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Spatial Differentiation in Farming Practices and Their Impact on Rural Livelihood: A Case from Hills of Nepal

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Introduction

Farming practices adopted by the farmers in the hills of Nepal differ owing to spatial differentiation that leads to varying resource availability, physical infrastructure development and external intervention. Differential farming practices within a short transect brings impact on local livelihoods. Not only is the resources availability, but are their accessibility and quality, competition between activities on the farm, household and off-farm areas, socio-cultural, political and economical dimensions among others matter very much.

There resides important relationship between farming systems and spatial aspect due to resource dependency (KC, 2005). Land availability in terms of quality and quantity also leads to the development of different farming systems (Bhatta et al., 2009a). Spatial differentiation of farm becomes pronounced when farms nearby capital centre are compared with those located farther. Thus both biophysical settings of resources and the socio-economic characteristics of farm families can be influenced by their spatial position. It has been hypothesized that there is a direct relationship between resource availability, utility potential, use and management (Doppler, 1998) and spatial differentiation leads different scenario in regards to the use of resources and local livelihoods. This research attempts to integrate micro-survey with spatial methodology using Geographic Information System (GIS). It first analyzes the socio-economic characteristics of farm-households and biophysical environment using spatial methodology (GIS) and finally linking them to differentiate cumulative effect of socio-economic and spatial factors on local livelihood.

Research questions

This study is basically concerned to answer the following research question:
- ➢ What are different farm components within peri-urban-rural continuum and how do they differ?
- ➢ What is the effect of the spatial location of household on farm-family income? And what are the factors leading to do so? How do they shape local livelihood?

Research methodology

Study area: Based on the research questions, peri-urban and rural continuum of Lalitpur and Bhaktapur districts (hereafter called Kathmandu valley) in the mid hill of Nepal was selected (Figure 1) because of following reasons:
- ➢ This area since historic time has been dominated by agricultural activity.
- ➢ Vegetable production is commercialized and a large chunk of vegetable in the Kathmandu valley has been supplied by the farmers of this area.
- ➢ Though not too far in terms of distance from capital city, some villages within this area are very less developed and termed as darkness under the light and some villages are quite prosperous with all facilities.
- ➢ This area is considered the birth place of formal organic activity.

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> ➢ Market for organic products has been more or less available not within the area itself but in the valley centre.
> ➢ Organic, inorganic and subsistence farming practices have been performed by the farmers in different locations.
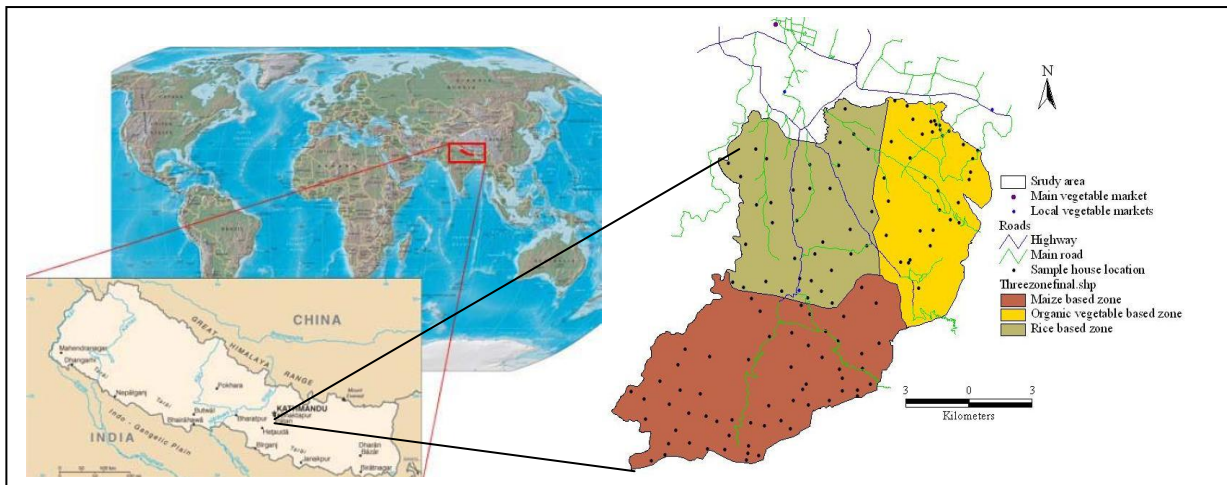

