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Optimising breeding programmes with local pig breeds in North Vietnam considering functions of pigs for smallholders and logistic determinants

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List of abbreviations

ADG	average daily gain
AEC	provincial Agricultural Extension Centre
AES	district Agricultural Extension Station
AI	artificial insemination
AnGR	animal genetic resources
B	Ban breed
BESH	Bäuerliche Erzeugergemeinschaft Schwaebisch-Hall (Producer Association Schwaebisch-Hall), Germany
BF	backfat
BS	breeding scheme
BW	body weight
CALPI	Capitalisation of Livestock Programme Experiences India
CE	choice experiments
cf.	confer
CP	Charoen Pokphand
cp.	compare
ΔF	change in inbreeding coefficient per generation
DARD	provincial Department of Agriculture and Rural Development
DFG	Deutsche Forschungsgemeinschaft (German Research Council), Germany
DLP	Department of Livestock Production, a professional department of the Ministry of Agriculture and Rural Development, Vietnam
e.g.	exempli gratia (for example)
Eq.	equation
ESR	oestrogen receptor gene
F1	crossbred offspring from different purebred parents
FAO	Food and Agriculture Organisation
FARROW	farrowing interval
GGP	great-grandparent stock
GP	grandparent stock

GSO	General Statistics Office, Vietnam
hh	household
IIA	Independence of Irrelevant Alternatives
kg	kilogram
km	kilometre
Lao PDR	Lao People's Democratic Republic
LR	Landrace
LW	Large White
MARD	Ministry of Agriculture and Rural Development, Vietnam
MC	Mong Cai
mm	millimetre
MNL	multinomial logit
n	sample size
NACEPIG	National Centre for Pig Breeding and AI, Vietnam
NBA	number of piglets born alive
NIAH	National Institute of Animal Husbandry, Vietnam
NOPICO	Northern Pig Breeding Company, Vietnam
OPTS	On-farm performance testing scheme
PIC	Pig Improvement Company, subsidiary (business unit) of biotechnology leader Genus Plc.
Pseudo-R^2	goodness of fit
resp.	respectively
RUDEC	Rural Development Centre, Vietnam
SDAH	provincial Sub-Department of Animal Health
σ_A	genetic standard deviation
SFB	Sonderforschungsbereich (Special Research Program) of the German Research Council (DFG)
SFSC	short food supply chains
VINALIVESCO	Vietnam National Livestock Corporation, Vietnam
VND	Vietnamese Dong (exchange rate 1 January 2006: 1 US $ ~ 15,900 VND)

vs.	versus
WTO	World Trade Organisation
Y	Yorkshire

CHAPTER 1

GENERAL INTRODUCTION

1 General introduction

1.1 Background

In 1986, the government of Vietnam abandoned the path of collectivisation of agriculture and adopted measures to liberalise the economy and to privatise agriculture (Castella and Quang, 2002). Since the start of this process, the pig production sector has been substantially developed, Vietnam's pig herd being the largest in Southeast Asia (26.6 million head, preliminary estimates for 2007), constantly growing at an average annual growth rate of 5.1% between 1995 and 2006 (GSO Vietnam, 2009). National development plans forecast an increasing market orientation and a growing demand for pork in Vietnam and therefore aim at further increasing the pig herd number to 34.7 million until the year 2020 (DLP, 2006), concentrating on the production of high-quality pigs reared in industrial production units (e.g. MARD, 2005). Nevertheless, it is estimated that 80% of the national pig population are still kept at smallholder farms (FAO, 2005), where pigs form an integral part of mixed crop-livestock farming systems (Devendra et al., 1997). Pigs perform multiple functions, including provision of income, savings and manure, and contributing to human nutrition (Valle Zárate et al., 2003), which are embedded in traits seldom traded on any market (Ouma et al., 2004; Scarpa et al., 2003b; Tano et al., 2003), thus having been widely ignored in the breeding planning in the past. Although systematic approaches to the planning of breeding have been scientifically developed in the 1960s and 1970s (e.g. Fewson, 1969; Jacubec and Fewson, 1970; Niebel and Fewson, 1979a-d), the planning of breeding for marginal production systems constitutes a relatively young approach.

Despite efforts to increase the proportion of sows from exotic breed lines, smallholder pig production in Vietnam, particularly in the north, is still mainly based on local sows such as the Mong Cai, Muong Khuong and Lang breed, sows of exotic breed lines only representing about 10% of all sows in the country (DLP, 2006). Exemplarily, Lemke et al. (2006) showed that smallholder pig production in the northern mountainous province Son La is still based on the Mong Cai (MC) and Ban breed. Due to a rapid transition process from subsistence to increasingly market-orientated pig production, local sows are predominantly mated to boars of exotic breed lines to produce fatteners that meet the

demand for lean-meat pork on urban markets (Lemke et al., 2006; Lemke and Valle Zárate, 2008). However, the carcass quality of crossbred pigs is still poorly meeting market demands as compared to pure exotic pigs, the backfat thickness of crossbred pigs in Vietnam having been reported at 26.9 mm (LW x MC) and 27.1 mm (LR x MC) compared to 20.4 and 20.9 mm for pure LR and LW pigs (Duc et al., 2002). The poor access to organised markets limits smallholders' access to information about prices and other supporting information, making their participation in markets inefficient, and increases their input and transaction costs, resulting in low output prices. The sector of public support services of smallholder farmers is underfinanced and staff often poorly qualified, thereby restricting smallholder farmers to gain knowledge to apply new production technologies (Lapar et al., 2003; Lapar et al., 2006). The majority of pig breeding systems in Son La are small private operations with the majority of the pig population being kept at small household farms (81%), while larger breeding farms providing pig breeds are absent (DARD, 1999). Furthermore, generally scarce natural resources and insecurity of resource availability characterise smallholder production systems in marginal regions of northern Vietnam and hamper the implementation of measures that target at the intensification in these systems (Devendra et al., 1997; Valle Zárate et al., 2003).

Overcoming the constraints that smallholder pig production is facing is a prerequisite to the successful integration of this sector in market-oriented pig production. One promising entry point is the development of sustainable village breeding programmes, strengthening the organisation of smallholder pig production and integrating appropriate pig breeds that can make efficient use of the limited resources and that can perform the multiple roles pigs still have for smallholder production (Valle Zárate et al., 2003). The success and long-term sustainability of such programmes depend not only on technical appropriateness, but also on the organisational feasibility under given environmental and structural conditions.

