

URBANIZATION DYNAMICS AND RURAL CONSEQUENCES IN HAI DUONG PROVINCE, RED RIVER DELTA, VIETNAM.

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ABSTRACT

Vietnam is experiencing a rapid urbanization with multiple consequences on the surrounding rural areas. These consequences may strongly affect the livelihoods of rural households. But the impacts of urban growth on rural areas are exceeding the periphery of capitals and concern also small and intermediate urban centres. There are indeed a wide range of interactions between urban and rural areas, which can be developed at different scales both on short or long distances. This paper aims therefore to analyse the dynamics of urbanization process around a secondary urban centre and the consequences on the activity system of rural households. The analysis takes place at two different scales: regional and local level, and combines satellite remote sensing and social surveys. The study area, Hai Duong Province, is located in the centre of the Red River Delta, halfway between Hanoi, the capital and Hai Phong, on the coast. Hai Duong city showed a rapid urbanization in the last ten years, leading to dynamics and issues mainly related to agricultural land use change, the development of new markets and the labour mobility.

On the regional level, both contemporary high spatial resolution image (SPOT 5) and past images (Landsat Thematic Mapper) have been used to produce different land covers of the study area. The processing started with the contemporary image, which benefited from image fusion, using the IHS (Intensity, Hue and Saturation) technique. This step produced more accurate data and made image interpretation easier. An unsupervised classification was then carried out, providing present land use situations. Past land cover situations were obtained from present land cover by following a technique of visual interpretation of changes. Areas of changes have been identified thanks to the accurate present land cover situation. Two past land cover situation were obtained. Change maps were then produced using post-classification method for two periods (1988-1994 and 1994-2003), allowing the identification of areas of change. On the local level, socio-economics surveys have been carried out within three selected communes, gathering information on about 50 rural stakeholders.

Results show that the urbanization process has strongly influenced the change of cropping pattern, labour force structure and income structure among the study area. The suburban area is deeply affected by urban expansion which took rapidly most of the good agricultural land. Some off-farm reconversion and the development of commodity chains with new actors and new market places can be observed with a relative success. But unemployment affects older former farmers and land price and land speculation strongly increased. Among farer areas from Hai Duong city, land use changes are less affected by urbanization. But employment opportunity and income structure remains affected. And changes can be observed among the agricultural sector, which can still provide opportunity. Some case of dynamic agricultural clusters can be highlighted. It creates alternatives for non-farm activities, but needs a sufficient social capital that promotes the local dynamism and the entrepreneurship. Nevertheless, it can be an interesting way to develop economic activities in rural areas, contributing to a better balanced spatial development between urban and rural areas.

Keywords: Urbanization, Urban-Rural Interactions, Land use change, Agricultural cluster, Remote Sensing, Secondary Cities, Vietnam.

INTRODUCTION

Vietnam is experiencing a rapid urbanization, with an average annual urban population growth rate of 3,2 % in 2006 (UNESCAP, 2007). Around 24 millions of people are living in urban places, which represent less than 30 % of the total population. But urban population is expected to double over the next 25 years (UN, 2008, Roberts & Kanaley, 2006). This important urbanization is creating many challenges for the country food production, the natural environment and the rural landscape. But public authorities have not yet found a way to deal with urbanization and the forces behind it (Roberts & Kanaley, 2006).

The consequences of urbanization can result in changes in the livelihoods of the rural households according to the interactions existing between urban and rural areas (Thanh *et al.*, 2008; Thanh *et al.*, 2005). In addition, urban-rural interactions are increasingly recognized as part of the livelihoods strategies and as central in processes of social, economic and cultural change in both cities and countryside (Kammeier, 2002, Tacoli, 1998). A diversity of linking mode can be observed between urban and rural areas which can be developed both on short and long distances (Veltz, 1996). The impacts of urban growth on rural areas are exceeding the periphery of capitals and concerned also small and intermediate urban centres (Tacoli, 1998; Lin, 2001). Small and intermediate cities do not only play a transit function from countryside to the capital but are also a place of consumption, a place for job opportunity or redistribution of goods.

With regard to this situation, there is a need to have a quick and reliable method to assess the consequences of urbanization process. Remote sensing has proven to be a useful technology that can provide up-to-date information to study urbanization (Maktav *et al.*, 2005a). Various studies showed the capability of remote sensing images to produce land cover at the urban-rural fringe or to monitor the urban growth by using time series of satellite images, which provide an historical analysis of the changes (Maktav *et al.*, 2005b, Schneider *et al.*, 2003, Fahim, 1999, Gao, 1998, Charbonneau *et al.*, 1993). In addition, socio-economics field surveys at household level are of first importance for process understanding. Detailed information obtain from rural stakeholders could supplement the use of remote sensing in order to get a better comprehension of the urbanization consequences on the livelihoods of rural stakeholders.

The objective of this paper is therefore to analyse the dynamics of urbanization around a secondary urban centre in the Red river delta and to examine the consequences on the activity system of rural households. Remote sensing and socio-economics surveys will be combined in the methodology in order to get the benefits of both tools.

MATERIALS AND METHODS

1 Study areas

Regional study area

Hai Duong city is located at 60 km far from Hanoi south-eastward, inside the important economic triangle formed by Hanoi-Haiphong-Quang Ninh (Figure 1). The population density of this secondary city is 3.700 habitants per km². The provincial average annual growth rate is about 10% per year (1999-2003) and shows the starting phase of industrialisation and urbanisation. The agriculture is diversified and still played important role comparing to other province in Red river delta.

