

## 1 Introduction

### 1.1 Background and research objective

In Vietnam, pigs are of utmost importance. The Vietnamese pig herd is with 23 million heads the largest in SE Asia (FAOSTAT, 2004). Pork accounts for about 70% of all livestock products (Lich, 1999). 99% of the total pork production are consumed within the country (FAOSTAT, 2004). Over the last decades, supply of pork per capita has increased dramatically, while changes for bovine meat, poultry meat or eggs were much less important (figure 1). 80% of total pig production are estimated to be small-scale (Lapar et al., 2003).

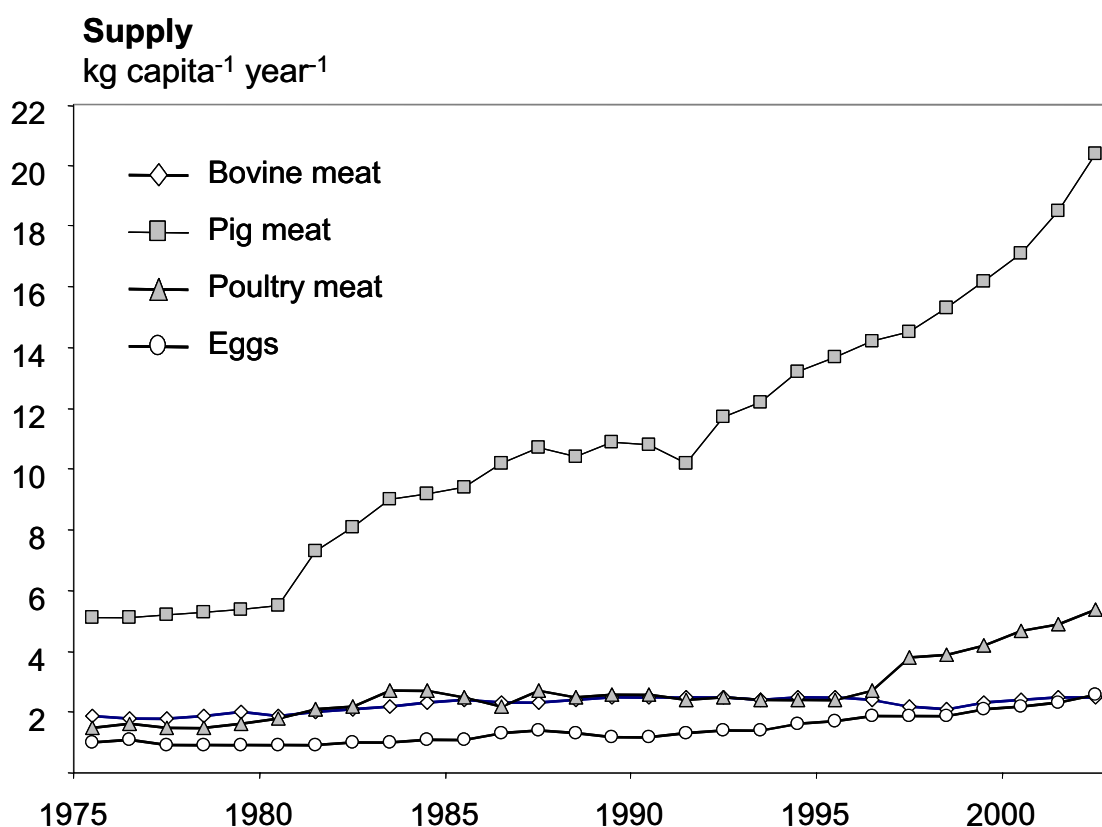


Figure 1: Domestic supply of bovine meat, pork, eggs and poultry meat in Vietnam

Supply for domestic utilization defined as [production + imports - exports + changes in stocks]. Source: FAOSTAT, 2005

This study focuses on smallholder pig keepers in Son La province in the North West of Vietnam. The North West is a generally marginalised region due to its geographical and infrastructural remoteness, mountainous surface and resulting limitations for agriculture (Jamieson et al., 1998). The population is dominated by ethnic minorities. The poor linking between North West and Red River Delta, including the capital Hanoi, has hampered the region's development concerning infrastructure, industry and linking to other Vietnamese markets. The North West has after the Central Highlands the second highest poverty incidence in Vietnam (Vietnam Development Report, 2004). On the other hand, the region's isolation resulted in relative autonomy. The Black Thai of North West Vietnam remained for a long time auto-

mous and were not integrated in any of the neighbour states. Only in 1888, the North West became part of the French overseas territory Tonkin (Sikor, 1999). In 1954/5, the Thai-Meo-Autonomous Zone became part of the newly founded Vietnamese state; yet, the state paid great attention to the historical autonomy of the Thai. Provincial structures were in the North West established only as late as 1962 (Sikor, 1999). This indicates that the development of the Black Thai farming systems might show peculiarities in comparison to the development of lowland farming systems.

