Chapter 4

The sustainability of pig production

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Intensive pig farm amidst rice fields in Hòa Bình

Small family farms dropping out of the picture

Family pig farming: a disappearing tradition

For a long time, pig farming was an essential activity for rural households. Up until the early 2000s, a family of four lived on an average income of US$750 per year. In general, one quarter of this income came from pig farming. In 2001, over 7 million households had at least one pig. Pig production was one of the economic pillars of farm sustainability. However, as the economy developed, other sources of revenue began to compete with this activity. In 2010, pig production accounted for only 15% of the income of the 4 million rural households which continued to engage in this activity.

Local pigs on a family farm near Hanoï

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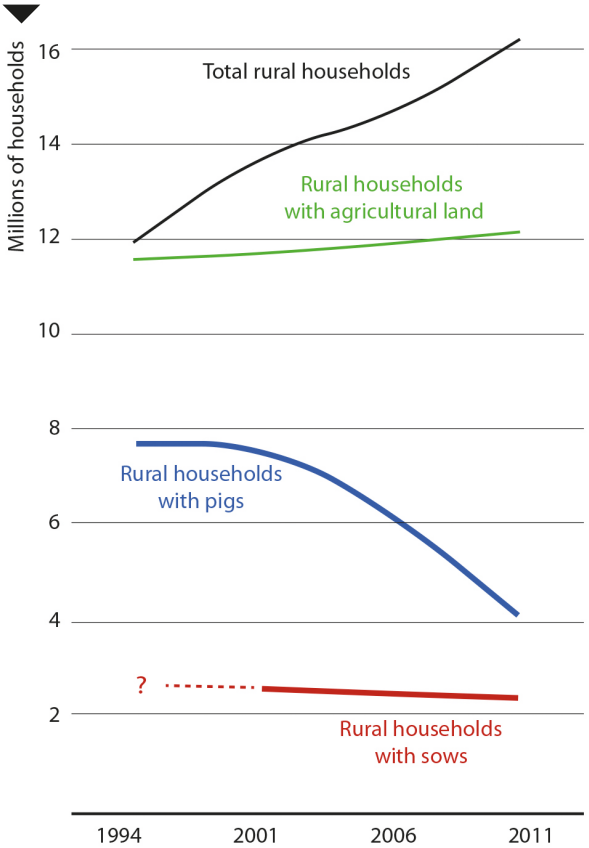
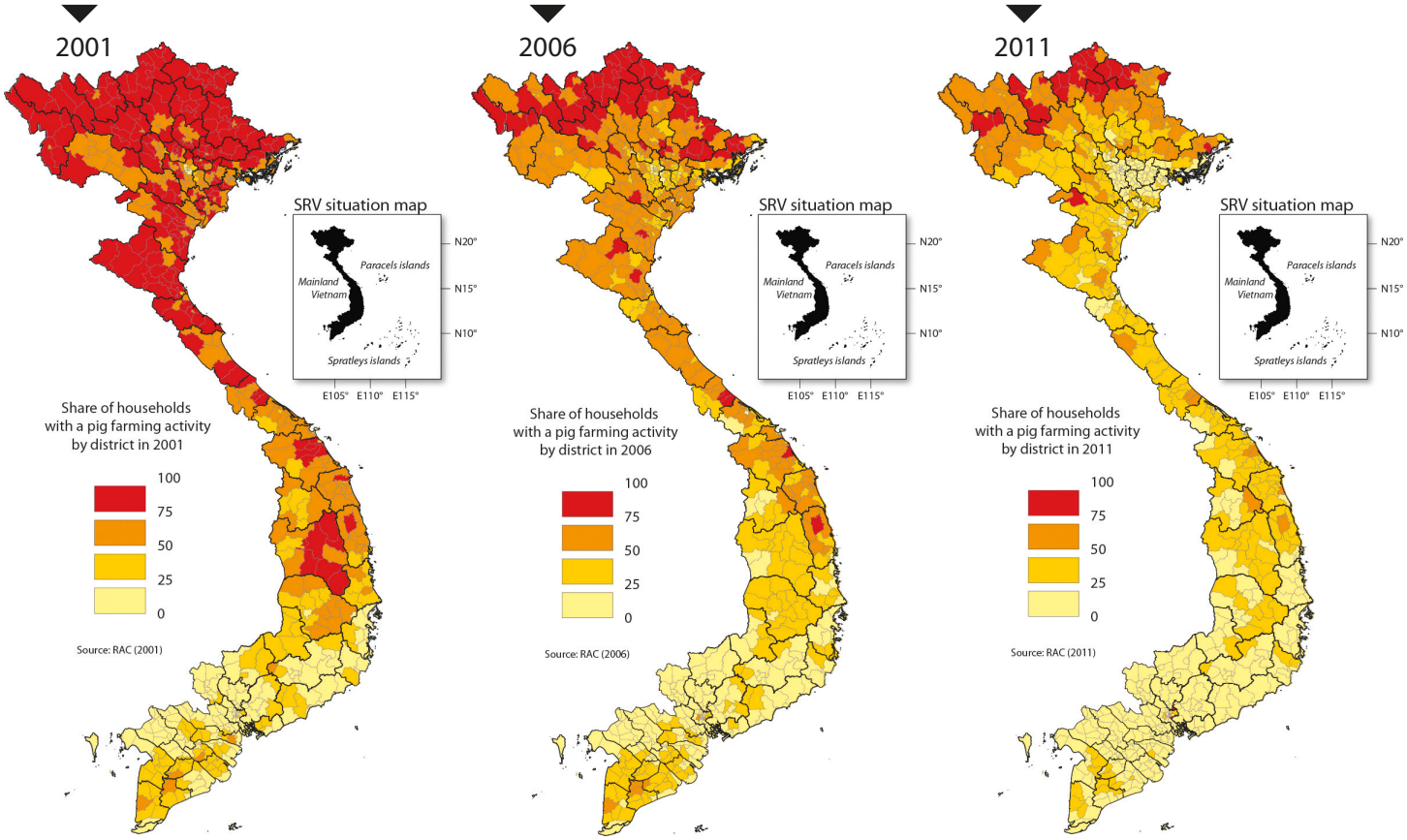
Evolution of the number of rural households with or without agricultural land, pigs (fertilizer) and sows



Source: RAC (1994, 2001, 2006, 2011)

Evolution of the share of rural households keeping at least one pig by district in 2001, 2006, and 2011



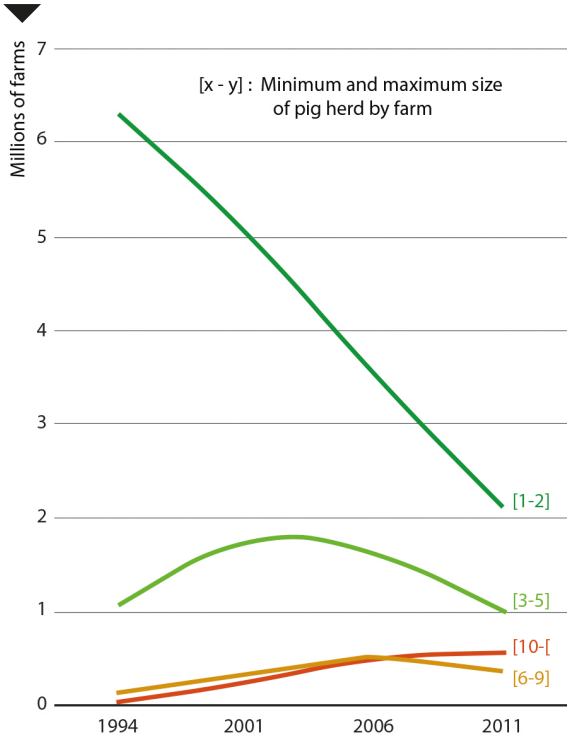
The collapse of family pig farming

Between 2001 and 2011, the number of farms engaged in pig production dropped from 7 million to 4 million. During the same period, the number of rural households grew from 13 million to over 16 million. In other words, in the space of ten years, the share of rural household with at least one pig dropped from 53% to less than 25%. This collapse must be studied in detail because it reflects a profound restructuring of pig production.