Local study area

The study will investigate the following three communes as local study areas: Tu Minh, Thach Khoi and Thanh Xa. Tu Minh commune is located southwest of Hai Duong at four kilometers far from the city centre, along the national road 5. The commune includes nine villages for a total 9,390 persons. The population density is high with 1,450 habitants per km² and the annual growth rate is 15% per year. This suburban commune has experienced high agricultural land loss, with 18 % per year (1997-2003). Urban development and the

establishment of many factories and enterprises have created a strongly attractive environment for the young labour force of the commune.

Thach Khoi is a suburban commune located at about ten kilometers south of the city centre. The total population counts 8482 persons for an average density of 1591 habitants per km². With an average annual growth rate of more than 10 %, the local economy is mainly based on agriculture production but services sector and commercial activities are very developed. For the last 10 years, the economic structure of Thach Khoi has strongly changed with a conversion from agriculture to industry and service. While the agriculture production still represented 80% of the local gross domestic product in 1995, it reduced to 45% in 2004.

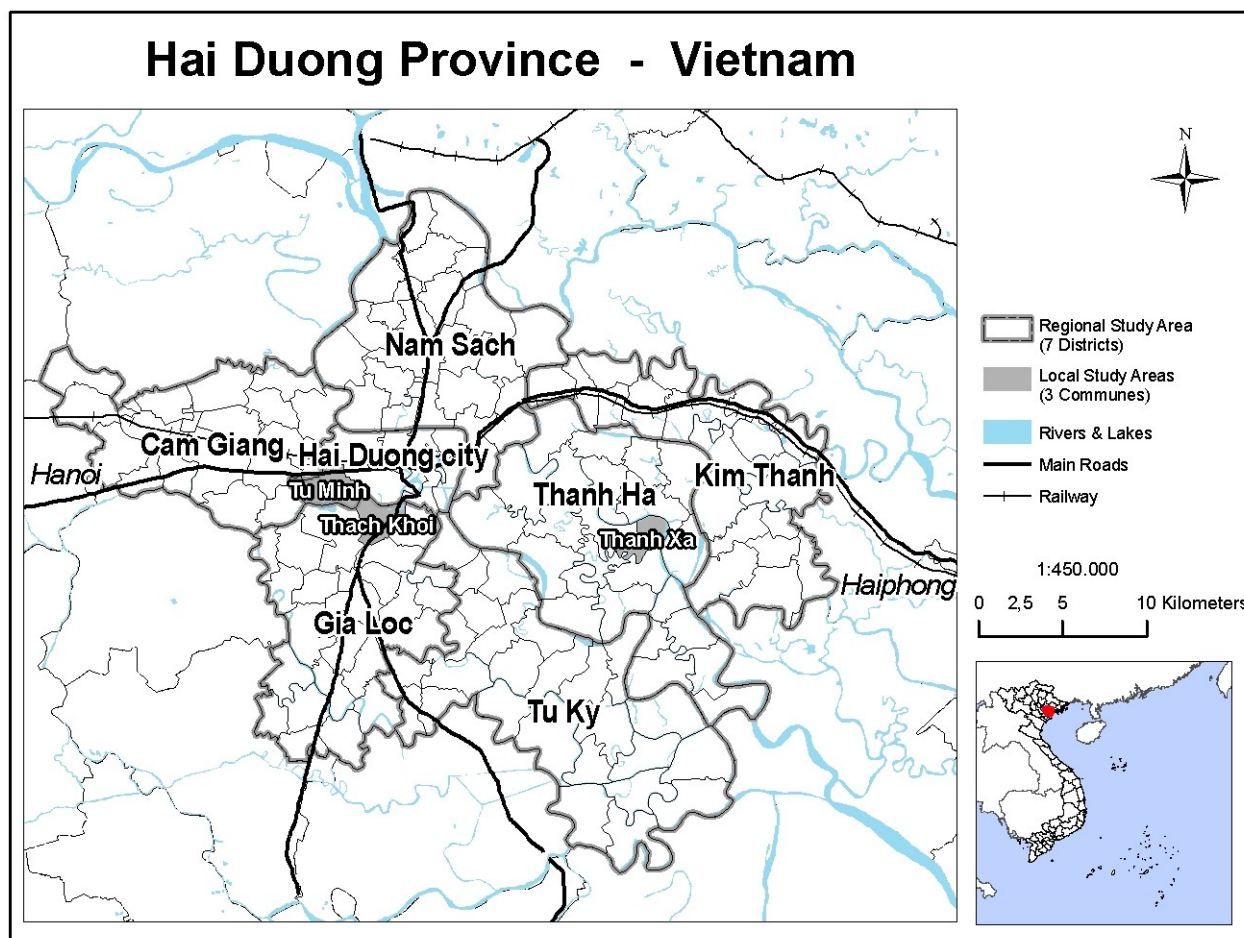


Figure 1: Regional and local study areas

Thanh Xa is an agricultural commune located at about 25 kilometres at the southeast of Hai Duong. The local economy is mainly based on agriculture production, which contributes for 67% to local gross domestic product. Thanh Xa is one of the communes which converted most of its agriculture land to fruit tree plantation for the Thanh Ha thieu litchi cultivation. The total population is 4166 persons with an average population density of 900 habitants per km².

2 Overall approach

The overall approach combined two levels of analysis: regional and local (Figure 2). At regional study level, the main land use dynamics are derived from present and past remote sensing images. This information is used to provide an insight of the urban and agricultural spatial dynamics at stake among the regional study area. Remote sensing processing is also planned here at the early stage of the study for helping the selection of local study areas for further in depth field survey. At local level, socio-economic surveys are conducted in order to achieve the main consequences and transformations on the livelihoods of the farmers living in the selected local study areas.