1.2 Research objectives

This study attempts to identify an appropriate design for sustainable village breeding programmes for different smallholder pig production systems, i.e. market-oriented and subsistence-oriented, in marginal mountainous areas in northern Vietnam. Based on

essential steps that have been described for the development of livestock breeding programmes for marginal areas (Valle Zárate, 1995), specific objectives of this study include

a) identifying the contribution of important pig breeding traits to the breeding objective and evaluating smallholders' breed preferences;

b) analysing existing and alternative breeding schemes with regard to their logistic and socio-cultural feasibility, costs and sustainability, i.e. robustness against changes to derive sustainable, adapted and cost-effective breeding schemes for smallholder pig producers; and

c) evaluating the organisation of pig breeding at village level, including its institutional setting to develop recommendations how to improve structures of pig breeding organisation at village level and how to link smallholder pig breeding to other breeding institutions.

These research objectives lead to the following research questions:

a) What are the most important pig breeding traits for smallholders in different production systems? Are traits perceived at an optimum level or should they be improved in future breeding programmes?

b) What are smallholders' breed preferences and which breeds should be incorporated in future breeding programmes?

c) Are existing breeding schemes economically and genetically profitable? What are promising breeding schemes?

d) How is smallholder pig breeding organised? Which organisational structures exist?

e) What are logistic determinants, i.e. the infrastructural, technological and institutional settings of smallholder pig breeding?

f) Are institutional innovations, i.e. farmer cooperatives attractive to smallholders and thus an option to support the implementation of village breeding programmes?

1.3 Study framework

This study was conducted as part of a research project on "Efficiency of smallholder husbandry depending on intensity of management and genetic potential of livestock in mountainous regions of Northern Vietnam" in the frame of the Thai-Vietnamese-German collaborative research programme on "Sustainable land use and rural development in mountainous regions of Southeast Asia" (SFB 564). The project has been implemented by the Institute of Animal Production in the Tropics and Subtropics of the University Hohenheim in cooperation with the National Institute of Animal Husbandry (NIAH) in Hanoi, funded by the German Research Council (DFG). Besides funding from the DFG, this study received funding from the Federal State of Baden-Württemberg.

The project aims at developing sustainable village breeding programmes to improve the efficiency of smallholder pig production in Son La province. In a first step of the project, a production system analysis was realised (Lemke et al., 2006). Two distinct smallholder pig production systems have been identified in Son La province, i.e. demand-driven and resource-driven. These differ in management intensity (semi-intensive vs. extensive), pig breeds used (predominance of Mong Cai vs. Ban) and farmers' production objectives (market-oriented/ income generation vs. subsistence-oriented/ saving function). The differences in the management intensity together with differing genetic potentials of pigs result in a higher productive adaptability of improved pigs in the more market-oriented production system. Yet, it is assumed that pigs do not express their full genetic potential and higher performances are expected under improved management conditions (Lemke et al., 2006). Hau (2008) confirmed this assumption, showing that reproductive and productive performances specifically of pig breeds with a higher performance potential are higher under improved management conditions.

Lemke et al. (2007) found that the use of improved genotypes yields higher revenue and gross margins in the market-oriented production system, but also concluded that the use of improved genotypes in the resource-driven production system might not be justifiable because of higher input costs, limited market access and lower market-orientation. For this type of pig production, the use of the local Ban breed seems more reasonable because of a comparatively higher benefit cost ratio. This conclusion was further underpinned by Hau (2008) who assessed a sharper decline in performances for improved Mong Cai pigs

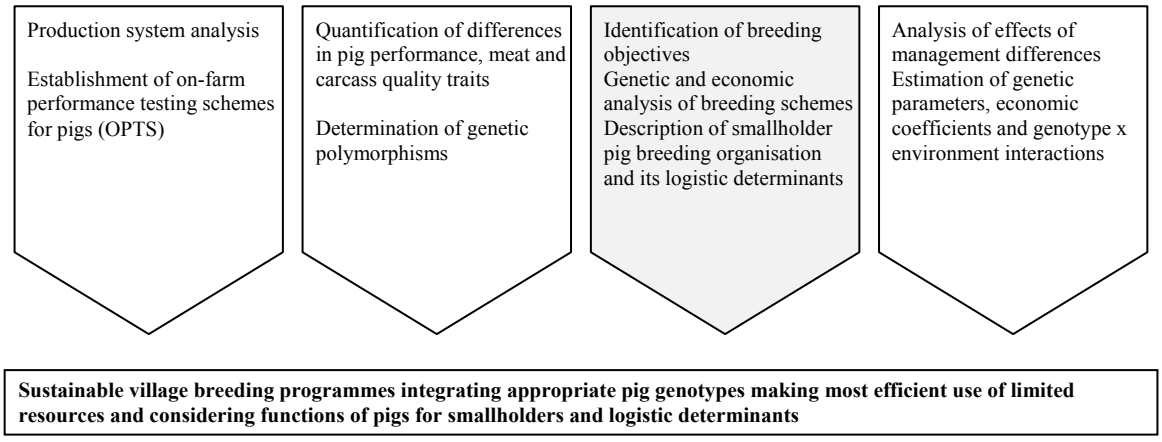
reared under resource-driven production conditions as compared to performances of the Ban under similar husbandry conditions.

In a next step of the project, on-farm performance testing schemes (OPTS) have been established in the villages to assess pig performances individually. The OPTS do not only represent a major component of a breeding programme, but also characterise the organisational structures for the formation of a pig breeding association. Currently, 236 farm households in nine villages form part of the OPTS with in total 328 breeding sows of which 35% are improved local Mong Cai sows, 42% are local Ban sows and the remaining are crossbred sows, sows from exotic breed lines and sows of undefined genetic make-up. Data on reproduction, off-take and purchase of pigs, diseases, treatments, losses, and purchase of feed and veterinary products are recorded on a bi-monthly basis, in addition to pigs' individual weight and body measures. In addition, carcass quality is assessed on sub-samples. Through comparative performance testing of the local sows and their offspring (from pure breeding and selected crossbreeding), genotypes with high productive adaptability are to be identified. Hau (2008) quantified differences in reproductive and productive performances, carcass characteristics and meat quality traits between local Mong Cai and Ban pigs.

Besides, the relationship between genetic polymorphisms at selected loci and reproductive performances was determined. Estimated performances strongly differed between the two local breeds (with the exception of some meat quality traits), Mong Cai pigs performing better than Ban pigs. The two alleles (A and B) and three genotypes (AA, AB, and BB) of the oestrogen receptor gene (ESR) were found with different allele frequencies in both breeds, significantly influencing the reproductive performances (Hau, 2008).

The present study was conducted to complement results obtained in previous studies. Together with results of an ongoing study that analyses the effects of management differences, and results of forthcoming studies that will estimate genetic parameters, economic coefficients and genotype x environment interactions. The results of the present study will support the development of sustainable pig breeding programmes by identifying breeding objectives and estimating the importance of breeding objective traits for different smallholder pig production systems, by genetically and economically

analysing existing and alternative breeding schemes for pigs and by describing the organisation and planning procedures of smallholder pig breeding at village level and its logistic determinants. The study framework is illustrated in Figure 1.