Small specialized farms on the decline

The number of farms with 1 to 3 pigs fell from 6.3 million to almost 2.1 million between 1994 and 2011. This drop was continuous for nearly twenty years. At the same time, the number of farms with 3 to 5 pigs increased between 1994 and 2001, only to fall since 2006. Farms with 6 to 9 pigs increased up to 2006 and then their numbers began to drop. Only farms with more than 10 pigs have continued to increase in number. However, it is highly likely that in 2016 this category also was on the decline. All analyses converge in pointing to a rapid disappearance of the smallest farms.

Evolution of the number of rural households with pigs according to the size of the herd on the farm



Source: RAC (1994, 2001, 2006, 2011)

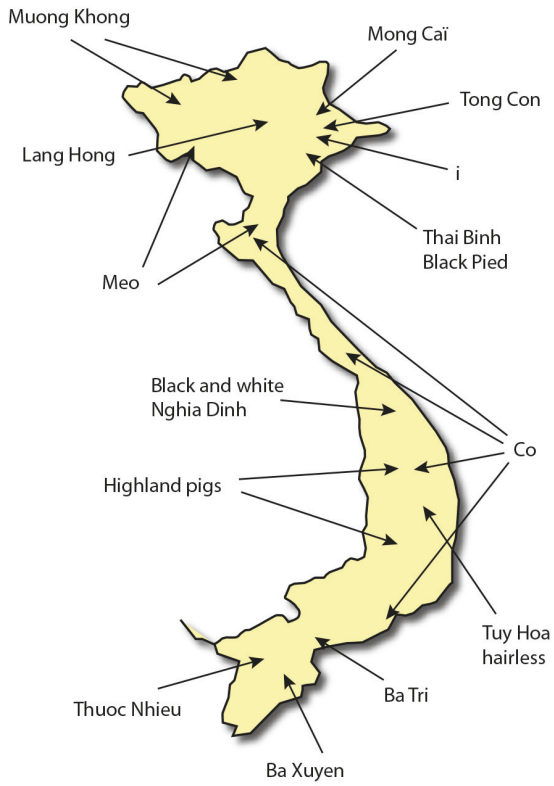
The north-south gradient of pig production

Pig farming is distributed along a strong north-south gradient. The districts with the largest share of households engaged in pig farming are in the north, while districts in the south have relatively low participation rates compared to the rest of the country. One also may observe a coast-mountain gradient. In the Red River Delta, the share of households with pigs is lower than in highland regions. This distribution corresponds fairly well with the distribution of the economic poverty rate in the country. Indeed, economic poverty is associated with a subsistence and self-sufficient economy. The gradual disappearance of districts with more than 75% of households raising pigs may be a sign of the general economic development of the country as well as the specialization of households.

Is the genetic diversity of Vietnamese pigs at risk?

The collapse of family farms raises questions about the survival of pig genetic diversity in Vietnam. The development of more intensive farms is leading to less productive breeds being set aside in favour of exotic ones. According to Molénat and Tran The Thong (1991), pig genetic diversity in Vietnam relies on local diversity and crossbreeding with exotic breeds. This diversity is first a matter of geography. Diversity is greater in the highlands than in the lowlands. Hardy breeds are more easily maintained in inaccessible valleys than in the plains. Centuries of breeding and crossbreeding have created productive breeds. Today, crossbreeding is increasing in more accessible areas as well as in the mountains. The disappearance of millions of small pig units carries a risk of genetic diversity loss.

Map of local pig breeds in 1994



Transporting a pig in Đồng Văn

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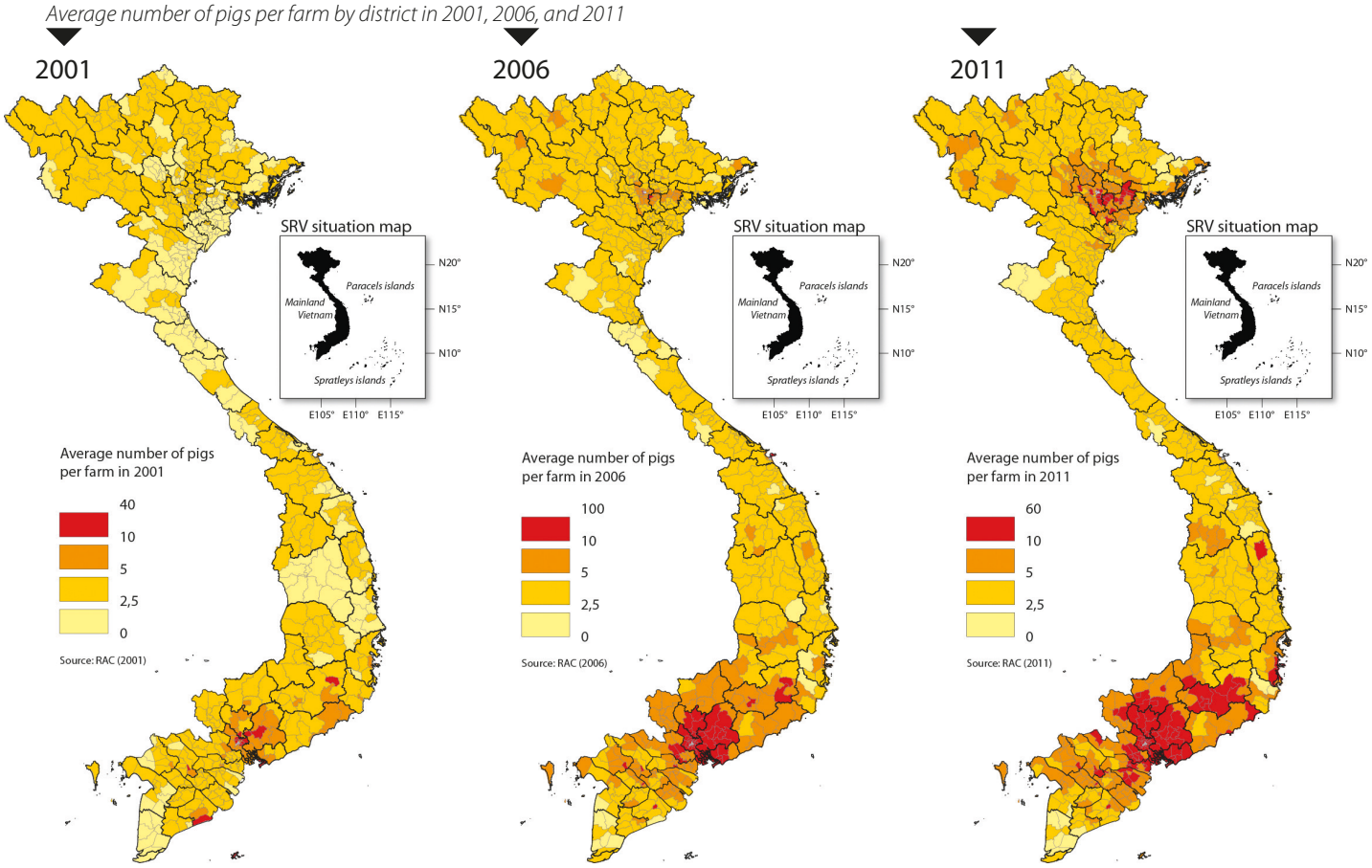
Concentration and specialization of livestock production

Average number of pigs per farm by district in 2001, 2006, and 2011



The restructuring of the sector

To understand the restructuring of pig production, farms and livestock were divided into groups according to herd size. The categories were: 1 to 9 pigs, 10 to 49, 50 to 99, 100 to 499, and 500 pigs or more. In 2001, farms with 1 or 2 pigs represented 99% of farms and accounted for 75% of production. In 2011, the categories 1-9 and 10-49 pigs represented 99% of the country's farms. The remainder represented barely 50,000 farms. However, this 1% of farms accounted for more than 15% of production. In 2011, farms with more than 10 pigs held over 50% of the national herd. This concentration has boosted medium-sized farms, but large farms (over 100 pigs a year) are gaining ground.

