for careful harvesting. Application of manure is confined to the first two zones. It is surprising that they supply decomposed leaves to the field as far as 2 km from home. Thus, the value of input declines sharply only for the zone beyond a distance of 2 km.

Intensity of Wheat Crop Cultivation

Wheat is another crop for which intensity of cultivation has been assessed. Information on intensity of wheat crop cultivation shows a pattern compatible to von Thunen's idea or to the situation found in many European and African villages.

The value of overall inputs to wheat crop per *bigha* of land is highest for the second zone in the land around Banjhadi village. Beyond 0.5 km investment on wheat declines rapidly as indicated by Table 2.

Table 2
Average Value of Input to Wheat Crop According to Distance
(Input value Rs./bigha)

Distance from home (in Km)	Banjhadi	Nayagaon	Sakhi
Less than 0.25	2,196	3,040	5,928
0.25 - 0.5	2,264 (-1.3)	2,898 (4.7)	5,343 (9.8)
0.5 - 01	1,592 (12.2)	2,810 (3.0)	5,200 (2.6)
01 - 02	-	2,748 (2.2)	4,615 (11.3)
More than 02	-	2,608 (5.1)	4,485 (2.8)

Note: The figure in parenthesis show percentage decline.

Source: Field Survey, 1992.

The value of inputs used per unit of land around Nayagaon village is higher than that in Banjhadi village. It is clear from Table 2 that the value of inputs used to grow wheat in Nayagaon village shows a declining tendency with distance. Even the use of chemical fertilizer is seen to have declined with increasing distance. All other inputs decline invariably at farther location. Farmers are unable to pay equal attention to the distant plots and consequently they do not expect good return from those plots. Therefore, they are rational to curtail amount of inputs with increasing distance.

Sakhi village is not an exception. The value of inputs to wheat cultivation around the village diminishes substantially with distance. It is because the use of manure for wheat is virtually nil in the holdings beyond 1 km. However, what is shocking is, the value of input per unit of land in Sakhi village is far higher than that of other two villages under study.

Some of the features are common for all the villages and one of them is more common than others. For both the crops the intensity is highest for the zone contiguous to the houses and this decreases slightly in some cases and precipitously in others as the distance increases.

Conclusion

The present study amply suggests that there is no clear-cut zoning of land use (on the basis of crop location) in the field around the villages. However, the crops like vegetables, maize, and mustard are found solely located in the holding adjacent to houses. Paddy is dominant at all locations except for the land around Sakhi village, where maize predominates the first three zones contiguous to the house. Though, wheat forms the major crop of winter season, it is, however, replaced by less demanding crops like lentils and *arisi* at farther locations. An impact of distance becomes even more conspicuous, as information reveals that the farmers leave the farther plot fallow during winter season. This is because the net return is very small. The influence of distance on the intensity of cultivation is quite prominent. Inputs of labour, fertilizer/manure and pair of bullocks decrease in general. The level of input depends on availability, perceived level of net return and capacity to afford the same. Generally, the size of inputs of labour and necessary pair of bullocks per unit of land in the hills is greater than that of Tarai and inner Tarai areas, as necessitated by topography and perhaps by small holding and low production. Nevertheless, farmers in all the villages apply large proportion of available inputs to the nearest holdings because the return is greater from these holdings than those located farther away from home.

The question at present is how we can enhance the production from agriculture, which is the only source of production in considerable amount in the country in a reliable and reasonably sustainable way. Adjustment of crops regarding location around the villages or urban center in the most profitably way may accrue additional and higher gains to farmers. Profit motive alone does not help increase production. Similarly expansion of agricultural extension services only is not enough to inspire farmers. It is heartening to note that expansion of irrigation facility may go a long way to enhance agricultural production. This may reduce the chances of leaving agricultural land fallow during winter and may help increase the use of modern technology.

As the present study shows that there is ample room to increase production by increasing inputs to the plot at further location. We may achieve this by inducing slight mechanization or by suggesting to disperse residence of the farmers over a large agricultural land in order to reduce distance to the land. At least in the present level of modernization large landholding do not appear profitable. The agricultural activity in Nepal, thus, demands state involvement to a large extent. Leaving this sector to the mercy of market economy may lead to economic disaster.

Notes

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