Own research is presented in the grey block arrow.

Figure 1: Key themes of the research project

1.4 Study design

The present study covered nine northern provinces, eight provinces in the delta region, comprising Hanoi, Hung Yen, Ha Tay, Hai Duong, Hai Phong, Ninh Binh, Quang Ninh and Thai Binh, and the Son La province in the north-western mountainous areas of Vietnam (Figure 2).

Main focus was in Son La province where in total nine villages were selected, differing in distance from the provincial or district capital (close, far), ethnic affiliation (Black Thai, Hmong) and production type (market-oriented, subsistence-oriented). Pig production in Ban Buon, Ban Co and Ban Bo (all Black Thai villages) is clearly driven by the market demand for lean pork. Villages are located close to the provincial capital Son La town. The Black Thai villages Na Huong and Bo Duoi are located at the hillside, relatively close to Hat Lot town, the capital of Mai Son district (3 km and 5 km, respectively). Although pig production in these villages can be considered as market-oriented, farmers still widely rely on farm resources to feed pigs. The same can be stated for the remaining two Black Thai villages Ot Luong and Ban Dau (or Giau). These are located relatively far away from Son La town (15 km) and the sloped track that connects the villages with the town is not passable year-round (Figure 3). In contrast to the Black Thai villages, pig

production in the two Hmong villages Pa Dong and Tong Tai A' is saving-oriented, clearly driven by the availability of farm resources. Villages are located in hilltop areas, relatively far away from Hat Lot town (7 km and 9 km), with a sloped track connecting villages with the town. Like for Ot Luong and Ban Dau, the track is not passable year-round (Figure 4).

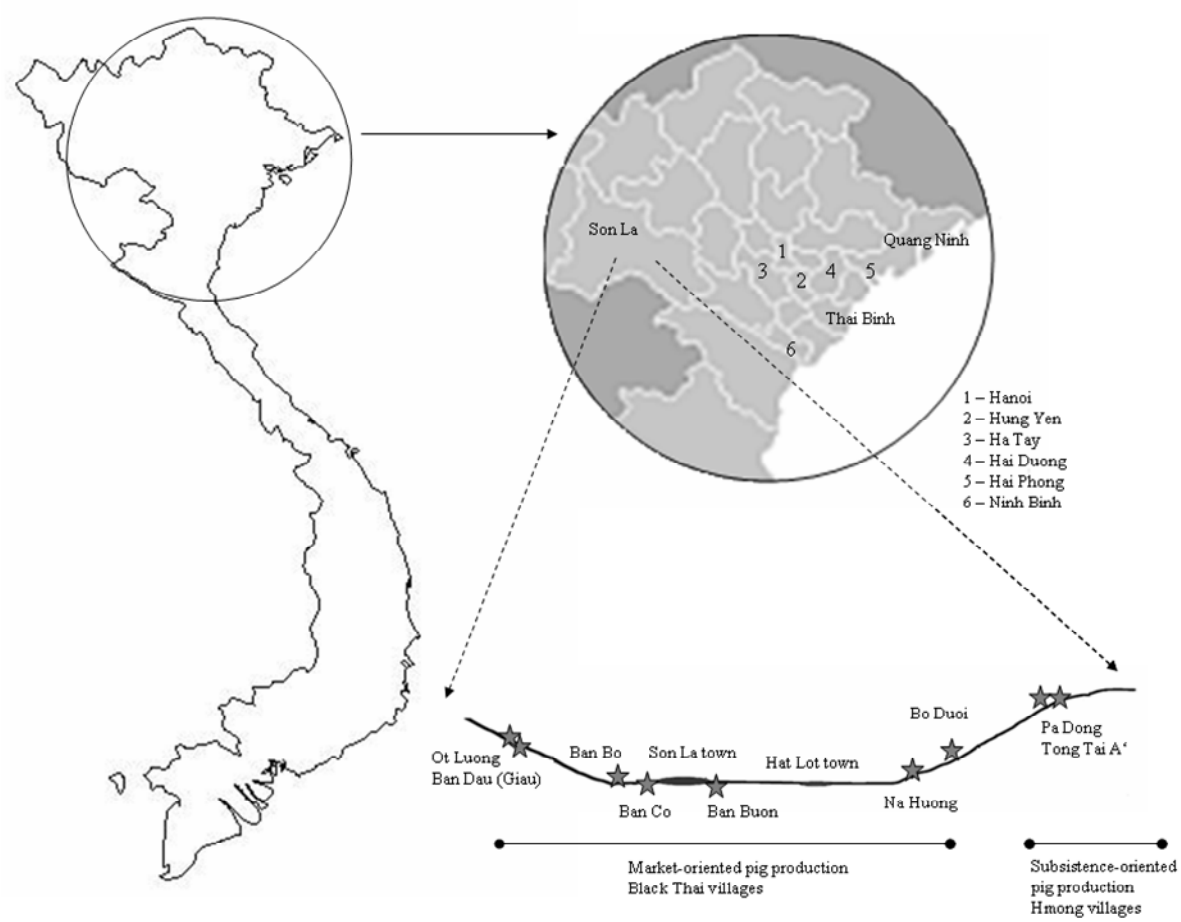


Figure 2: Map and schematic view of the study area

Figure 3: Track to Ot Luong and Ban Dau, blocked by a land slide
Rößler (2004)

Figure 4: Sloped track to Tong Tai A' at the beginning of the rainy season
Rößler (2006)

Assuming that smallholder pig breeding is not isolated but influenced by various other institutions, the survey was extended to central and local ministries, public companies, national research institutes and universities, public service providers, private boar keepers, (semi-) commercial farms, pig traders, foreign-invested companies, joint ventures and producer cooperatives in nine provinces, representing the institutional setting of smallholder pig breeding at village level.

Data collection was realised from April-September 2004, April-December 2006 and September-December 2007. Different data collection methods were used, including structured and informal interviews as well as informal group discussions. Choice experiments in form of an in-person survey instrument were used to define breeding objectives and to assess the importance of breeding objective traits. Structured interviews focused at gaining a deeper insight in smallholders' breed and trait preferences and breeding management. Models reflecting the predominant mating schemes at smallholder farms were developed, integrating data from structured interviews and information from the project's OPTS. A deterministic approach was used to assess the profitability and genetic merit of existing and alternative breeding schemes. Informal interviews and group discussions were complemented by a screening of documents, particularly legal documents regulating pig breeding and production, to provide a descriptive assessment of breeding institutions in Vietnam. The conceptual framework of the present study is illustrated in Figure 5.