The north-south pig concentration gradient

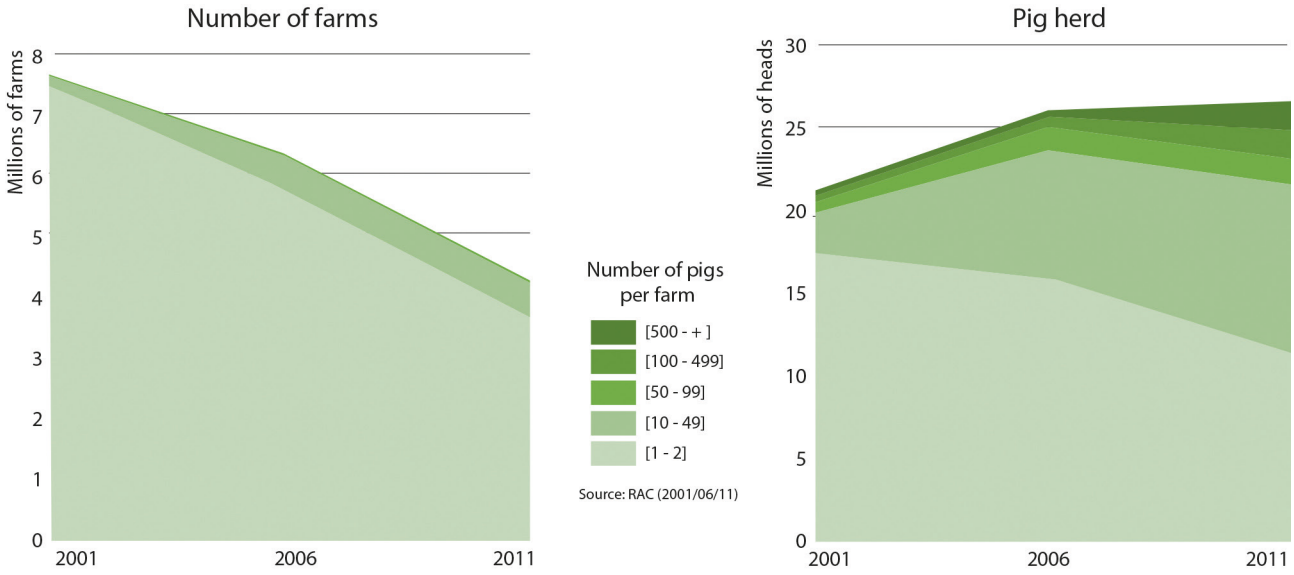
The evolution of pig concentration by farm shows a clear difference between the north and south of Vietnam. The Southeast region stands out from the rest of the country. The districts northeast of Ho Chi Minh City displayed average pig concentrations of over 10 pigs per farm as early as 2006, while in the Red River Delta, and particularly around Hanoi, the average concentration varies between 5 and 10 pigs by farm. In 2011, the districts on the Hanoï -- Hải Phòng axis had a concentration twice as high than the rest of the Red River Delta. In the south, the concentration also has increased. A group of more intensive districts appears to the south of the Highlands region. This development is marked by an increase in densities, but especially by the disappearance of small family farms. Only large farms are resisting changes induced by developments in markets and public policies.

Total pig density by farm type

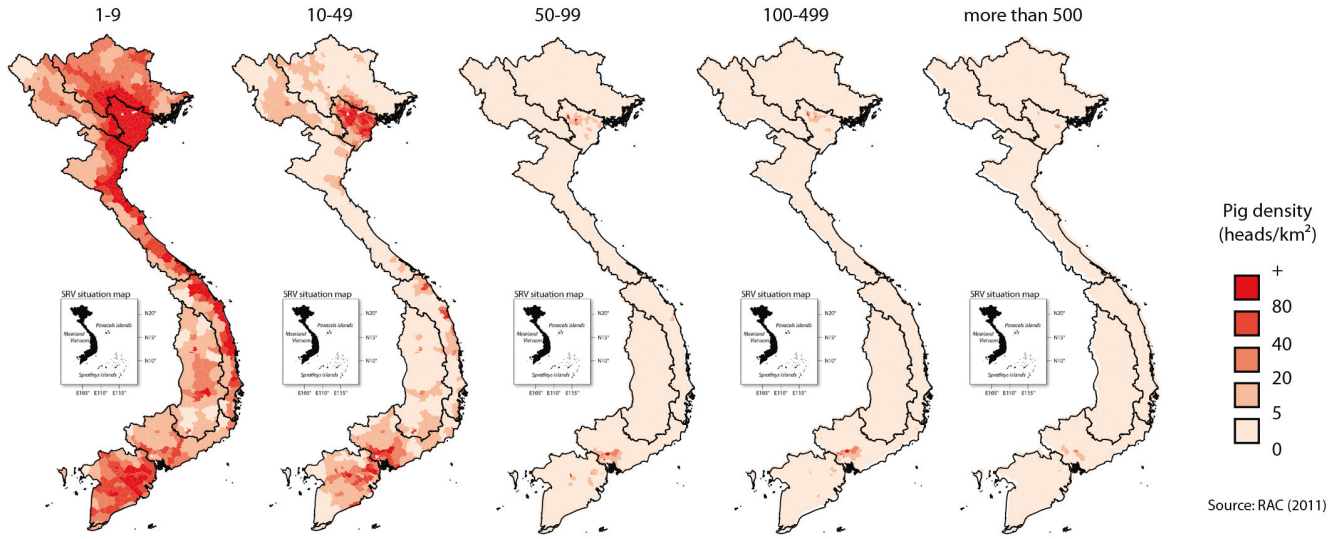
Thanks to the analysis of the contribution of farm types to total pig densities per district, it is possible to identify the locations favoured by certain types of farms. Between 2001 and 2011, the pig density of small farms decreased while there was a net increase in pig densities linked to medium-sized farms. Large farms primarily developed in well-connected regions. Mountain regions retained a more traditional production structure.