Figure 1. Study area with study zones

Study area has been divided into three sub study zones principally based on the dominant crop in the cropping pattern. It has been found that area with higher altitudinal gradient has been dominated by maize-mustard cropping pattern with maize as staple food crop. The lowland is being dominated by rice-wheat cropping while the farmers living at medium altitude nearby market center do have small parcel of land for market oriented organic vegetables. On this basis, there has been maize based, rice based and organic vegetable based zones.

Sampling design: Households were selected by applying spatial sampling and simple random sampling. Spatial sampling was employed since information on the number of households settled down in the study areas was not available. A sample of 130 households was determined in which 60 households from maize based farming and 35 each from rice based and organic vegetable based farming respectively were selected. Households from maize based and rice based farming were selected employing spatial sampling whilst those from organic vegetable based farming were selected using simple random sampling.

The spatial sampling method is based on the concept of spatial dependency which relies on the principle of proximity of locations to one another. Closer locations to one another are expected to have more similar values than those farther away (Tobler, 1970). The selection of this method for the survey was based on the principle that all households settled down in the study area were surveyed. On the other hand, simple random sampling deals with selection of household giving equal probability to each of the household. The rationale behind using simple random sampling for organic vegetable based zone is that a complete list of organic farmers was available and organic farmers were clustered in certain villages.

Data collection and analysis: Location specific information for an entire region is best handled by computerized information system with the use of Geographic Information System (GIS). Different analogue maps were purchased from Nepal Department of Survey and baseline GIS data for the study area was prepared using such maps. These maps cover roads, rivers and streams, settlements, administrative boundary, contour lines (100 m spacing) and elevations. Global Position System (GPS) was used to locate the household in terms of its latitude, longitude and altitude.

Spatial distribution of aggregated socioeconomic information such as land availability, crop productivity, farm-family income and so on were linked to the GIS by using each family's respective geographical position and their spatial autocorrelation were observed and then continuous thematic raster layer were produced for those factors found spatially auto-correlated by performing interpolation (Figure 2). Spatial autocorrelation can be defined as an assessment of the correlation of a variable in reference to spatial location of the variable and it measures the similarity of objects within an area, the degree to which spatial phenomenon is correlated in itself in space (Cliff and Ord, 1981). Spatial autocorrelation coefficient measures two things within the geo-space: the proximity of locations, and the similarity of the characteristics of these locations (Lee and Wong, 2001).

Inverse distance weighted (IDW) method of interpolation was used in this study which is based on the weights, which are inversely proportional to the square of the distance from the centre of the zone of interest. A radius can be

defined by the user; points closer to the location of estimation are weighted greater than those farther away. Interpolation was done in Arc View GIS. Output grid surfaces were created in which value of each cell is calculated considering the values of 12 neighboring sample points and their distance to the point of estimation. A linear trend in the sample data was assumed for the model.