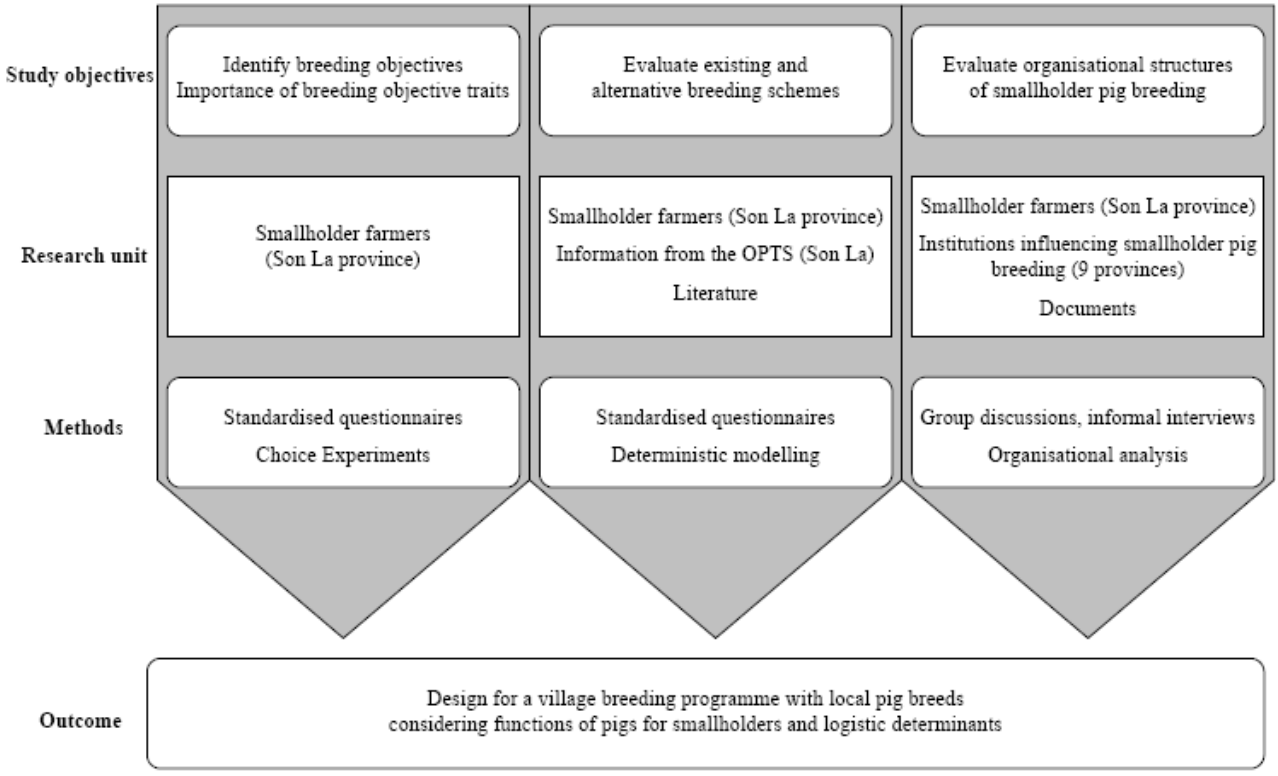


Figure 5: Conceptual framework of the overall study

1.5 Structure of the thesis

Chapter 2 (corresponding to paper I) assesses smallholders' preferences and the trade-offs for a list of adaptive and productive traits. These include growth, reproduction, disease resistance, feed requirements and appearance. A choice experiment (CE) is applied to characterise functions of pigs and to assess the importance of traits in which these functions are embedded. Besides, estimated parameters are taken to assess the importance of different local breeds, since the traits investigated in the CE differ considerably between breeds. Thus, CE can help to further clarify whether it is reasonable to integrate the local Ban breed in future breeding programs or if it is more reasonable to replace it by improved breeds.

Chapter 3 (corresponding to paper II) further investigates smallholders' breed and trait preferences approaching smallholders in structured interviews. Frequency analysis is used for data on breeding practices and breeds used, and ranking of smallholders' trait preferences is performed. Based on these data together with CE results and information from the OPTS, a basic deterministic model of the main existing breeding scheme at

smallholder farms in the villages with market-oriented pig production is developed and economically and genetically evaluated. The basic breeding scheme is adjusted to evaluate effects of higher pig performances on the genetic and economic success of the breeding scheme.

Further model calculations are performed in chapter 4 (corresponding to paper III) considering two other basic breeding schemes: a simple two-breed-crossbreeding scheme Y x B to reflect the existing breeding scheme in more remote areas and a more sophisticated stratified breeding scheme linking the different production systems and combining different breeds (Y x (MC x B)). Basic breeding schemes are adjusted restricting the body weight, putting more emphasis on reproductive than on production traits or reducing the number of breeding objective traits, respectively. Possibilities how to organise breeding and supply chains in remote areas in the uplands of Northern Vietnam are assessed, in a way to improve smallholder pig production.

Chapter 5 (representing paper IV) finally evaluates the organisational feasibility of village breeding programmes and possibilities for their integration into provincial, regional and national structures. An institutional analysis is used to provide a descriptive assessment of breeding institutions in northern Vietnam. The survey is not limited to the villages in Son La provinces, but is extended to other levels in Son La province, to other provinces and further to a desk study of legal and other documents.

Chapter 6 generally discusses the results of the different parts of the study and the methodological approaches and presents general conclusions and recommendations.

CHAPTER 2

Using choice experiments to assess smallholder farmers' preferences for pig breeding traits in different production systems in North-West Vietnam

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2 Using choice experiments to assess smallholder farmers' preferences for pig breeding traits in different production systems in North-West Vietnam

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2.1 Abstract

Livestock form key components of the livelihood strategies of many of the world's poorest people. However, despite the potential to alleviate poverty and improve food security through livestock development interventions, the lack of smallholders' participation in the planning and design of breeding programs has often been a major cause of the failure of such programs. Particularly in developing countries where livestock production is still mostly subsistence-oriented and livestock fulfil manifold functions a considerable number of livestock breeding programs have failed. The development of adequate tools to characterise these functions, bearing in mind that these are expressed only rarely in properly functioning markets, is therefore important.

This paper seeks to advance the application of such methodologies to the smallholder pig sector in Vietnam. A choice experiment was applied across 140 households involved in pig breeding in order to assess farmers' preferences and the trade-offs for a list of adaptive and productive traits. These included growth, reproduction, disease resistance, feed requirements and appearance.

The findings indicate that smallholders highly value both adaptive and performance traits, particularly in resource-driven (i.e. subsistence) production systems. Performance traits were more highly valued in the demand-driven (i.e. market-oriented) systems. These findings have implications for breeding program breed choice and breeding objectives.