3 Regional level data sources and processing

Satellite data sources

The satellite data used in this study (Table 1) included Spot 5 images (HRG - High Resolution Geometry) to assess contemporary land cover situation and Landsat Thematic Mapper images for the evaluation of the previous land cover situations. The different images have been acquired during the dry season (December until March). This period is considered as more appropriate for farming system analysis (Giri *et al.*, 2003 and UNEP, 1995) and offers more cloud free conditions.

Table 1: Description of acquired satellite images

Satellite	Sensor	Bands	Pixel spacing (m)	Observation date
Spot 5	HRG1 – multi-spectral	4	10 x 10 ¹	14/01/2003
	HRG1 - panchromatic	1	5 x 5	14/01/2003
Landsat 5	TM	7	28.5 x 28.5 ²	23/12/1994
Landsat 4	TM	7	28.5 x 28.5 ²	22/12/1988

Satellite data processing

The satellite images processing included several steps (Figure 2): (1) image pre-processing including registration and pansharpening; (2) image classification using an unsupervised classification, (3) land cover validation and (4) change detection using a post classification method.

In the first step, the Spot images were rectified for their inherent spatial deformations according to co-registration principle. The panchromatic image was first corrected by collecting 58 Ground Control Points (GCP's) on 1/50.000 topographic maps, reaching a RMS error of 0,58 pixels. A first order transformation and a nearest neighbour resampling method were performed. Once orthorectified, the panchromatic image served as model to correct the corresponding multi-spectral SPOT image. Then, the Landsat images were rectified using the Spot orthorectified image as a master and following the same co-registration principle. A similar first order transformation and the nearest neighbour method were applied. Moreover, to make sure of the quality of all later treatments (fusion, classification and change detection), a sub-pixel accuracy was always obtained. Therefore, the rectification of the 1994 Landsat

¹ Except for the mid infrared band which pixel spacing is 20 x 20 m

² Except for the thermic infrared band which pixel spacing is 120 x 120 m

image used 49 GCP's with a RMS error of 0,54 pixels and 41 GCP's were used for the 1988 image, which showed a RMS error of 0,57 pixels.

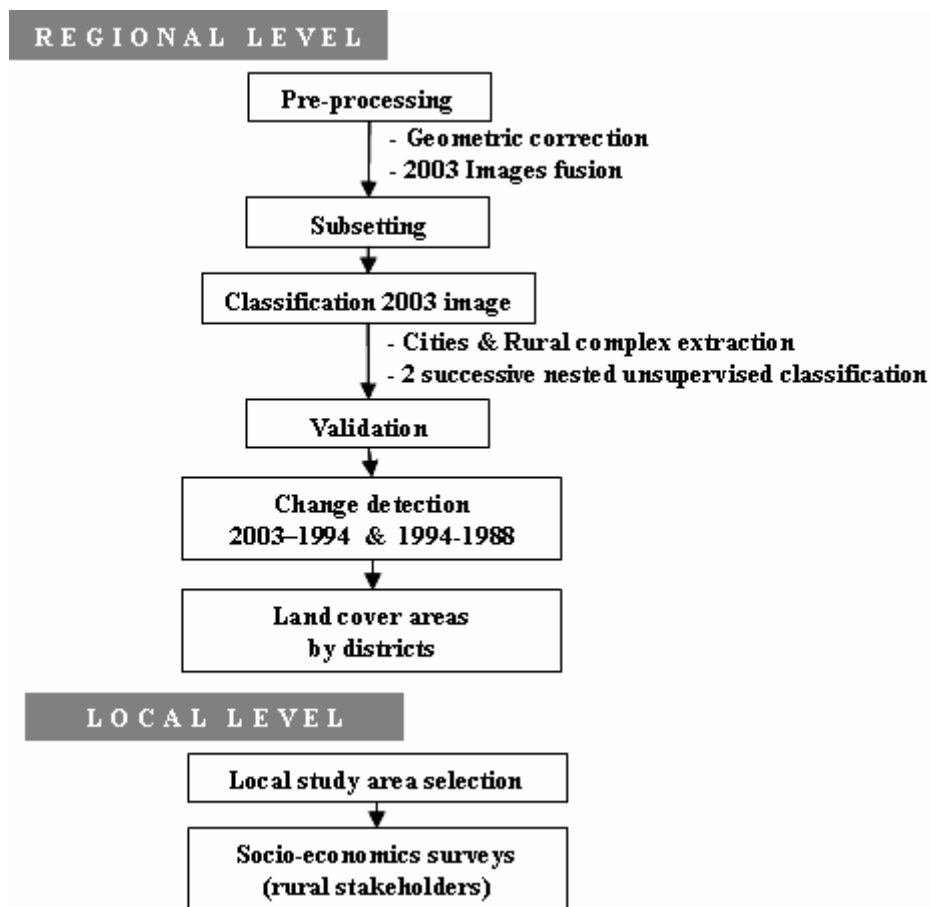


Figure 2: Flowchart of the overall methodology

In order to take all the benefit from the higher spatial resolution (5m) of the panchromatic image and from the higher spectral resolution (4 bands) of the multispectral image, an image fusion was performed with the pair of SPOT 5 scenes. This operation combined their characteristics and produces a new multispectral image with a spatial resolution equal to that of the panchromatic one. Image fusion can usually be done at different stages of data analysis and according different techniques (Pohl and van Genderen, 1998). In order to facilitate later treatments (classification and interpretation), image fusion was performed here before any processing. At this stage, image fusion means combining pixels, which results in merging physical parameters. The IHS (Intensity, Hue and Saturation) technique was applied. This method is recognized as the most common procedure in image fusion (Pohl and van Genderen 1998, Amarsaikhan and Douglas 2004). It transposes the multispectral image into the I-H-S system in order to manipulate the spatial (I component) and the spectral (H and S component) information independently (Carper *et al.*, 1990 in Chibani and Houacine, 2002). Following this step, the component I is substituted by the panchromatic image. Because IHS does not allow using more than 3 spectral bands, Spot 5 image has been processed following a special methodology. Two IHS were performed independently – with the G-R-NIR and the G-R-