Cost distances from the different parts of the study zones to the market center was measured using GIS based cost weighted distance model (ESRI, 1997) and distance grid cells to travel from different location of the watershed to nearest market center were prepared (K.C., 2005). Road infrastructure and slope were considered while finding cost weighted distance.
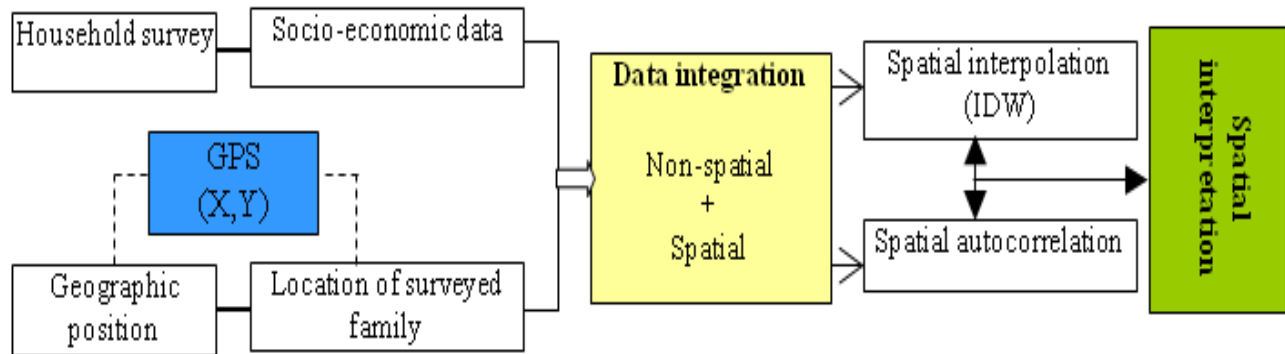

Figure 2. Procedure of integration of micro-survey data into GIS environment

Results and discussion

Maize based, rice based and organic vegetable based zones have been identified on the basis of crop domination at differing altitudinal gradient, slope and remoteness. Maize based zone is characterized by low level of productivity, high reliance on agriculture, lack of infrastructure, low quality of the land, remote from the valley centre and low levels of living standard. This zone enjoys with integrated farming system with at least few livestock and some grazing/pasture land along with access to community forest. Similarly rice based zone is attributed by moderately productive land, intensive rice wheat production; market oriented vegetable production, moderate availability of infrastructure such as road, irrigation and input market. Strength of integrated farming starts becoming loose because of expensive land and lack of grazing land. Nevertheless farmers living in remote part of this zone do have integrated farming system while those living nearby market centre have commercialized and specialized farming especially inorganic vegetable production and mushroom cultivation. Organic vegetable based zone possesses relatively flat land-land very much suitable for rice-wheat cropping pattern, fertility declining scar are rampant especially where injudicious application of agro-chemicals have been made, birth place of organic farming and increasing organic vegetable production and high return thereof. In this zone, most of the farmers have food production area and some parcel with organic vegetable production. However, mostly farmers don't have livestock component with some exception of keeping poultry.

The closer the farmers are to the market and other infrastructure centre, the better the tendency to adopt improved practices. This is attributed due to higher level of education, higher purchasing power and influence of the extension services therein (Bhatta et al., 2008). At the same time, farmers living in the remote area have been practicing traditional subsistence farming and their level of education is very low and they are skeptical towards innovation and its use (Bhatta et al., 2009b).

Yield of food crop is higher in the lower altitude while area is higher in higher altitude (Figure 3). Figure 4 shows yields of the rice paddy in the space which depicts the declining yields *per se* as one goes to higher altitude. This tendency is principally because of the fact that land is relatively cheaper in the rural areas while it is mostly sloppy with lack of irrigation facility and other essential inputs which are fundamental for higher production. In the peri-urban area because of increasing pressure on land with increasing population, growing scarcity of the farming land has made land extremely expensive for agriculture. Nevertheless, farmers do agriculture intensively and hence get good outcome *per se*.