2.2 Introduction

Livestock form key components of the livelihood strategies of many of the world's poorest people, with different species fulfilling different functions in the household economy (Anderson, 2003). In mountainous regions of North–West Vietnam, livestock husbandry in general and pig husbandry in particular is a major development opportunity

for smallholders under conditions of growing population density and land pressure. Yet, options for intensification in marginal areas are limited by low and unsteady resource availability. Thus attempts have to be made to increase production efficiency through improved utilisation of limited natural and household resources (capital and labour). In pig production, this implies the development of sustainable breeding programs, integrating appropriate breeds that can make efficient use of the limited resources (Valle Zárate et al., 2003). Despite the potential for improvement through indigenous breed selection, crossbreeding with exotics has been the preferred form of genetic improvement by donor and extension agencies to date. However, results in many countries have been diverse, with a significant number of such programs failing (e.g. see Ayalew et al., 2003). Such failures often result because of a mismatch between the program's breeding objectives (often focused on product outputs) and those of the smallholder (multipurpose), as well as by neglecting issues related to measures of lifetime efficiency. Mismatches arise from both limited involvement of communities in program implementation and from the difficulties inherent in accounting for many of the important non-market values and functions of livestock in smallholder systems (Ouma et al., 2004).

The development of adequate tools to assess market and non-market values of these functions, bearing in mind that these are expressed only rarely in properly functioning markets, is therefore important (Scarpa et al., 2003a).

This study attempts to assess such values across different smallholder production systems in North-West Vietnam using a choice experiment (CE) approach. It aims to define the contribution of various pig breeding traits to the breeding objective in different systems to guide the development of breeding programs and to assess the role of local breeds for such programs. Section 2 provides further background regarding smallholder pig production in Son La province, as well as to non-market animal genetic resources (AnGR) valuation tools. Section 3 covers materials and methods. Results and discussion are presented in Section 4 and implications for the development of sustainable breeding programs for different smallholder production systems are presented in Section 5.

2.3 Background information

2.3.1 Smallholder pig production in Son La province

Smallholder pig production in North-West Vietnam is not homogenous. Lemke et al. (2006) generally distinguished between demand-driven and resource-driven pig production. Pig keeping by smallholders in remote, steep hillside areas is still largely traditional. The local Ban breed is still the main breed in these resource-poor production systems. It is well adapted to the low-input management. Ban pigs are fed on available feed from the farm land are able to cope with low nutritional value of feed, with great seasonal variations and with uncertain hygienic circumstances. They also have a reputation for good disease resistance. Thus, the keeping of these pigs requires low investment and maintenance costs (Tjällden, 1999; Lemke et al., 2000). According to Lemke et al. (2000), less favourable characteristics of this breed are a high fat content (although this can be a preferred trait in rural areas) and a low lean meat ratio, besides a low growth rate and a low fertility.

By contrast, pig production in the mountain valleys is less extensive and increasingly driven by the market demand for lean pork (Lemke et al., 2006). Here, improved Vietnamese and exotic breeds have replaced the local Ban. The most important breed in terms of overall numbers in these demand-driven production systems is the improved Mong Cai. Mong Cai sows are used for crossbreeding with exotic boars to produce crossbred pigs for fattening (Tra, 2003; Lemke et al., 2006). Major advantages as compared to exotic breeds are their adaptability to local husbandry conditions and their assumed disease resistance. Their disadvantages include an unsatisfactory feed efficiency, a low growth rate and a low lean meat ratio compared to exotic breeds (Thien et al., 1996).

The most important benefits of exotic breeds as perceived by smallholders are a high productivity as a result of a good growth rate. However, smallholders are aware of the disadvantages and risks of keeping exotic breeds such as a low adaptability to local husbandry conditions and high input costs (Tjällden, 1999). Husbandry systems that are

based on high levels of capital investments and managerial skills are unlikely to be suitable for smallholder production (Preston and Murgueitio, 1992).

2.3.2 Economic valuation of animal genetic resources

The role of livestock species in traditional farming systems is often poorly understood. Many characteristics of well-adapted indigenous livestock breeds in developing countries, such as foraging capability and asset functions are not traded in any market. Thus, the difference between the market value of a particular breed and its total economic value to its owner may be large. In order to identify the importance of these benefits, non-market valuation tools are required (Scarpa et al., 2003b; Tano et al., 2003; Ouma et al., 2004).

Tano et al. (2003) argue in favour of using stated preference approaches given that many transactions do not take place in a formal market. Livestock are sometimes not traded or sold, but instead stay in the livestock-keepers' household or are passed on to other households through traditional exchange practices. Stated preference methods assess the value of such non-market goods by using individuals' stated behaviour in a hypothetical setting. In particular, CEs have been increasingly applied to the valuation of non-market livestock goods. For example, a study by Scarpa et al. (2003b) valued cattle traits in Kenya by comparing CE results with results obtained by the hedonic price method, confirming that the former is a useful tool. Scarpa et al. (2003a) conducted a CE study amongst households of backyard pig producers in Mexico in order to assess the importance of the traits that distinguish the Box Keken breed from potentially more productive, yet less adapted exotic breeds.

2.4 Material and methods

2.4.1 Study area

The study was conducted in Son La province, located in North-West Vietnam. The majority of land is mountainous, with only 13.6% covered by agricultural land. 89% of the total population live in rural areas (General Statistics Office of Vietnam, 2004).

Fieldwork was carried out from April until September 2004. Six villages covering a gradient from extensive to intensive pig production were selected for the study. The

selected villages reflect differential access to various resources and services, as well as differential breed preferences. The two Hmong villages far from town and the two Thai villages close to town represent two extremes of a continuum, from a remote, steep hillside area with subsistence-oriented pig production, adjusted to limited and unsteady resource availability, to an area in the mountain valley close to town being increasingly influenced by the market economy. The remaining Thai villages fall in-between these two extremes, with production being less resource-driven than in Hmong villages and having better access to resources and services due to a better infrastructure. The underlying assumption for choosing villages in different economic environments is that farmers' preferences for important pig breeding traits would be quite different. Future breeding programs, as well as incentives to conserve the local Ban breed, need to account for this heterogeneity in order to secure sustainability of such programs.

2.4.2 Survey approach

Data were collected by means of CEs in form of an in-person survey instrument. A total of 140 households were surveyed, of which 33 households with demand-driven pig production, 44 households with production in transition and 46 households with resource-driven production. In order to ensure a balanced selection, a set of criteria for selection of households was developed by the authors and discussed with the village heads. These criteria included household's involvement or interest in pig breeding. Others were the age, gender, years of experiences in pig breeding or production and sow breed(s) kept by the respective household. Based on these criteria the village heads were asked to select households for the survey.