MIR colour composition³ – before regrouping the four bands in a single image. Nevertheless, the correlation between the component I and the panchromatic image is rarely perfect, which may lead, for the IHS technique, to modifications of the spectral properties of resulting multispectral images. A detailed validation is necessary and has been performed here. After the fusion step, a subset of the image was defined according practical experiences and the hypothesis that areas which are affected by the urbanization are located around the city of Hai Duong and along the main traffic roads. The subset concerned therefore all the neighbouring districts of the urban district of Hai Duong and also the district of Kim Thanh crossed by the national road 5.

The second step included image classification. Two successive nested unsupervised classifications were performed on the pansharpened SPOT image, using the ISODATA algorithm. The resulting classes from the first ISODATA are interpreted and assigned to one of the elements defined in the legend. The second ISODATA is then performed in the unassigned classes of the first classification results. For each classification, an output of 45 to 50 classes was defined and 50 iterations were specified. A mask covering cities and villages has been applied to extract them before the classification process. During the process of interpretation of the output classes, the coherence of the elements of the desired legend is controlled. The eleven elements defined for the legend are *Fruit tree*, *Winter crop*, *Grassland*, *Ponds and Fruit tree*, *Inundated fallow land*, *Fallow land*, *Construction area*, *Specialized land (as brick factory and other non-farm use...)*, *Urban Area*, *Rural complex*, and *Water bodies*. This method allows a better distinction of the desired elements and take the maximum benefit from the spectral content of the image but requires a longer interpretation and assignation tasks. Historical Landsat images of 1994 and 1988 followed a different treatment. The past land cover situation was derived from the present situation following a visual interpretation of changes methodology. By superimposing a copy of the land classification results of 2003 on the previous images (successively 1994 and 1988), and by a careful examination of these two layers, areas where changes can be distinguished are identified. The assumed change areas are delimited by editing the classification layer in order to fit the previous image interpretation. By repeating this visual interpretation of changes on all the study area, extension and/or regression of land cover types and change in the land cover nature, are delimited. Finally, at the end of the process, the classified layer becomes the classified layer of the past dates (1994 or 1988).

The third step was the validation of the land cover produced. A validation field trip was carried out in different places among the seven districts in order to make an accuracy assessment of the land covers products. A set of validation observation was collected and compared to the obtained land cover class at the same location.

The last step is the change detection which uses a post-classification method and leads to the production of two change maps (1988-1994 and 1994-2003). Among all the combinations of changes possible between two dates, only several have been selected according their feasibility and their interest for the study: 13 types of change from 1988 to 1994 and 16 from 1994 to 2003.

³ G stands for Green band of Spot 5 image covering the green part (0.5 μ m – 0.59 μ m)of the electromagnetic spectrum; R, the Red band (0.61 μ m – 0.68 μ m); NIR, the near infrared band (0.79 μ m – 0.89 μ m) and the MIR, the mid infra red band (1.58 μ m – 1.75 μ m).

4 Local level data collection and processing

Local study areas selection

Three local study areas were selected according the land use dynamics in progress, obtained by the satellite image processing. The distance from the city centre was also used as criterion to guide the selection. The three areas selected are the Tu Minh, Thach Khoi and Thanh Xa commune.

Socio-economic surveys

Among each selected communes, rural stakeholders were interviewed. It mainly concerned farmers but also communal and district officers. A total of 50 stakeholders were interviewed and farmers have been selected randomly among each commune. An open questionnaire has been used and covered the following main topics: household composition, production resources (labour force, land and capital), activity system, and commercialization of farm products.

RESULTS

1 Regional Analysis: land use dynamics in Hai Duong

The analysis of the satellite images during the winter season in Hai Duong province allowed obtaining the different land cover situations (Figure 3). On the 2003 Spot 5 image, the following land covers could clearly be identified through the classification process: *Winter crop, Fruit tree, Grassland, Fruit trees-ponds system, Inundated fallow, Fallow land, Construction area, Specialized land; Urban area; Rural complex, and Water bodies*. In the 1988 and 1994 land cover maps, the lower resolution of the Landsat images did not allow a clear distinction of the fruit trees-pond system. In addition, due to policy restriction, few land transformation for non-farm uses (*Specialized land*) were allowed from the cooperative and are therefore not observed in 1994 and 1988. It also concerned big scale transformation of rice field to install fruit tree plantation which was not allowed before 1993, resulting in that no large fruit tree parcel was observed in the 1988 land cover.

Nevertheless, the regional land use dynamics around Hai Duong city have been achieved through the land cover change analysis of the different dates (Figure 4). It seems that most of the change occurred during the period between 1994 and 2003. The main dynamics concerned urban and industrial extensions, winter crops dynamics and fruit tree related transformations. According to the land cover changes, the Hai Duong urban area (purple areas in Figure 4) expanded mostly to the South and the West. Industrial areas (red areas) expanded especially along the national roads 5 and in specific locations, such as Nam Sach and Dai An industrial zones. The first one is located in the Nam Sach district at the North of the national road 5 and the second is located also close to the same national road but at the West of Hai Duong city in the direction to Hanoi. These expansions almost exclusively took place at the expense of agricultural lands and transformed the function of certain places and their activity system.