Commercial farm in the province of Đồng Nai

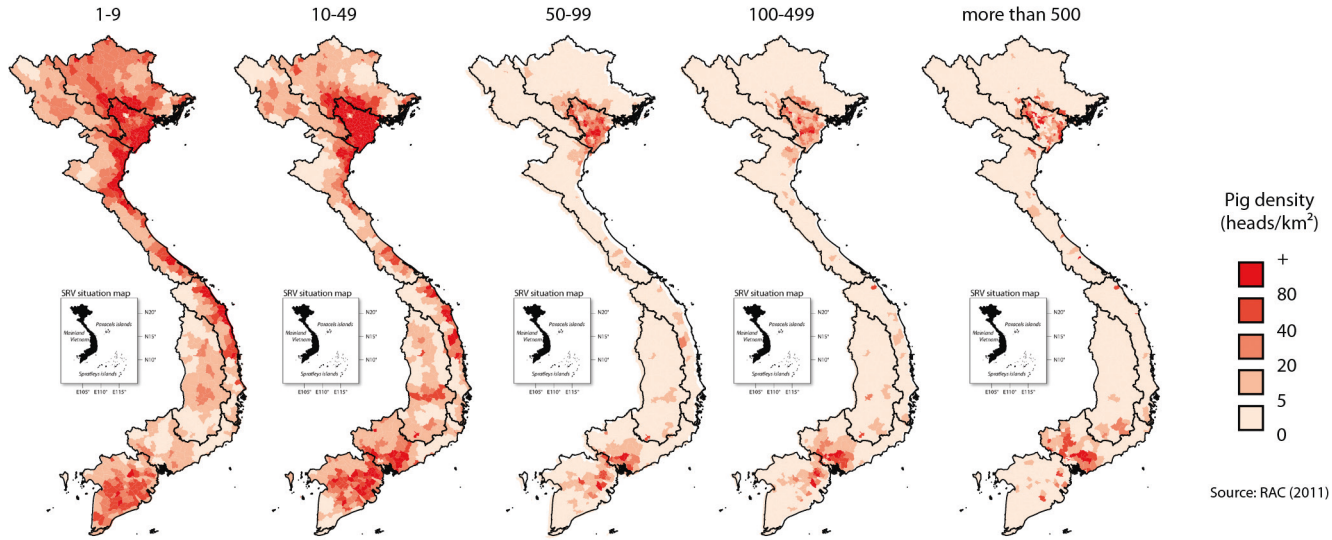
Evolution of the number of farms with pigs according to herd size between 2001 and 2011



Contribution of different pig farm categories to the total pig density per district in 2001

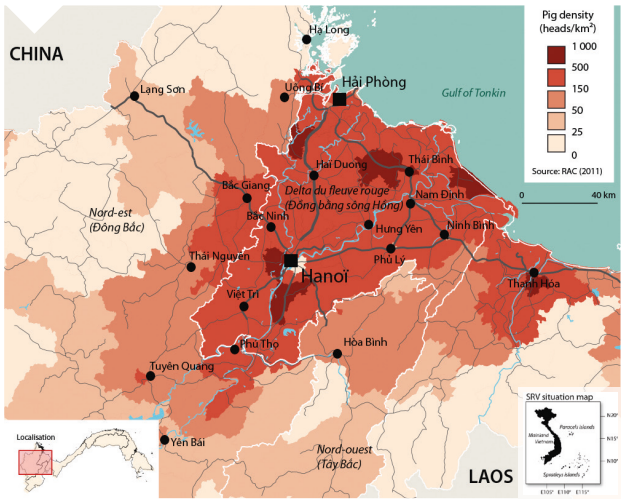


Contribution of different pig farm categories to the total pig density per district in 2011

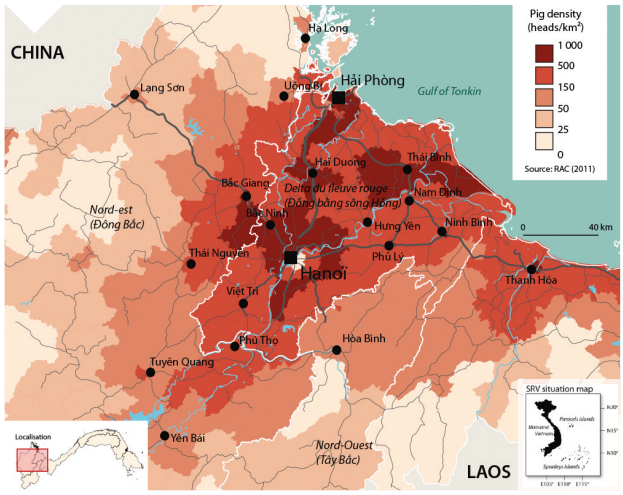


Relocation of pig production away from large cities

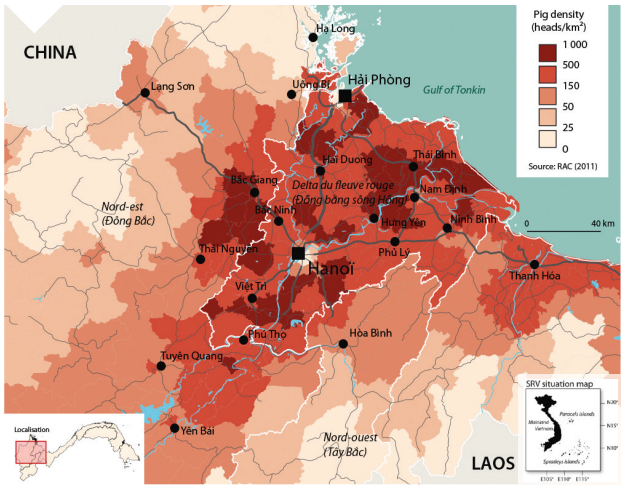
Pig density around Hanoï in 2001



Pig density around Hanoï in 2006



Pig density around Hanoï in 2011



The push and pull of large cities

To better understand the spatial dynamics of the redistribution of pig production in a context of restructuring, one needs to look at the outskirts of major cities such as Hanoï and Ho Chi Minh City. As a reminder, these two cities alone hold about 10 million inhabitants, 7.4 million in Ho Chi Minh City and 2.6 million in Hanoï. The markets in these cities continue to have a polarizing effect on commercial breeding activities and were at the core of the transformation of the geography of pig farming during the 2000s.

The Red River Delta and its densities

The force of attraction on the farms was noticeable around Hanoi in the early 2000s. The majority of communes with pig densities higher than 500 heads per hectare were found within a 20-kilometre radius of the city. Likewise, numerous communes within 20 kilometres of Hải Phòng reached similar densities. In the peri-urban countryside, pig production is considered to be an income-generating activity that allows rural people to connect to the development dynamics emanating from cities.

Development corridors

The regions along the major transport routes initially benefited because feed imports from Hải Phòng encouraged the establishment of agro-industrial factories along the national highway between the capital and the port. In areas where agro-industrial factories were set up, the density exceeded 500 pigs/km².

Towards the end of the pig belt

Between 2006 and 2011, the high densities around Hanoi began to erode under the weight of urbanization. The extension of the province of Hanoï in 2008 offered the city land for rapid urbanization. The farming communities living near the capital opted for other sources of income than livestock production. In peri-urban areas, livestock farming was indeed less profitable than secondary or tertiary sector activities, and was above all a source of pollution, which led public authorities to limit the activity.