2.4.3 The experimental design

Basic principles of CE trace back to the random utility theory of Thurstone (1927). The method also draws on the consumer theory developed by Lancaster (1966), which postulates that the overall utility or preference can be expressed as a function of the attributes of the good rather than the good *per se*. In the context of pig breeding, the latter permits the analysis of farmer's preferences in terms of the benefits that they expect to attain from different genetically determined traits. Hypothetical profiles are described in

terms of trait levels. Estimated parameters can be taken to assess the value of non-market, socio-economic benefits of pigs in smallholder production systems. In addition, parameters can also be taken as indicators of the value that farmers assign to different breeds, since the traits investigated in the CE differ considerably between breeds. Thus, in this CE, estimated parameters are relevant for assessing the importance of local breeds. They may help to clarify whether it is reasonable to integrate the local Ban breed in future breeding programs or if it is more reasonable to replace it by improved breeds.

Relevant attributes and levels for this study were identified with farmers during focus group discussions carried out during the development of the CE survey instrument. The six most important traits identified for female weaner piglets, the class of pig most frequently purchased for breeding, and their respective trait levels across a number of breeds/crosses are presented in Table 1. Note that given the trait level differences between breeds, the CE is designed in a way that farmer preferences for a particular trait level can be associated with a particular breed/cross even though the breed is not itself explicitly included in the individual animal profiles.

Table 1: Pig breeding traits and trait levels used in the choice experiments

Breed group / Trait	Ban	MC	MC × Ban	Exotic or Exotic Cross
Liveweight at seven months (kg)	30	60	45	75
Frequency of illness	Rarely (once a year)	Occasionally (twice per year)	Rarely (once per year)	Often (4-6 times per year)
Feed purchase requirement	No feed purchase	Protein rich feed (fish, soya)	Energy rich feed (maize, concentrate)	Protein and energy rich feed
Body conformation	Short body, snout and legs	Medium body, snout and legs	Medium body, snout and legs	Long body, snout and legs
Litter size	6-7	14	10-11	12
Purchase price of breeding piglet (VND)	15,000-16,000	25,000	18,000-22,000	28,000

VND=Vietnamese Dong (USD1=VND16,300; exchange rate as of August 1, 2004) (OANDA, 2004)
MC=Mong Cai
Note: An orthogonal design was used for making sure that all main effects are covered in the survey.

Source: Authors' survey

1) Liveweight: This trait is known to differ largely between local and exotic breeds, being highest in the latter provided that there are no dietary constraints. It is used as a proxy for the growth rate of pigs.
2) Frequency of illness: Local breeds are appreciated for their adaptive traits, especially for smallholder production conditions, and are said to be more disease resistant than exotic breeds.
3) Feed purchase requirements: The ability to consume a variety of feeds is an important attribute for pig production on smallholder farms. Pigs are mainly fed on farm produced feed resources such as maize, by-products like rice bran, and especially vegetables. Local pig breeds are well adapted to feed that is low in nutrients and sometimes scarce, while exotic, high performance breeds and their crossbreds require feed with high energy density and protein content.
4) Body conformation: Another trait perceived important by smallholder farmers is the body conformation.
5) Litter size: Without dietary restrictions, improved and exotic breeds have superior reproductive performance compared to local breeds (number of litters per year, number of piglets born alive).
6) Purchase price: Besides the replacement of sows by own progeny, the purchase of breeding piglets was essential in the households surveyed. Prices represented actual market prices at the time of the survey.

Given that four traits have four levels and the remaining two traits three levels, there are 265 (44+32) possible pig profiles in a full factorial design. These were reduced to a manageable size of 34 profiles using an orthogonal or in other words fractional factorial design (Design Expert Version 6.0.1). The design ensures the identification of the main effects with a minimum number of profile combinations. A choice set with uncorrelated attributes was then generated. Descriptive cards in English and Vietnamese with pictorial illustrations were used.

2.4.4 Data collection

After the collection of socio-economic data, each respondent was introduced to the type of choice task required. Respondents were then presented with the full set of 17 pair-wise choices (totalling 34 individual profiles). Each choice task asked the respondent to hypothetically buy for breeding one of two available animal profiles. If neither of the animal profiles was found satisfactory, the respondent could choose the 'do not buy option'. The results of 17 respondents were discarded in model estimation because of inconsistencies. Thus, a total of 2091 (123×17) observations were obtained.

2.4.5 The econometric model

The multinomial logit (MNL) model is one of the most recognized discrete choice models (Train, 2003). It assumes that each individual chooses the alternative that has the highest perceived utility. Individuals are assumed to evaluate choice alternatives on the basis of their attribute levels, finally selecting the alternative they subjectively assess to provide them with highest utility. The general model can be written as follows:

$$U_{in} = X_{in}\,ß + \varepsilon_i, j=1,2,\ldots,J_n \in C_{ns} \quad (1)$$

where n=1,…,N denotes individuals; i,j=1,…, J_n denotes alternatives; C_{ns}, s=1,…,S is the choice set faced by an individual n; Xin is a matrix characterising attributes of i,j alternatives for an individual n, ß is a conformable vector of unknown parameters, and ε_i is the error term. It is assumed that an individual n chooses amongst a given choice set C_{ns} the alternative i that maximises his/her utility.

If the error term ε_i is assumed to be independently and identically distributed with an extreme value type I distribution, the standard multinomial model applies (Louviere et al., 2000). In this case, the probability that choice Y has trait j is given by

$$\Pr(Y_i = j) = \frac{(X_{in}\,ß)}{\sum_{j \in Cns} (X_{jn}\,ß)} \quad (2)$$

Parameter estimates of the pooled model

NLOGIT 3.0/ LIMDEP 8.0 econometric software was used to estimate the basic standard MNL model (Greene, 2002). The basic model was used to estimate attribute values for smallholders across different pig production systems, and to test whether the demand for each attribute is significant. The higher this value, the more preferred the attribute level and the stronger its relative influence on respondents' choices. Attribute levels with negative estimates of β have a negative effect on utility levels, and are considered unattractive.

The maximum likelihood method is used to estimate the parameter β, maximising the log likelihood function L. The overall fit of the model can be measured by McFadden's Pseudo-R^2. The Pseudo-R^2 should be above 0.1 to accept the model, whereas a value between 0.2 and 0.4 is considered as extremely good fit (Louviere et al., 2000; Scarpa et al., 2003a, b; Schmitz et al., 2003). Furthermore, the Independence of Irrelevant Alternatives (IIA) property underlying the MNL model has been tested using the Hausman test contained within NLOGIT 3.0. The IIA property states that the ratio of choice probabilities of two alternatives is unaffected by other alternatives (Louviere et al., 2000).