Most of the farmers in the study area do have some units of livestock (Figure 5). This is because most of the farmers still do have integrated farming system especially in the hilly areas. Large animals like cattle, buffalo and goats becoming fairly common in the higher altitudinal gradient while small animals particularly poultry becomes popular in the lower altitude and the areas nearby market centre. This is the reason why TLU becomes smaller as one goes

towards the peri-urban area (Figure 5). Farmers in the maize based area heavily depend on farm manure for crop nutrition and at the same time livestock acts as reserve wealth or security for the household. Dairy farming is booming in this area basically the impetus towards cooperative dairy farming.
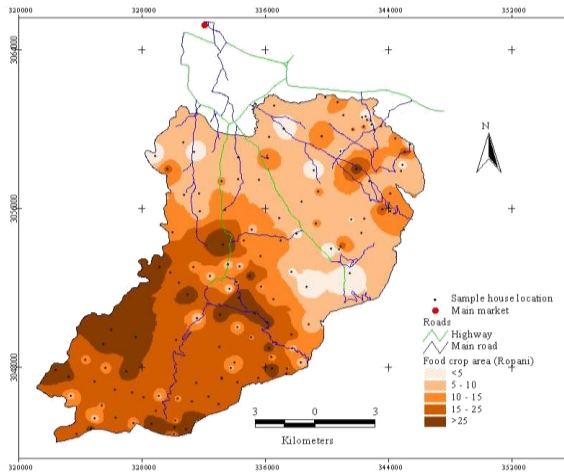

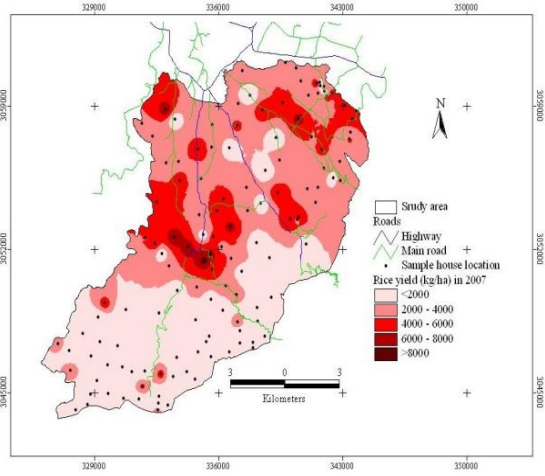Figure 3. Spatial distribution of Food crop area (ropani)

Figure 4. Spatial distribution of rice yield (kg/ha)

Higher farm and family income was found in the most favorable zones (Figure 6). Family income was significantly higher at organic vegetable based zone as compared to highland which could be due to the accumulated effect of land quality, market oriented production, education level of farmers, distance from market and road, availability of the off-farm opportunities among others. Significantly higher off farm income has been noted in the peri-urban areas which is basically due to more job availability, higher education and less time to reach to the job market among others.
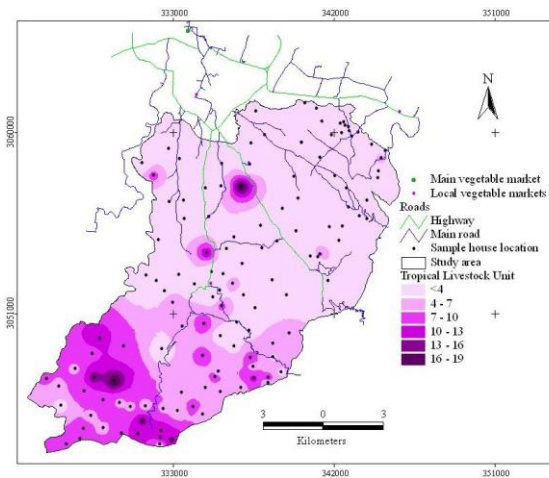

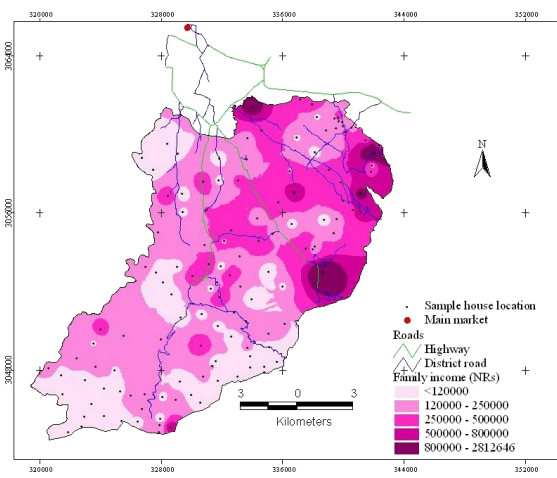Figure 5. Spatial distribution of tropical livestock unit