Local pigs in the province of Hanoï

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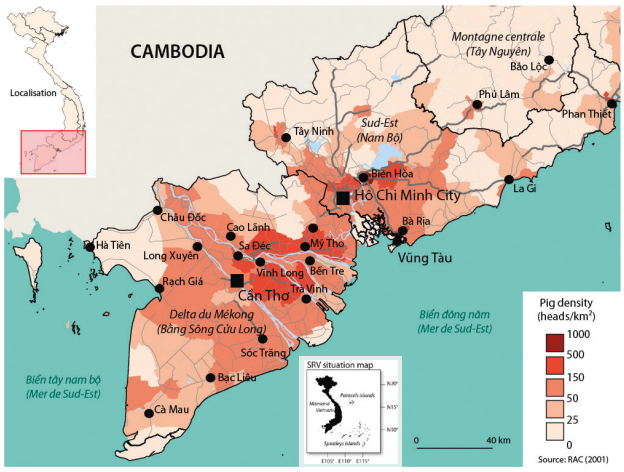
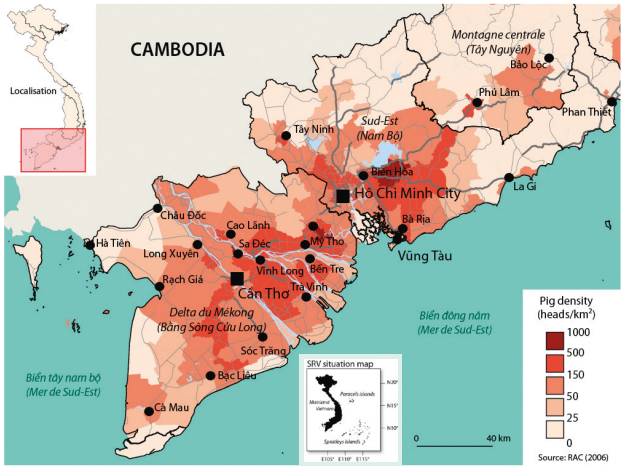
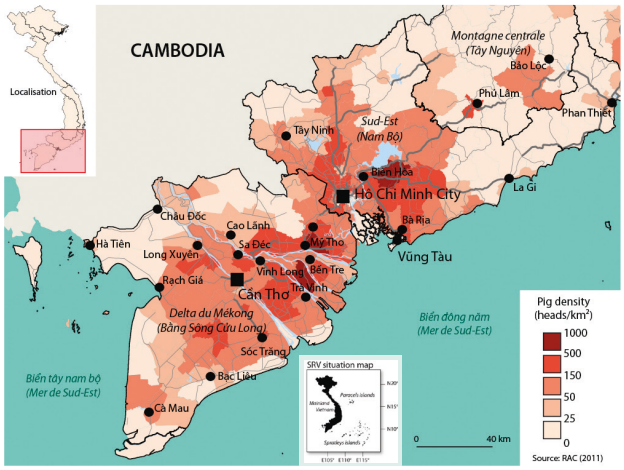
Pig density around Ho Chi Minh City in 2001



Pig density around Ho Chi Minh City in 2006



Pig density around Ho Chi Minh City in 2011



Ho Chi Minh City and the Mekong Delta

The country's leading economic metropolis, Ho Chi Minh City, lies at the convergence of two regions: the central highlands to the north, and the Mekong Delta to the south. The city also is at the crossroads between Cambodia and the port of Vũng Tàu, the country's deep-sea port. In the Southeast region, human population densities are considerably lower than in the Red River Delta. Nevertheless, they exceed 450 hab/km². Traditionally, southerners consumed relatively more aquaculture products. However, since the 1990s, meat production has been expanding.

The historic region of the Lower Mekong

In 2001, high pig densities primarily were found in the Mekong Delta. This location was due to the river transport of raw materials. Cambodia and Mekong rice farmers sold their rice to intermediaries who transported the grains to the ports of Cần Thơ and Vĩnh Long. By-products of rice processing were then mixed into animal feed. Pig densities in the eastern part of the Mekong Delta were then over 50 pigs per km².

The spectacular development of the Southeast region

However, one must note the existence of high densities to the north of Ho Chi Minh City in the region known as the Southeast. Along the main axes of communication, several communes have over 500 pigs per km². The process of industrialization had already begun in the early 2000s. From 2011, densities increased in the Ho Chi Minh City - Biên Hòa -Vũng Tàu triangle and around Mỹ Tho. The highest densities are located outside the 50 km limit around the capital. What are the consequences from an environmental perspective?

Does concentration pose risks?

The emergence of high densities in the south of the country is linked to the restructuring of production. However, the densities in the south are technically lower than in the north, notably in the Red River Delta. Does this mean that there are higher environmental risks in the north than in the south? Survey data show that environmental problems are sharper in the south. In the north, livestock numbers are higher but farms are smaller, and therefore spread out in the environment. Crop and livestock farming are more closely integrated, which reduces environmental risks.

Local pigs in the province of Đồng Nai

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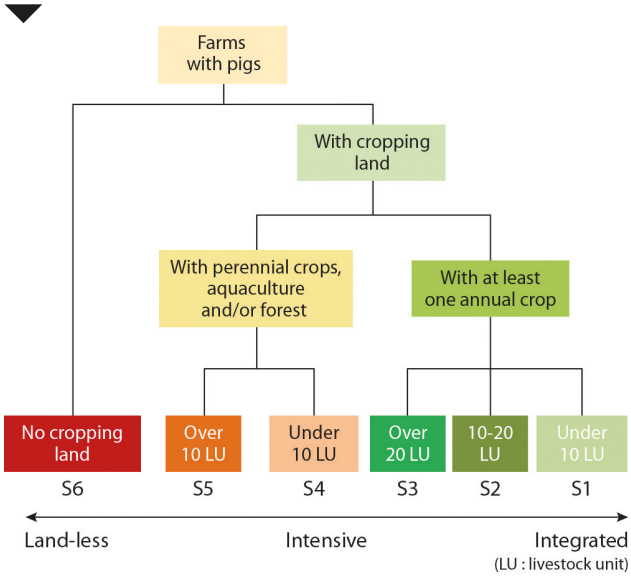
Diversification of pig farming systems

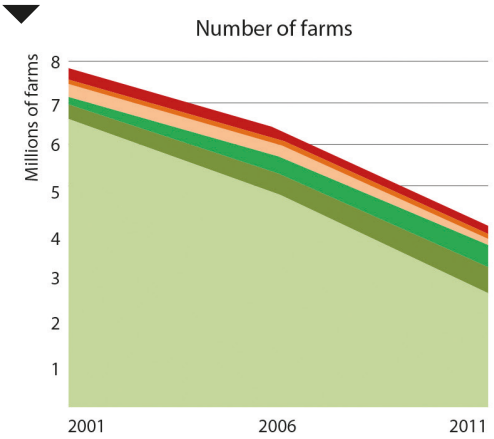
Crop-livestock integration in Vietnam

What are the effects on the environment of the restructuring of pig production? What is the crop-livestock integration dynamic within farms? Is the development of commercial livestock farms and intensive family farms leading to a phenomenon of agricultural specialization of production systems? How can this transformation of systems be measured? Based on international typologies and farming systems approaches, we consider livestock farming activities in relation with the types of crops present on a farm. Using data from the agriculture censuses of Vietnam,we relate different livestock numbers to different crop farming areas. It is then possible to differentiate among pig farms, distinguishing those which have at least one annual crop (possible integration), those which only have perennial crops, and lastly those that have no farm land, and are thus no-cropping farming systems. Using these typologies, we defined six farm categories.

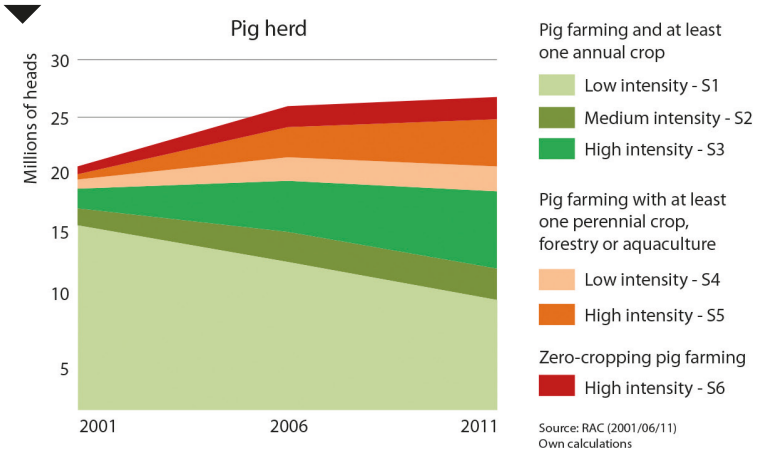
Pig farm categories according to the connection to the land, type of crop and animal density.