Coding

Ordinal variables (frequency of illness, feed purchase requirements and body conformation) were effects-type coded. In order to avoid the so-called “dummy variable trap” (linear dependency problem by including dummy variables), one level of these attributes was omitted as a base level. Estimated coefficients for the remaining levels indicate the value farmers placed on the change from the base level to the level of higher utility. Omitted levels were: low frequency of illness, no need to purchase feed and short body, snout and legs. The reference base takes the level of utility of the negative sum of the estimated coefficients for remaining attribute levels. Estimates for the numerical variables (liveweight and number of piglets) indicate the value farmers assign to a weight increase of one kg and an increase in litter size by one piglet.

Part worth values of attributes

Part worth values reflect the relative importance respondents put on attributes, or trade-offs they are willing to make among them. If cost is included as an attribute in the CE, it is possible to estimate indirectly the willingness to pay (WTP) or willingness to accept compensation (WTAC) for all other attributes included in the study. The WTP for a certain attribute or attribute level indicates the price ("implicit price") the respondent is willing to pay for a unit increase in this attribute or the compensation he/she is willing to accept for a decrease in this attribute. The "implicit price" or part worth is calculated as follows:

$$W = -1 * \left(\frac{\beta_x}{\beta_{price}} \right) \quad (3)$$

where β_x is the estimate for the attribute x from the MNL model, and β_{price} is the estimated price coefficient. For effects-type coded attributes, the implicit price for each attribute level shows the mean WTP for a change from the excluded base level to the respective level. The mean WTP for the base level is the negative sum of implicit prices of the other levels.

2.4.6 Preference heterogeneity across different production systems

Farmers in different production systems may have different trait preferences. Where such differences in trait preferences across production systems exist, they should be considered in order to ensure an efficient design of breeding programs. To compare if parameter estimates of the pooled model are shared across the three different production systems, separate MNL models have been calculated to obtain estimates for each system. Then, four separate log likelihood ratio (LR) tests were performed to test whether trait preferences differ across production systems,

H_0: $\beta_{pool} = \beta_{dem} = \beta_{inter} = \beta_{res}$ versus

H_A: $\beta_{pool} \neq \beta_{dem} \neq \beta_{inter} \neq \beta_{res}$

where β_{pool} are the vectors of estimates for the MNL parameters from the pooled model, β_{dem} are the MNL estimates for the demand-driven, β_{inter} estimates for the transitional and β_{res} estimates for the resource-driven production system.

2.5 Results and discussion

2.5.1 Pooled model

The pooled model was used to estimate attribute values for smallholders of different pig production systems represented by the full sample, and to test whether or not the demand for each attribute is significant. Maximum likelihood parameter estimates are shown in Table 2.

Table 2: MNL estimates for smallholder farmers (all production systems)

Attribute	Coefficient	SE	p-value
Purchase price	-0.0135**	0.0050	0.0068
Performance traits			
Liveweight	0.0170**	0.0014	0.0000
Litter size	0.0444**	0.0091	0.0000
Frequency of illness			
Occasionally (twice per year)	0.5384**	0.0961	0.0000
Often (4-6 times per year)	-0.5416**	0.0354	0.0000
Feed purchase requirements			
Protein rich feed only	-0.0835	0.0662	0.2076
Energy rich feed only	0.1255	0.0672	0.0617
Protein and energy rich feed	-0.3810**	0.0390	0.0000
Body conformation			
Medium body, snout and legs	0.1083	0.0700	0.1219
Long body, snout and legs	0.0494	0.0384	0.1981
Ln-Likelihood		-1807.845	
Pseudo-R^2		0.21	
N of observations		2091	

** p<0.01; SE=Standard error

Purchase price per kg in Vietnamese Dong (divided by 1,000): (1) VND15,000; (2) VND20,000; (3) VND25,000; (4) VND28,000; Liveweight at seven months: (1) 30 kg, (2) 45 kg, (3) 60 kg, (4) 75 kg; Litter size: (1) 6 piglets, (2) 10 piglets, (3) 12 piglets, (4) 14 piglets; Frequency of illness (baseline 'rare'); Need to purchase feed (baseline 'no need to purchase feed'); Body conformation (baseline 'short body, snout and legs')

Source: Authors' survey

Results of the Hausman test showed that the IIA property is not violated. The overall explanatory power of the model is good with a Pseudo-R^2 of 0.21.

Based on the parameter estimates, implicit prices of the traits and their different levels were derived using Eq. (3). Implicit prices for estimates of the standard MNL model are given in Table 3.

Table 3: Implicit prices for attribute and attribute levels (full sample)

Attribute	Implicit price (VND)	SE (VND)	p-value
Performance traits			
Increase in liveweight (per kg)	1,300**	500	0.0056
Increase in litter size (per piglet)	3,300**	1,000	0.0027
Frequency of illness [a]			
Rarely (once per year)	200	-	-
Occasionally (twice per year)	40,000*	17,600	0.0229
Often (four to six times per year)	-40,200**	14,000	0.0050
Feed purchase requirements [a]			
No need to buy feed	25,200	-	-
Buy protein rich feed	-6,200	4,900	0.2002
Buy energy rich feed	9,300	6,500	0.1529
Buy protein and energy rich feed	-28,300**	10,600	0.0074
Body conformation [a]			
Short body, snout and legs	-11,700	-	-
Medium body, snout and legs	8,000	6,100	0.1849
Long body, snout and legs	3,700	3,100	0.2438

N of observations: 2091; * $p<0.05$; ** $p<0.01$; SE=Standard error;
USD1=VND16,300; exchange rate of 1st August, 2004 (OANDA, 2004), rounded at 100
[a] Prices of the baseline level are given as the negative sum of implicit prices of the other attribute levels.

Source: Authors' survey

Results of the pooled model indicate that smallholders highly value both adaptive traits (frequency of illness and feed requirements) and performance traits (liveweight and litter size) when considering purchasing pigs for breeding. Similar importance of adaptive traits in conjunction with performance traits has been reported by Scarpa et al. (2003a) for backyard pig production in Mexico, by Ouma et al. (2004) for cattle production in Kenya and Ethiopia, and by Tano et al. (2003) for adaptive traits in cattle production in West Africa.

Coefficients of the price and performance traits are statistically strongly significant and have expected signs. The price coefficient is negative, implying that smallholders prefer

cheaper animals. Liveweight and litter size both have a positive sign, indicating that smallholders prefer breeds with good growth performance and good reproductive potential, both being closely related to exotic breeds and the Mong Cai. Additional piglets are valued at VND3300 each and additional liveweight at VND1300/kg (USD1=VND16,300). The latter seems to be underestimated as cost-benefit analyses suggest a net benefit of VND4300 per kg liveweight (Lemke et al., 2007).