Son La itself is a mountainous province. Its area of 1.4 million ha includes only 9% agricultural land (GSO, 2001). In contrast, the Red River Delta and Mekong River Delta use 58 and 75% of their area for agriculture (GSO, 2001). The anyway limited agricultural land, growing population and increasing land pressure together with environmental degradation and unsustainable change of traditional farming systems put the uplands under a considerable pressure (Jamieson et al., 1998). Especially due to increasing land pressure, there is limited room for spatial extension of cropping. Farmers have to find other ways to improve their livelihoods, and animal production seems to be one of them, especially production forms that are less land-dependent like pig or poultry keeping. Limited availability of resources in marginalised areas limits farmers' possibilities to intensify livestock production. Improved resource utilisation, i.e. increased production efficiency, is assumed to be an option to optimise smallholder production systems.

The uplands are not a homogenous area; and regions differ in biophysical conditions, remoteness and thus access to markets and infrastructure, demographic structure, ethnic composition, local customs and village-specific rules, available technology and policy implementation (after Sikor, 1999). Such heterogeneous regions differ in the conditions provided for husbandry and particularly pig production and in the resulting characteristics of pig production systems. As appropriate breeds are decisive for efficient resource use within specific production systems, this study aims to investigate smallholder pig production in Son La along a gradient of increasing remoteness and altitude and decreasing production intensity (figure 2). It is hypothesised that remoteness is a major differentiating factor, by which biophysical constraints interact with socioeconomic aspects of development (Alther et al., 2002). Remoteness is understood as distance, duration and frequency of transportation for people and goods between the respective village and the next regional market and administrative centre.



Figure 2: Map and schematic view of the research region Son La province

Red stars indicate location of four selected villages Ban Buon, Ban Bo, Na Huong and Bo Duoi

This study attempts to characterise the existing pig production systems, and to assess the suitability of pig breeds for different production conditions. This involves the following sub-objectives:

- to describe current conditions of smallholder pig production, including pig production management and the distribution of breeds in pig production systems of different remoteness and production intensity,
- to quantify the performances of pig breeds/genotypes under prevailing management conditions in investigated pig production systems,
- to assess the inputs and outputs of pig production and to derive indicators for the efficiency of resource use (biological resources, capital resources) as criteria for the comparative evaluation of pig production systems,
- to identify the position that pig production occupies in the overall livestock systems of investigated farm systems and to identify and quantify competition and complementarities in resource use and utility of pigs in comparison to other species for the household,
- to describe development processes that have generated the currently existing pig production systems and to identify and discuss its driving forces and dynamics,

- to discuss constraints and potentials of future development of investigated pig production systems.

By fulfilling those aims, the study aims to develop suggestions for sustainable development of smallholder pig production in the research region in the near future. More specifically, it prepares the ground for the set up of community-driven village breeding programs for pigs (see 1.2).

In section 1.2 of the remainder of chapter 1, the design of this study is outlined and the study is put in the context of the overall research program, while 1.3 describes the further thesis structure.

## **1.2 Design of the study**

This study is part of a research program on “Efficiency of smallholder animal husbandry depending on intensity of management and genetic potential of livestock in mountainous regions of Northern Vietnam” that is conducted in the frame of a Thai-Vietnamese-German collaborative research program on “Sustainable land use and rural development in mountainous regions of Southeast Asia“ (SFB 564) and in cooperation with the National Institute of Animal Husbandry Hanoi. SFB 564 is conducted by the University of Hohenheim and funded by the German Research Council DFG. Besides funding from DFG, this study received co-funding from the Federal State of Baden-Wuerttemberg and the German Academic Exchange Service DAAD.

The program on “Efficiency of smallholder animal husbandry” aims to develop community-driven breeding and management programs using livestock genotypes with high productive adaptability (i.e. high performance under local production conditions). As the intensification of livestock production is limited in the marginalised uplands, it is assumed that such programs are a way to increase production efficiency through improved resource utilisation, avoiding resource mining by keeping inappropriate genotypes not adequately integrated in the actual farming systems. This study supported the overall objective by conducting a situation analysis in livestock production systems of four villages along a gradient of increasing altitude and remoteness and decreasing production intensity (figure 2) and analysing the pig production systems along this gradient, following the research objectives mentioned under 1.1. Most of the farmers, who had taken part in this study, later on agreed to participate in the newly established village breeding programs for pigs.