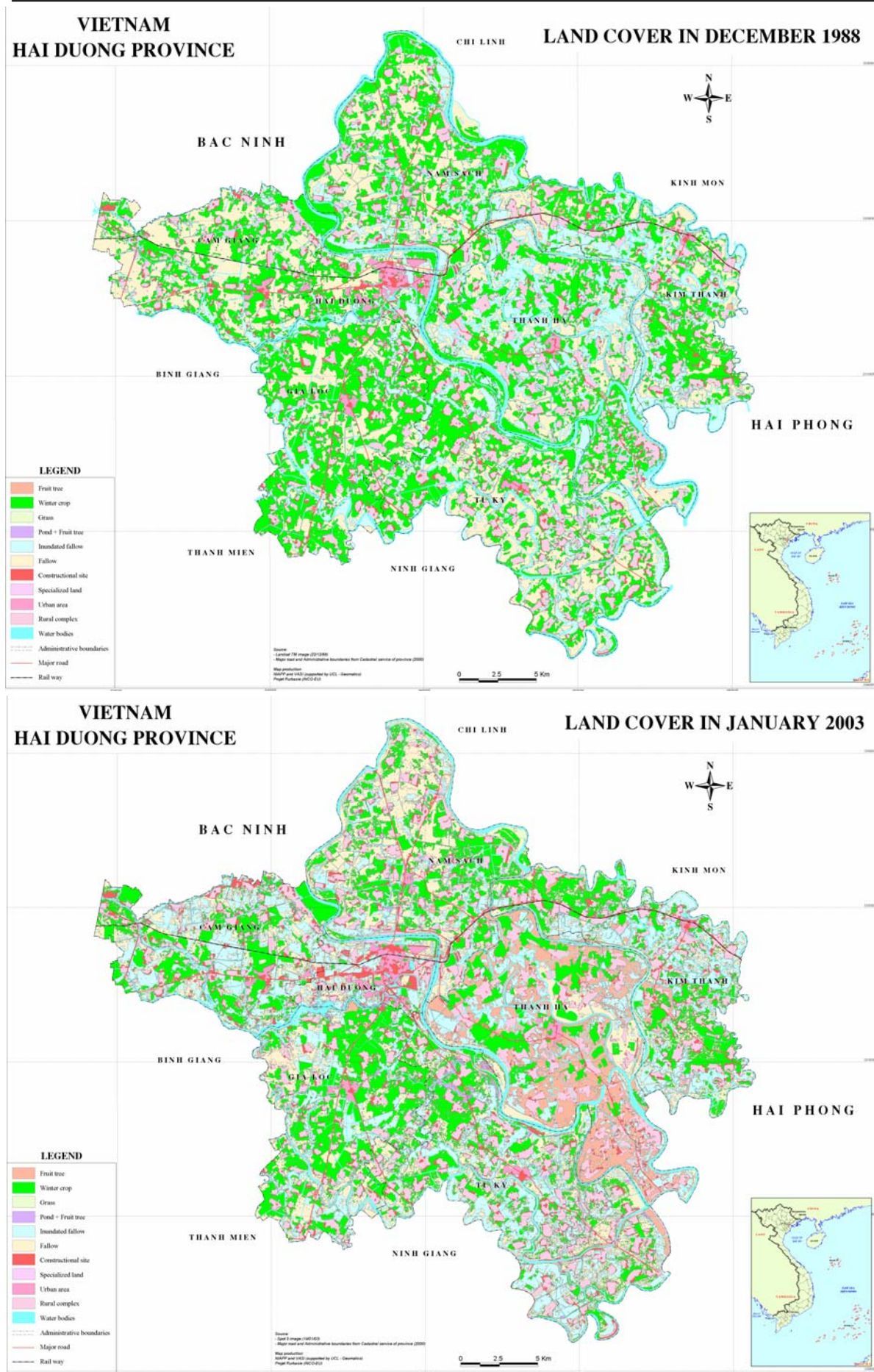


Figure 3: Regional land cover situation of 1988 (top) and 2003 (bottom)

The other land cover changes concerning agricultural lands are related to winter crop dynamics. A relative increase can be observed among the districts studied between 1988 and 1994 (Table 2). But the recent trends (1994-2003) showed a general decrease among the districts. Nam Sach district and Hai Duong city present a sharp decrease in agricultural land but in other places like Gia Loc, Cam Giang and Kim Thanh, the decrease is less important and most of the winter crop production is concentrated in these places. Only winter crops of Gia Loc district still represent more than 5% of the total province area and cover more than 37% of the area of the district. Land cover changes showed that they are developing more to the south of this district (Table 2).