Evolution in the number of pig farms by category between 2001 and 2011



Evolution of pig production by farm category between 2001 and 2011



Low intensity systems falling sharply

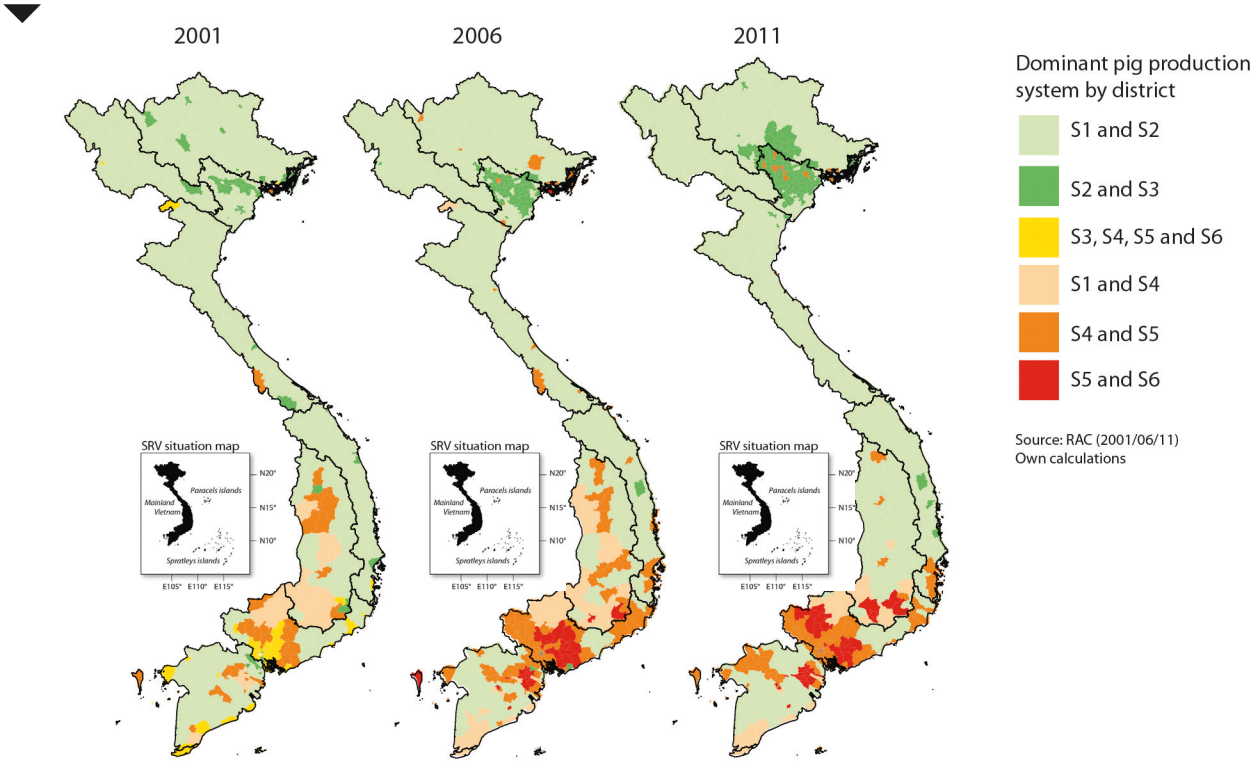
In 2001, pig farms were predominately in system category 1: presence of annual crops with low pig densities. They represented 90% of the farms and 80% of the herd. In 2011, these farms continued to represent 80% of the farms, but accounted for only 40% of production. They had dropped in number from 6.5 million to less than 3 million farms.

Intensive systems picking up the slack

At the same time, more intensive livestock systems have grown in terms of production. Categories S3 (annual crops + high pig density) and S5 (perennial crops + high pig density) accounted in 2011 for 10% of farms and concentrated more than 25% of the national herd. There were approximately 400,000 S3 and S5 farms in 2011. Strictly no-cropping farming systems (S6), that is to say without farm land, are declining in number but are increasing slightly in numbers of pigs. The majority of these systems are located around cities for reasons related to economics (proximity to markets) and urban planning. In these areas, agricultural activities are disappearing under urban sprawl. These no-cropping pig farming systems could rapidly disappear.

A small pig farm and its management of effluents

Typology of districts according to the under and over representation of pig production systems



The geography of crop-livestock integration

The intensive systems (S3 and S5) are overall overrepresented in the Red River Delta and the Southeast region. In 2001, the intensive systems were mostly located in the Southeast and were mainly integrated with perennial crops (S5). The majority of intensive annual crop systems (S2 and S3) were concentrated in the north along the Hanoi-Hải Phòng road where animal feed factories were established. The intensification in the north spreads out from transportation infrastructure across the region. In the south, one can observe the extension and relocation of intensive areas between 2006 and 2011.

New models of pig production?

While this typology shows quantitatively the diversification of farming systems, it is fairly easy to observe these new forms of farming systems in the field. Since the early 1990s, the Vietnamese government has been supporting the development of VAC (*vườn - ao - chuồng*) farms, which consist of a small livestock production unit, a fish pond and a garden. Fluxes of nutrients between those 3 units (crops, residues, effluents, water) create a closed agro-ecological integration loop within the farm. This ideal model can take different forms. However, the farms often have gardens that are too small to manage the nutrient load of the pond water. The surplus is thrown into nearby rice fields. Likewise, the vegetable gardens are now giving way to cash crops with a high added value. These new crop-livestock integration models place an emphasis on arboriculture. Numerous Vietnamese livestock farmers use a large part of pig effluents to fertilize the trees (longan, mango, grapefruit, cashew nuts, rambutan, coffee). There are numerous possible combinations. Animal manure provides farmers with an effective fertilizer to adapt to changing market conditions. Demand for manure around pig farms is creating a local and regional market for organic fertilizers of animal origin.

Widely diverse systems despite the restructuring

Beyond the classical analysis of the restructuring of pig production based on herd size, a livestock farming systems approach makes it possible to describe a process of diversification in pig production models rather than a process that is a priori one of homogenization. Indeed, the increase in the average herd size per farm is not a uniform pathway leading to the emergence across the country of the same forms of industrial livestock production. Rather the process is generating more models than there were originally. The integrated systems (S1, S2, S4) remain overall on the decline, and as 2030 approaches, some of these small pig farms could become less and less important.

Sacks of pig effluents in a perennial crop area

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Is the development of landless farming systems safe?

Multifactorial approach to livestock production risks

Several dimensions must be considered to fully grasp the environmental impact of livestock farming. Attention must be paid simultaneously to waste production, nutrient levels, and air, water and soil pollution. The effects on the health of human and animal populations also must be taken into account. However, the lack of official data and of reliable field data render it difficult to consider all of these dimensions. We therefore shall estimate the concentrations of the three main nutrients present in livestock waste (nitrogen N, phosphate P, and potassium K) at the farm and territory levels.

Estimation and modelling of nutrient flows

The level of NPK nutrients in livestock manure has been widely studied around the world, which renders it possible to identify an average content per animal based on its weight and diet. Working from this estimation per animal, it is possible to estimate the level per farm. This content can be compared to the fertilizer requirements of plants per hectare, and thereby deduce the balance at different administrative scales: a volume of animal waste per farm is estimated and compared with the theoretical capacity for treating agricultural land. If the farm produces more waste than it has land, then the waste is not absorbed by the soil and consequently is a source of pollution. When this is the case, we compare the surplus of all of the pig farms with the agricultural land treatment capacity of farms without livestock units. If a waste surplus is observed at the scale of a commune, we redo the calculation at the district level and then at the province level.