Figure 6. Spatial distribution of family income (NRs)

Cost distance in terms of travelling time shows that travelling time to market centre is increasing very rapidly as one goes to the higher altitude and in the rural area while the tendency is very slow in the peri-urban villages basically due to good quality of road infrastructure and less sloppy land structure (Figure 7). More travelling time to market centre means more cost of transportation on the one hand and on the other hand less influence from the market centre. Moreover, for the perishable products like vegetables, large chunk of produce will be lost in the transport route. As travelling time is increasing, the opportunities like off farm earning, health and housing, quality education and extension service become diluting and these all have large bearing on local livelihood. Additionally opportunities for food, health and housing and quality education are better as one move from rural to urban area. Most of the farm households are food secured in the peri-urban area while the percentage of farm households with food security substantially declines in higher altitudinal gradient (Figure 8).
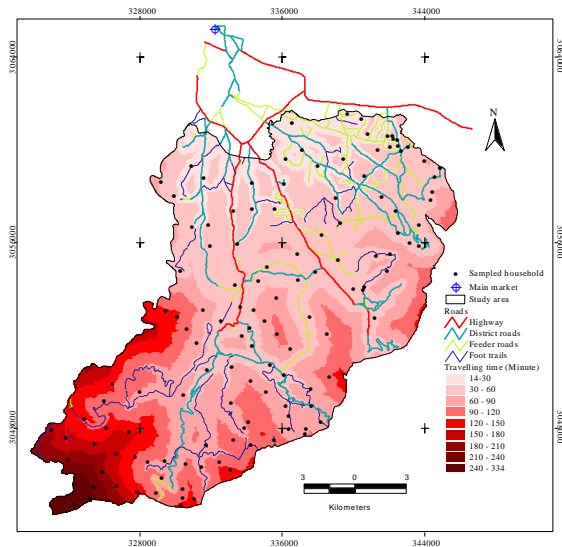
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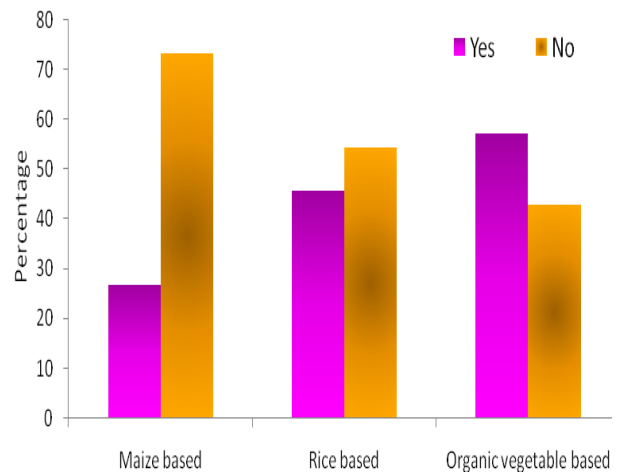Figure 7. Cost weighted distance in terms of travelling Time to the market centre

Figure 8. Food security situatio of the households

Conclusion

- Farming differentiation in rural-urban continuum is high towards more favoured areas while it is slow and low in less favored sparsely populated areas.
- People in rural areas have poor livelihood status because of less infrastructure development. This area also lacks off farm income opportunities and farmers are heavily indebted to integrated farming system which is just for subsistence.
- Efficient strategies especially in developing road and market infrastructures should be hammered out in rural areas to curtail the disparity in living standards caused by spatial differentiation.

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