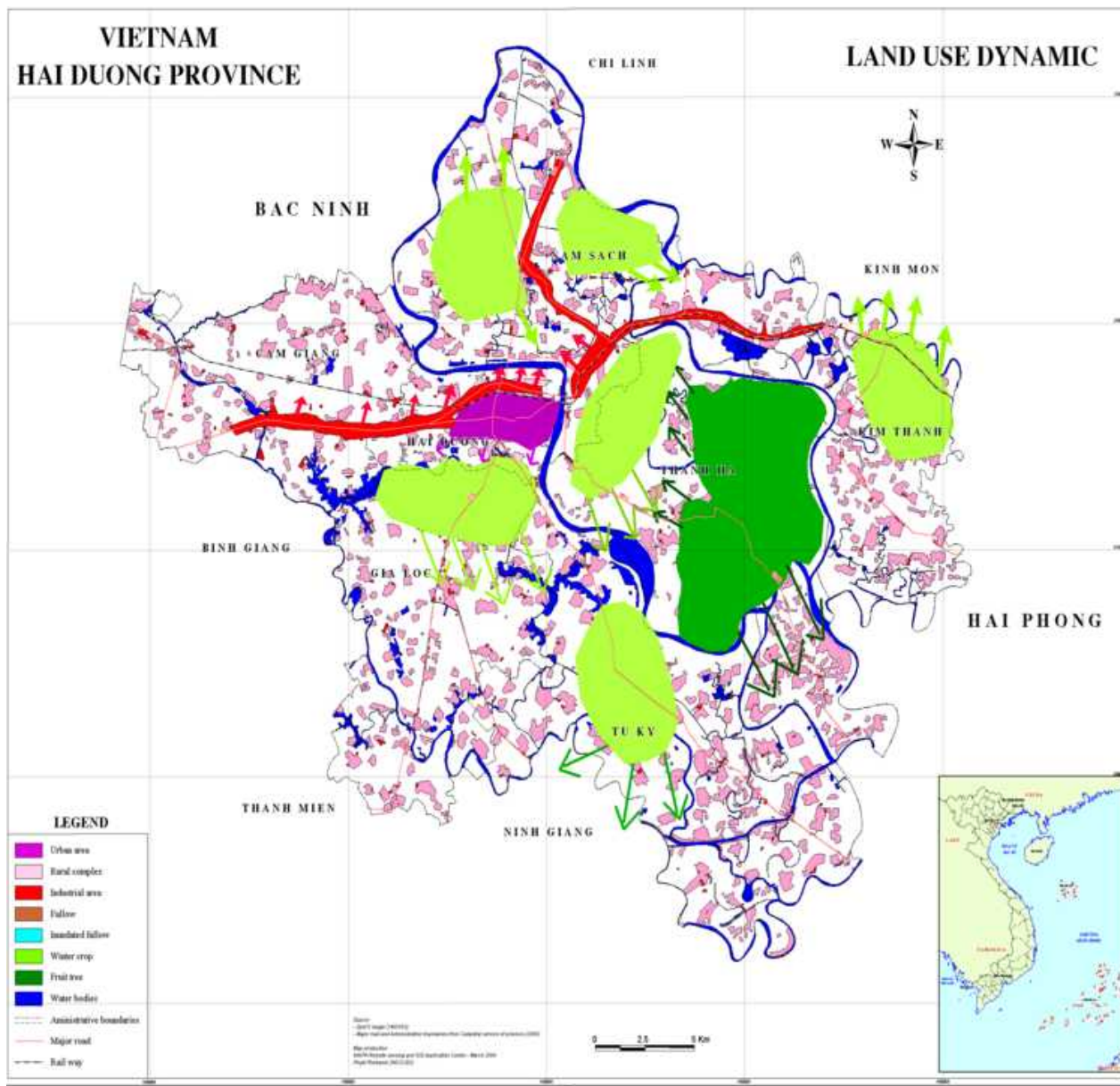


Figure 4: Regional land use dynamics derived from land cover changes (1988 – 1994 – 2003)

Table 2: Total area of winter crops by district derived from 1988, 1994 and 2003 land covers

District	Total area of winter crops (ha)								
	1988			1994			2003		
	Area	% of province total	% of district total	Area	% of province total	% of district total	Area	% of province total	% of district total
Gia Loc	5997.7	6.89	48.25	5768.6	6.63	46.36	4618.2	5.31	37.12
Nam Sach	4878.7	5.61	36.20	5505.3	6.33	40.80	3268.5	3.76	24.30
Tu Ky	5472.2	6.29	31.57	5573.3	6.41	32.18	3461.8	3.98	19.99
Kim Thanh	3498.3	4.02	30.30	3859.7	4.44	33.50	2916.4	3.35	25.30
Cam Giang	3550.7	4.08	33.60	2899.6	3.33	27.50	2926.0	3.36	27.70
Thanh Ha	4764.7	5.48	29.80	3857.3	4.43	24.10	2307.3	2.65	14.40
Hai Duong	1015.6	1.17	27.40	510.6	0.59	13.80	156.9	0.18	4.24

The main reasons to this decrease are related to the installation of factories and enterprises which attracted agricultural labourers and also to the lower interest of certain crop production like sweet potato or maize on the markets compared to vegetables or other commodities like meat, eggs, etc.

Another important land use dynamic concerned the installation of fruit tree and fruit tree-pond systems. This dynamic is already present in 1994 but the phenomenon became more pronounced on the 2003 land cover. These massive transformations of rice field into fruit tree plantation are mostly concentrated in the district Thanh Ha. An equivalent of 20% of the district area was converted from previous fallow land to fruit tree plantation between 1994 and 2003. And during the same period, 10% of the total district where winter crop were previously cultivated was also converted to fruit tree plantation.