Fieldwork for this study was conducted in Son La province. Four villages of ethnic Black Thai were selected. Villages Ban Buon and Ban Bo in a mountain valley near town with favourable market access were selected to represent a demand-driven pig production system (i.e. driven by the market-demand for pork) while villages Na Huong and Bo Duoi at a hillside away from town with limited market access were selected to represent a resource-driven production system (i.e. driven by the availability of farm resources). Stratified household selection aimed to include households with purebred Mong Cai or Ban sows in late pregnancy or lactation (to facilitate collection of reproductive performance parameters). To balance sam-

ple size and avoid distortion of real conditions, few households keeping crossbred sows were included. At total, 64 households of ethnic Black Thai were selected. Due to the prevalence of pig genotypes in selected villages and stratified sampling procedure, effects of breed and village were largely confounded as MC sows prevailed in villages near town while Ban sows prevailed in villages away from town.

This study limited on purpose the number of farms for household interviews, but aimed for repeated farm-visits and data collection in order to understand dynamics of resource use and pig production performances. Farms were visited four times between March 2001 and July 2002; twice in a season of relative feed abundance (March/April) and twice in a season of relative feed shortage (June to August). Data collection methods comprised structured household interviews and rapid rural appraisal tools (RRA). Individual live weights of 755 pigs were recorded. Interviews and weighing of pigs were conducted once per farm visit, thus four times per household. In total, 234 interviews were conducted. Interviews focused on socio-economic household data, cropping, livestock and pig husbandry (input, output, management, utilisation of products) and pigs' performances. RRA tools comprised key person interviews, discussions with farmers, mapping, ranking, diagramming and calendar tools. Pig production management was described and the frequency of management interventions was recorded. Pig performances were quantified and analysed concerning the genotype as main effect. Productivity indices for sows of different breeds and with different offspring genotypes were derived. Production inputs, outputs and utilisation of outputs were assessed for pigs and in comparison for the other domestic animal species. Parameters of economic success and resource use efficiency (feed use efficiency, gross margin, net benefit, benefit cost ratio) were derived and analysed concerning the village as main effect. Developments of the livestock system over the last decade and developments of pig production systems since the 1950s were assessed; village-specific specialisation- and differentiation processes and their driving forces were investigated. To assess development trends of smallholder pig production, a spreadsheet model was developed to compare the effect of selected impact factors on different combinations of pig breeds and production conditions on the basis of their gross margin and net benefit. Statistical data analysis was conducted applying linear models, loglinear models, regression analysis and non-parametric tests, using the statistical software SAS 8.02. RRA findings were presented as original research results and were used to interpret findings from quantitative-statistical data analysis.

In 2003, after the end of data collection for this study, On-Farm Performance Testing Schemes (OPTS) were established in two of the investigated villages, namely Ban Buon and Bo Duoi, with the aim to record pig performances under farm conditions. A data-recording system was established where farmers assessed performance data themselves and entered them in a data bank, assisted by researchers with additional data collection, data back checking and data bank management. Results from the data bank went into the answering of research questions, controlled mating and optimisation of pig production management. Meanwhile, OPTS have been extended to a total of 5 Black Thai and 2 H'mong villages. In a next step, the established breeding and management programs will be optimised. Focal points will

be the production of lean pork with higher-yielding pig genotypes in demand-driven production systems of the Thai and of branded pork from local Ban pigs in resource-driven production systems of the H'mong. Accumulated population data will be used to estimate genetic parameters, economic coefficients for selection traits and genotype x environment-interactions. The design of different pork production and marketing programs will be optimised through bio-economic modelling. Further, organisational and logistical aspects of setting up breeding and management programs have to be analysed and quality of targeted end products has to be evaluated and to be maintained.

### **1.3 Structure of the thesis**

Chapter 2 (corresponding to paper I) introduces the two investigated pig production systems. It describes the pig production management in the two production systems, and comparatively quantifies performances of the two investigated pig breeds under prevailing management conditions. Methods in this study involve interview and rapid rural appraisal techniques, and recording pigs' liveweight by weighing. The collection of performance data by interviewing and measuring is critically discussed.

Chapter 3 (corresponding to paper II) presents the quantification of production inputs and outputs, feed use efficiency and economic benefit and efficiency in two investigated pig production systems, based on which the suitability of local Ban and improved MC for smallholders in the different systems is discussed. Associations between household characteristics, livelihood strategies and the effectiveness of pig production are concomitantly considered.