Pig effluents released into the environment

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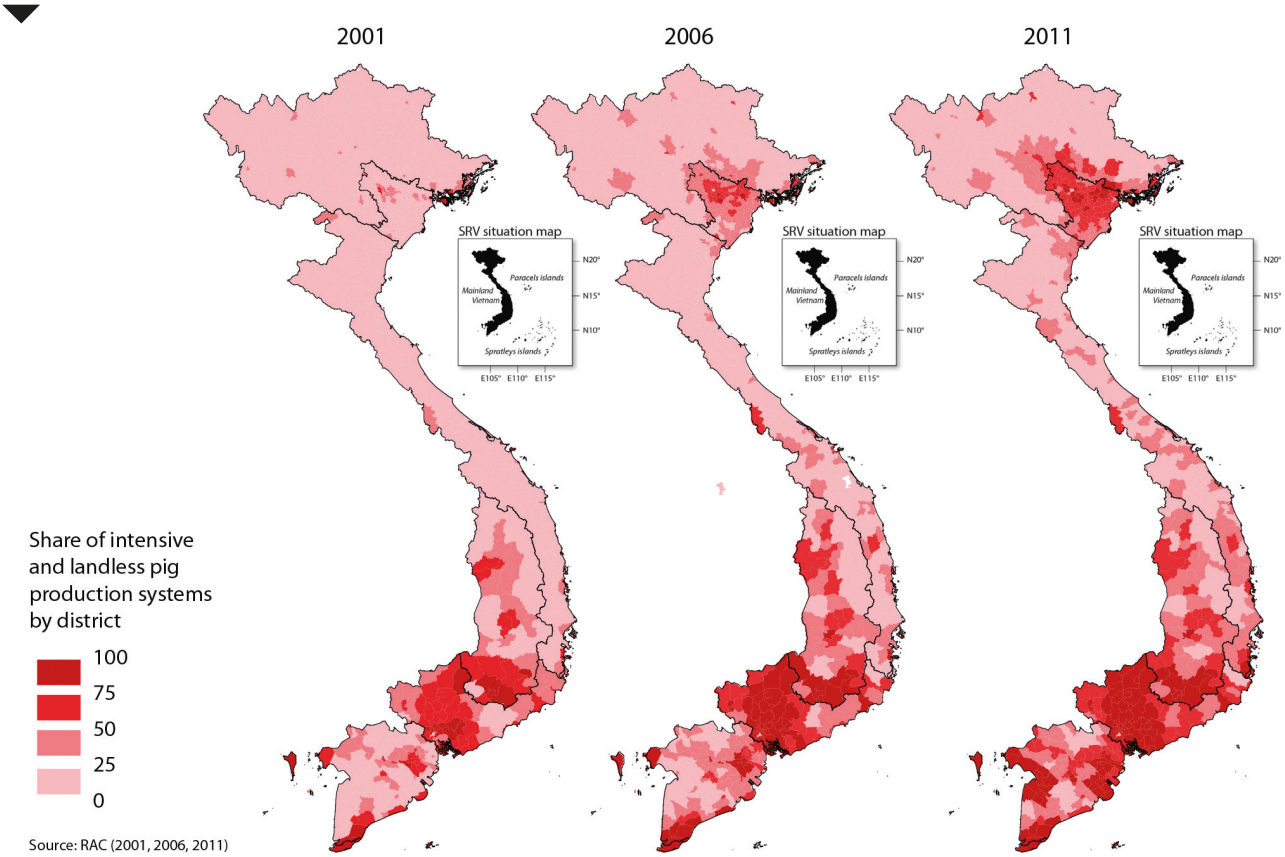
Regions dominated by intensive systems

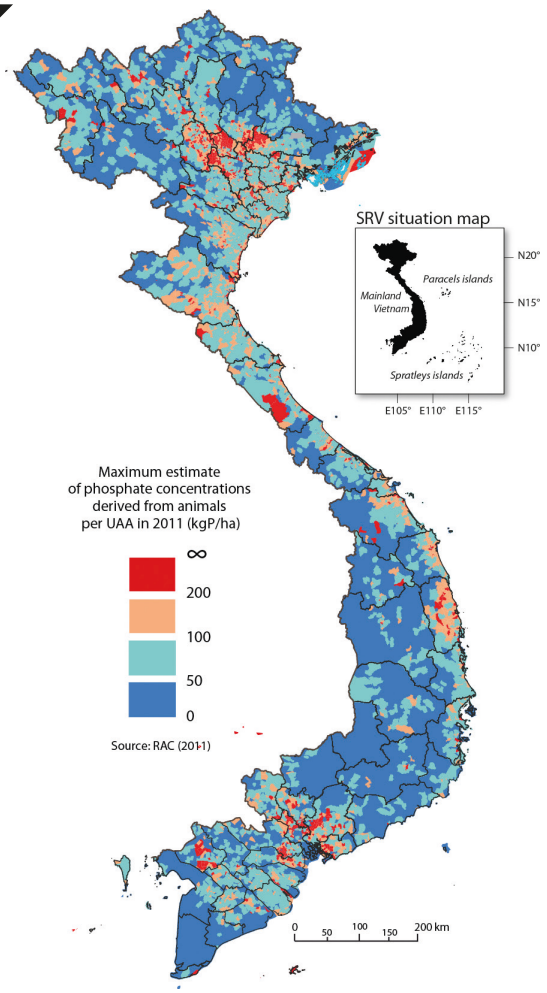
In both the north and south, intensive systems (S3, S4, S5 and S6) now account for over 75% of livestock in a growing number of districts. Mainly located around major cities, these intensive systems predominate in large agro-ecological regions such as the Southeast, the Red River Delta and the Mekong Delta. It seems that these intensive systems are spreading in the central and highland regions.

Share of intensive and landless systems in district output between 2001 and 2011.



Source: RAC (2001, 2006, 2011)

Maximum estimate of the concentration of phosphate derived from animals per agricultural area in 2011



Targeting environmental policy

On the basis of these data, the government could first focus on communes at high and very high risk and then on communes at lower risk. The vast majority of communes with surplus waste are on the outskirts of Ho Chi Minh City and in the Red River Delta. 120 communes have more than two times their phosphate requirements. The overwhelming majority of these communes are urban neighbourhoods with limited livestock production but also equally limited agricultural land. Of the top 10 surplus districts, nine are in the Southeast region. The top five are in the immediate vicinity of Ho Chi Minh City. Out of all of the districts with a surplus, only two can be considered to be "rural areas". The risk at the district level is therefore more diluted by the presence of the agricultural land of communes with lower livestock densities.

Technological response to risk in rural areas

In 2008, the government set up a zoning policy aiming to relocate intensive farms. The objective was to move intensive farms away from residential areas. The provinces of Đồng Nai (50 km from Ho Chi Minh City) and Hưng Yên (30 km from Hanội) were the pilot sites for this experiment. In Đồng Nai, for example, the authorities defined "livestock concentration zones" (LCZ) in the district of Thong Nhat. The establishment of these zones was supported by the World Bank. The results obtained demonstrate that these livestock zones favour commercial livestock farms and increase livestock concentrations. Actual investments on the environment remain below what was expected.

From estimating concentrations to risks

It is possible to determine a level of environmental risk at the commune or district level from the estimated NPK balances per farm. For this, it is necessary to sum all the balances of the farms in the same commune or district and to compare them with the usable agricultural areas. The ratio obtained renders it possible to better grasp the surplus of effluents produced by livestock farming systems at the level of an administrative unit. There are four risk levels (low, medium, high and very high). If the effluent surplus does not exceed 50% of the agricultural requirements, then the saturation capacity has not been reached and the potential risk is low. Between 50 and 100% of requirements, the risk level is estimated to be medium. Beyond 100% for one nutrient (N or P or K), the risk level is considered to be high. When the levels of all of the nutrients exceed 100% of requirements, the situation is considered to be a very high risk. These calculations indicate that 1,000 communes have a high risk level, and 500 communes are facing a very high, if not alarming, risk.