Based on these main land use dynamics in progress around Hai Duong city, three local study areas were selected: Tu Minh, Thach Khoi and Thanh Ha (Figure 1). Additional criteria of selection were the distance from the city centre. The Tu Minh commune is located within the area of urban and industrial expansion and is providing pigs and rice noodle to the city. Thach Khoi commune is located close to the city but on the other side of the southern river, among the area of agricultural diversification, through winter crops. And Thanh ha is located within the area of Fruit tree plantation

2 Local analysis: rural livelihoods transformations

Tu Minh commune: Hai Duong suburban area

Tu Minh commune is deeply affected by the urban planning. Its location close to the city, along the national road 5 and within the area planned for both the urban and industrial development, led to important transformations. Huge land cover changes have been observed in the commune leading to a sharp decrease of agricultural land, which represents only 20% of the total commune area in 2003, to the benefit of non-agricultural land uses.

While agricultural land is getting scarce, farmers are facing important challenges of conversion. Our survey reveals that the economy the household of the commune developed according two main sectors: non-farm activities and animal husbandry. Some former farmers operated a non-farm conversion to rice cake, rice noodle production. This is the case, for example, of 60% of the household in Lo Cuong village. This conversion is often associated with pig raising, which benefits from by-products of the rice cake/noodle production. This activity led to the development of a commodity chain with new market actors (i.e. collectors

and suppliers) and various market places. One important point is that Hai Duong only represents 20% of the destination of this rice cake/noodle products, and 80% are going to other provinces, i.e. Lang Son and Quang Ninh. It should be also pointed out that this activity was already present in the commune before but at a very low level and it concerned a limited number of household. The agricultural land shortage resulting from the urbanization encouraged people to develop this activity. The second conversion concerned large scale pig raising, like it can be observed in Xuan Duong or Thuong Dat villages. In this large scale pig raising villages, the pork is mainly consumed to Hai Duong (65%) and the rest is sold in other markets, such as Hanoi, Haiphong. Nevertheless, if the scarcity of the agricultural land increases, this kind of production may suffer and be reduced in the future.

In addition, there are some other non-farm activities, which provided job for people in Tu Minh commune: construction workers, mechanics, handicraft, trade, etc. But in most of the case, the demand only concerned less than 30 years old and skilled people, which represents only less than 10% among household. In addition, in term of non-farm job opportunity for Tu Minh commune, Hai Duong city contributes to 60% and others provinces to 40%. So these young and skilled people have also to sell their labour force outside, i.e. Hanoi Quang Ninh and Lang Son. The consequences on agricultural labour force are a high level of unemployment (70%) among former farmers older than 40 years old with low skills.

Thach Khoi commune: winter crop diversity and agricultural cluster

Thach Khoi commune also experienced a decrease of its agricultural lands but to a lesser extent. According communal statistics, agricultural land reduced from 320 ha in 1996 to 240 ha in 2004. This reduction was mainly due to the requisition of communal land for the establishment of factories or industries mostly in the north of the commune but also for housing. The increasing non-farm, services and trading activities provide job opportunities mainly for less than 30 years old people, where agriculture labourers are mainly more than 35 years old for women and more than 45 years old for men.

During the same period (1996-2004), water surface for aquaculture increased by more than 50 ha. The communal cropping patterns changed. Animal husbandry and fishery strongly developed as the commune people's committee promoted the conversion of low land to ponds, used for aquaculture and combined with pig raising. This resulted in the development among the commune of one of the main market place for fisheries of the province. And even if the agriculture land is only of 240 ha, the total cultivation area of the commune is 877 ha, which makes a ratio of 3.6. This ratio represents a rather high level of intensive cultivation, which is coupled here with diversification focusing to vegetables products:

More than 80 % of the vegetable production of the commune is sold to the central region of the country. The vegetable types supplied to these remote markets are middle quality class such as: cabbage, kohlrabi, kale, and small spring onion and garlic. The commune is also supplying fresh products to the Hai Duong markets. According to some traders, vegetables production of the commune is only supplying around 6-8% of total vegetables production sold to Hai Duong city. For the city markets, only high quality vegetables are consumed such as cauliflower, garlic sprout, garlic and tomatoes... Despite the low percentage of vegetable production from Thach Khoi supplying Hai Duong city, the market share of the commune to this city increased since 2000-2001 and vegetables types sold are more diversified. There are many active middlemen operating the commercialization of agricultural products in the commune and seeking for new markets. Beside farmers selling directly their products to

locals markets, two kinds of actors can be distinguished. On the one hand, there are big traders, who usually trade important volumes with distant markets mainly in the central region but also in the north and south of the country. They operated their transactions mainly through their telephone. The information about prices and on production is exchanged quickly between the markets actors. These traders play an important role to the farmers, encouraging them to cultivate specially vegetables to supply the market demand. On the other hand, there are small collectors, who directly buy vegetables from the farmers and transport them to the consumption area to sell to traders at the markets. They mainly sell the collected products to the neighbouring markets such as Hai Duong, Hanoi, Haiphong and Quang Ninh. Although the number of this kind of market actor is important within the commune, the collected amount is rather low, with about 200-300kg, mainly transported on motorbikes.

The commune belongs to a region which became a winter crop cluster before the urban and the industrial development of Hai Duong took place. But the recent dynamics showed a much more vegetable oriented cluster with various vegetable types and stronger connections to both remote markets places and market demand.

Thanh Xa commune: fruit tree production specialization area

The agricultural sector in Thanh Xa commune is the most important. It contributes nearly to 70% of the total production value of the commune, but Thieu litchi production is the main commercial good. In addition the Thieu Thanh Ha name received a Geographic Indication in 2007. The animal husbandry of the commune is less developed and concerned mainly home poultry raising, which contributed nearly to 30% of the agriculture production value. Beside agriculture, people also developed some non-farm activities, such as bricks and tiles production, handicraft products, mechanic repair services, trade and agricultural services, which contributed nearly to 10% to total production value of the commune. The agricultural sector employs more than 80 % of the total communal labour force.