Chapter 4 (corresponding to paper III) puts pig production in the broader context of smallholder livestock production. It describes differences in resource availability and service accessibility and analyses their influence on two investigated livestock production systems, especially concerning farmers' production objectives, resource allocation, and economic success of livestock production. Focus is on species' competition for limited resources and complementarities in their utility for the household. Ruminants, chicken, waterfowl, and fish are comparatively evaluated and opposed to pigs, which are seen as the key species in smallholder husbandry. Production potentials and limitations for husbandry in the near future are determined, factors for the sustainable development are discussed. A production system analysis approach is used, describing system components, quantifying inputs, outputs and indicators of economic efficiency and benefit of production systems, and discussing results in the light of Rapid Rural Appraisal findings.

Chapter 5 (corresponding to paper IV) asks how the fast changes in Vietnam and in the Vietnamese pig sector observed in the last decades and especially since 1986 affect smallholder pig producers in the two investigated production systems. It again compares the demand-driven production system near town with the improved Mong Cai breed and the resource-driven system away from town with the local Ban breed. Developments in investigated pig production systems in the last decades are described. A spreadsheet model is developed to predict the economic success of investigated production systems and pig breeds and to simu-

late the effect of selected impact factors on those systems. Methodological approaches of historic analysis and the model approach are critically discussed.

## **2 Evaluation of smallholder pig production systems in North Vietnam. 1. Pig production management and pig performances**

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## 2.1 Abstract

This study comparatively assesses the productive adaptability of pig breeds under different smallholder production conditions in Vietnam, comparing an indigenous with a Vietnamese improved breed. Fieldwork was conducted in four villages with different remoteness in North Vietnam from 2001 to 2002, in 64 households keeping the improved Mong Cai or indigenous Ban as sow breeds and progeny for fattening. Four visits per farm yielded 234 structured interviews. Reproductive performances were derived from 135 litters. Individual weights of pigs ( $n = 755$ ) were obtained. Data were analysed by regression, linear and generalised linear, especially loglinear models.

Two distinct pig production systems were identified, that differed in remoteness, market access, resource availability, distribution of pig breeds, and pig production intensity. The improved Mong Cai breed, kept near town under semi-intensive conditions, yielded higher performances (1.6 litters year<sup>-1</sup>, 8.4 piglets weaned litter<sup>-1</sup>, 83 kg piglets weaned sow<sup>-1</sup> year<sup>-1</sup>, ADG of crossbreds 161g day<sup>-1</sup>) than the indigenous Ban, kept further away from town under extensive conditions (1.1 litters year<sup>-1</sup>, 4.9 piglets weaned litter<sup>-1</sup>, 31 kg piglets weaned sow<sup>-1</sup> year<sup>-1</sup>, ADG of crossbreds 83g day<sup>-1</sup>). Total live weight offtake per household per year was higher near town and in one village distant to town. Improved genotypes remained even under demand-driven conditions below their performance potential. Under resource-driven conditions with a saving-oriented production pattern, the higher-yielding but more demanding Mong Cai might not be an efficient production alternative as a further performance reduction can be assumed. Ban sows with crossbred offspring yielded a considerable live weight output under resource-driven conditions and might represent a promising production alternative. Factors influencing the performance expression of pig breeds, and the suitability of different methods for the assessment of performance parameters on-farm are discussed.

**Keywords:** Vietnam; smallholder pig production; local pig breed; performance testing; on-farm; generalised linear models; loglinear models

## 2.2 Introduction

Vietnam owns with 23 million pigs the largest herd in SE Asia (FAOSTAT, 2004). 71% of farm households own pigs (MARD and UNDP, 2003). Pork accounts for 70% of all livestock products (Lich, 1999). Up to 80% of pig production are estimated to be small-scale (Lapar et al., 2003). Smallholders typically own one or two sows and less than 10 fatteners (Lapar et al., 2003). Pigs contribute between 9 and 41% of the income of pig keeping smallholder households in North Vietnam (Le Coq et al., 2002).

The North West of Vietnam accounts for 4% of the national pig herd (GSO, 2001). While the region has a relatively low per-capita-income and income density from pig production it is one of the regions with the highest share of household income derived from pigs (Epprecht, 2005). Compared to the lowlands, the North Western mountainous area is generally marginalised (Jamieson et al., 1998). Yet, it is not a homogeneous region. In densely populated mountain