Undersized biogas systems

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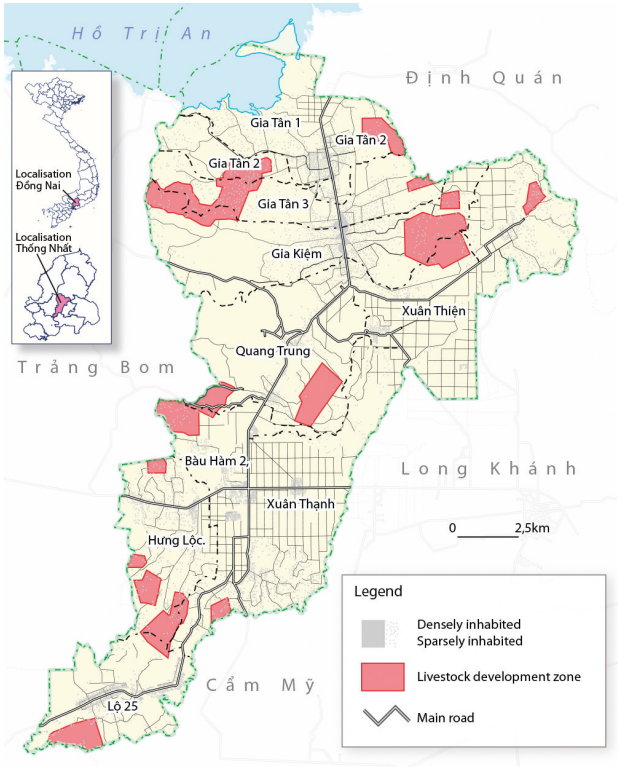
Livestock concentration zones in Thống Nhất

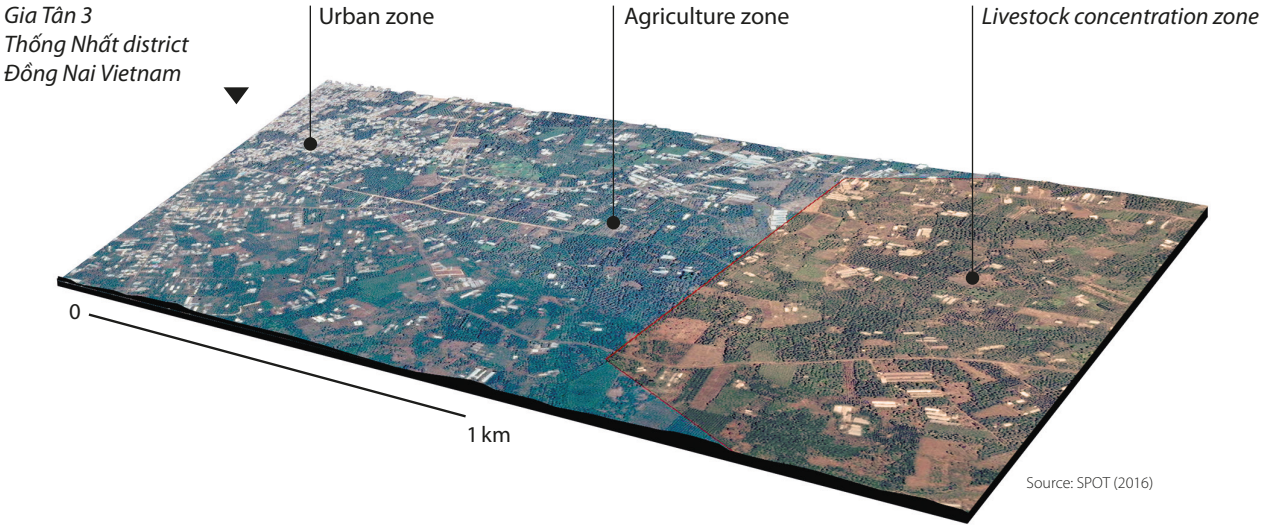


Zoning and development of intensive livestock production

"Livestock zones" well outside urban areas

In the south of Vietnam, the establishment of "livestock concentration zones" (LCZ) is part of a process of intensification of livestock systems in a context of rapid urbanization. The extension of built-up areas has been made possible by the development of pig farming. In effect, it is possible to change the agricultural use of a plot of land if the farmer establishes a livestock unit on it. Between 2005 and 2015, the urban area tripled in size. At the same time, the number of pigs multiplied by five, generating heavy pollution of ground waters. This zone is furthermore located less than 2 km from Tri An Lake, the primary water source for Ho Chi Minh City.

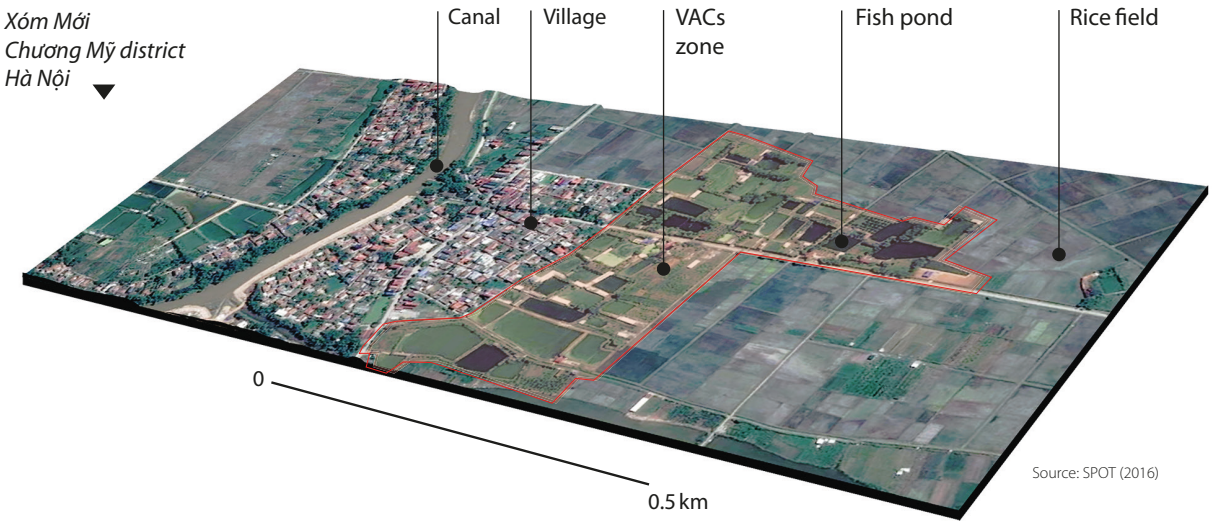
In the LCZs, local authorities are encouraging livestock farmers to themselves invest in road construction, treatment infrastructure and general development works. The State assumes the task of electrification up to the doors of commercial farms. In this part of Vietnam, the land market is open. The State has not managed to purchase land to develop these areas. The establishment of livestock zones has caused property prices to soar. The price of one hectare can exceed US$50,000. Some are partnering with landowners to set up intensive livestock units. However, this race to concentrate is increasing environmental risks because the funds invested in buying land are unavailable for environmental management.



Source: SPOT (2016)

Livestock production zones in contact with villages

In the north, the organization is different. The land belongs to the State. "Livestock concentration zones" also were established, and farmers interested in having a location in these zones register on official lists with commune authorities. User rights and investments are managed between the beneficiary and the local authorities. Due to a lack of space, livestock zones are adjacent to villages, which then serve as water treatment areas thanks to the fishponds. The VAC model (pig production + fishpond) prevails. The water is then used for the rice paddies.



Source: SPOT (2016)