The local policy for land transformation has had a strong impact in the commune. By allowing the transformation of rice field to permanent crop since 1993, the agricultural land has experienced huge changes of affectation. Nowadays, around 75 % of the agriculture land of the commune is converted to permanent crop, for litchi tree cultivation. Rice field only occupies 16% and the remaining land is dedicated to other annual crops. The most surprising fact is that between 1993 and 2003, the agricultural land increase by the conversion of unused land to fruit tree plantation.

The marketing channels of this production are diversified. According our survey, 80 % of the communal fresh production of litchi is sold to Ho Chi Minh city. The commodity chain starts from the producers in Thanh Xa to local collectors, who have 3 to 5 points of collection among the commune. Traders from Ho Chi Minh come to these points where the transaction is made with the collector. Once the litchis are packed, they are transported to Ho Chi Minh and are sold to wholesale markets and then reached the retailers there. 10 % of the fresh production is sold to China through the border in Lao Cai. Another 10% is also sold to abroad, in Cambodia, 5 % is sold to Hanoi where litchi is also coming from other place in Vietnam and the remaining 5 % to local consumers in Thanh Ha district.

With an average annual production of 3.5-3.7 tons per hectare and the litchi price at more than 10000 vietnam dong (vnd) per kg, the litchi farmers have more income from this permanent crop compared to rice cultivation. However, during the recent years, the litchi price has

decreased to only 3000 – 3500 vnd per kg, which reduces the interest of farmers for further investment in litchi plantation.

The Thanh Xa commune which belongs to a region mainly oriented to the production of one commercial good presents few connections to Hai Duong city and seems less affected by its urban and industrial development. However, the strong connections of the litchi products with nationwide and the increasing abroad markets linked this commune to urban demand and global market fluctuations and may cause new challenge for the livelihoods of local farmers.

DISCUSSION

In order to study the dynamics of urbanization process around a secondary city and its consequences, the paper chose to start with remote sensing images taken at several dates to assess the different land cover situations and the resulting changes in progress. This first step of the study was then followed by socio-economics surveys among selected places according the regional analysis. This local analysis provided in-depth information on the land cover changes highlighted and on the consequences to the livelihoods of rural stakeholders.

In the remote sensing data processing, the image fusion of the 2003 Spot image allowed to produce a detail present land cover. The visual interpretation of change method benefited from this accurate assessment of the present land cover situation together with accurate co-registration of the satellite images to produce both past land cover situations.

Nevertheless, one of the challenges of this method of visual interpretation is the working scale of the examination of the changes. The choice of the working scale has to be balanced between time constraint and expected accuracy of land cover map. In addition, due to the lower resolution of “historical” remote sensing data (Landsat TM, 30m, in comparison with SPOT 5, 5m), some change identification issues appeared and introduced some doubt in the interpretation of changes. Moreover, the interval between the date of acquisition of the 2003 Spot 5 image and the reconnaissance and validation field trips revealed that recent changes already took place and that some field situations differed slightly from the 2003 situation in the image.

The socio-economics surveys in the local analysis were carried out to only 50 rural stakeholders. Even if they covered different types of rural stakeholders (farmers but also communal and districts officers), this is a relative low number of people interviewed for three densely populated communes. It was maybe enough to get a general picture of the main consequences and changes for households but the sampling should be bigger to cover more the different household situations in order to get a more complete picture of the situation and a finer understanding of the consequences. The sampling could also be stratified according indicators such as the total income or the total land ownership of the household.

CONCLUSIONS

The holistic methodology combining remote sensing and socio-economic survey proved to be useful to highlight the main land use dynamics around a secondary city and was also useful to look deeper in the rural-urban interactions and rural consequences of urbanization process in the Red River Delta.

The vigorous development of urban areas affected directly the land evolution of communes, especially for the suburban communes: agricultural land decreased and tend to be converted to infrastructure, commercial services, industrial areas and urban housing constructions. The breaking out of industrial zones in urban area reached the limited area of urban. Therefore it forces factories and enterprises to invest further zones from the city centre and along the main roads, which creates advance conditions for suburban communes to have opportunities to develop industry.

The urban expansion is synonym with the increase of urban population rate, increase of the demand on houses construction, social welfare and culture. The development of the industry also creates jobs for labourers. However, in the suburban area, the agriculture land requisition means that a part of farmers turned out to be unemployed, as seen for Tu Minh commune. There is a lack of education program for job conversion or redeployment combined with urbanisation and industrialisation.

In areas far from the city centre, superficies devoted to intensive agriculture tends to increase and diversify to fresh agriculture production such as vegetables, fish, and meat to meet the demand of urban places. However, the importance of the consequences of the urbanization in these furthest areas is not high; and mostly concerned the nearby communes or the communes whose part of agriculture land was converted to new urban or industrial zones. Hai Duong is more an administrative urban centre rather than an economical one, so the new market opportunities are not so important. But the high density of population of the Red river delta can also create alternatives to non-farm activities. The phenomenon of agricultural cluster village was observed in Thach Khoi with a strong diversification on vegetable for market or in Thanh Xa with fruit tree plantation.

Thus the urbanisation process has pushed the transformation of the economic structure in the suburban faster than in other rural zones. This transformation can be observed in the changes among cropping pattern, labour and income structures. But the phenomenon of successive belts of influence of the urbanisation process can not be observed. Both regional and local analysis showed that land use dynamics are not only depending on the direct urbanization of Hai Duong city. Strong connection to both close or remote markets place and urban demand m have also strong impacts on rural areas.

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