A high frequency of illness shows an estimate with a high negative value and strong significance. This indicates that smallholders dislike animals susceptible to diseases, such as exotic breeds are supposed to be, as they imply a high production risk through animal losses. This is reflected in a highly negative value for susceptible breeds (−VND40,200). Lemke et al. (2007) estimated total veterinary costs at VND45,000 per household and year. Interestingly, a change from 'rarely ill' to 'occasionally ill' is valued at approximately VND40,000, implying that smallholders would be willing to pay this sum for a change between these trait levels (see Table 3). One explanation may be that smallholders tend to associate this trait level with the improved Mong Cai breed, that is preferred in the demand-driven and transitional production systems. Compared to other costs, veterinary costs only account for a small proportion of variable costs associated with pig breeding (Lemke et al., 2007). Breeds requiring supplementary feed and thus high monetary input for the purchase of feed, traits closely related to exotic breeds, are also disliked by smallholders. This result is not surprising, given that feed costs represent the bulk of variable cash costs for smallholder pig production in that area, accounting for more than 84% of variable costs (Lemke et al., 2007). This strong reluctance to buy supplementary feed (both protein and energy rich feed) is revealed by a high negative value of −VND28,300 (see Table 3). Non-significance of the remaining levels of this attribute ('need to buy protein rich feed only' and 'need to buy energy rich feed only') may be explained through the fact that smallholders in investigated villages use only small amounts of soybean, fish or concentrate feed as pig feed (Lemke et al., 2006), while farm-produced maize constitutes one of the most important feedstuff for pigs (Tra, 2003).

The body conformation *per se* of the animal tends to be less important than other traits. Non-significance of coefficients may arise from the complexity of this attribute.

However, it can be stated that farmers prefer medium animals (more closely associated with Mong Cai) to large animals (more closely associated with the exotic breeds). Such a preference is clearly compatible with their desire to combine both productive and adaptive traits.

2.5.2 Preference heterogeneity across different production systems

Maximum likelihood parameter estimates

Ouma et al. (2004) and Scarpa et al. (2003a) note that trait preferences are influenced by various factors including the production system, infrastructural and environmental constraints and availability of feed resources. This preference heterogeneity between different smallholder production systems in North-West Vietnam is also visible, as the log likelihood ratio test rejects the null hypothesis that regression parameters are equal for different production systems. Further log likelihood ratio tests for pair-wise comparison of parameters obtained for the different production systems show that farmers from each production system had different preferences for breeding traits. Estimates are shown in Table 4. The Pseudo-R^2 of the demand driven-system is relatively low as compared to the Pseudo-R^2 of the two other systems. Since the attributes are the same for all three models, the low Pseudo-R^2 suggests that attributes do not equally well reflect each of the three production systems and that other breeding attributes which were not included in the study (e.g. lean meat, body size) may also be important characteristics of breeding sows for smallholders in this production system. Another possible explanation is the rather small number of observations for this production system.

The price coefficient is only significant for the demand-driven production system, while for the other two systems, the price seems to have a low rank in farmers' trait preferences, the coefficient for the resource-driven production system even being positive. In the latter, smallholders seem to consider higher purchase prices as beneficial since it shows that the animal has a high value and good quality. The low rank preferences for the price by smallholders in both, the transitional and resource-driven production system may be due to the fact that pigs still perform traditional roles. A high relative liveweight has the expected positive sign for all sub-samples and is strongly significant, implying that

heavier animals fetch a higher market price. A good reproductive performance has a positive effect for smallholders in different production systems, however, this trait is not significant for the system in transition.

Table 4: MNL estimates of smallholder preferences in different production systems

Production system	Demand-driven		In transition		Resource-driven	
Attribute	Coefficient	SE	Coefficient	SE	Coefficient	SE
Purchase price	-0.0431**	0.0988	-0.0127	0.0107	0.0116	0.0088
Performance traits						
Liveweight	0.0170**	0.0027	0.0416**	0.0034	0.0084**	0.0022
Litter size	0.0357*	0.0173	0.0364	0.0196	0.0694**	0.0160
Frequency of illness						
Occasionally	0.1832	0.1239	1.9090**	0.3414	0.3759	0.2263
Often	-0.4692**	0.0704	-1.0715**	0.0842	-0.4426**	0.0582
Feed purchase requirements						
Protein rich feed	0.0460	0.1087	0.3021*	0.119	-0.5330**	0.1570
Energy rich feed	0.1121	0.1119	0.2887*	0.1280	-0.0371	0.1559
Protein and energy rich feed	-0.1842*	0.0750	-0.1523	0.0809	-0.7003**	0.0654
Body conformation						
Medium	0.0146	0.1111	0.4272**	0.1286	0.0326	0.1696
Long	-0.0180	0.0770	0.2609**	0.0858	-0.0658	0.0603
Ln-Likelihood	-548.069		-523.496		-536.471	
Pseudo-R^2	0.11		0.36		0.38	
N of observations	561		748		782	

* p<0.05; ** p<0.01; MNL=multinomial logit; SE=Standard error; Ln-Likelihood=Lognormal Likelihood
Purchase price per kg in Vietnamese Dong (divided by 1,000): (1) VND15,000; (2) VND20,000; (3) VND25,000; (4) VND28,000; Liveweight at seven months: (1) 30 kg; (2) 45 kg; (3) 60 kg; (4) 75 kg; Litter size: (1) 6 piglets; (2) 10 piglets; (3) 12 piglets; (4) 14 piglets; Frequency of illness (baseline 'rare'); Need to purchase feed (baseline 'no need to purchase feed'); Body conformation (baseline 'short body, snout and legs')

Source: Authors' survey

Estimates obtained for the full sample suggest that another important pig breeding trait is a low frequency of illness. Subsample coefficients support this result. The coefficients for a high frequency of illness are negative and strongly significant in all three sub-samples. Estimates for the level 'occasionally ill' are again positive for all systems, but only significant for pig production in transition. Estimates for the level 'need to purchase protein and energy rich feed' have the expected negative sign across all systems, but are only significant for the resource-driven production system (p<0.01) and the demand-

driven production system ($p<0.05$). For resource-driven pig production, adaptability to a fibre-rich diet is the most important trait for pig breeds. Farmers refuse breeds requiring high monetary inputs for feed. Accordingly, estimates for all attribute levels are negative and, except for the 'need to purchase energy rich feed', highly significant. Estimates for body conformation obtained by the restricted models differ from that of the full sample. However, estimates are again not significant, suggesting that this attribute does not have a strong influence on respondents' choices. An exception is the transitional system for which the appearance is highly significant, indicating that smallholders prefer big and long animals. As pig production in this production system is increasingly targeted at the urban market, smallholders just started to keep breeds with exotic appearance, i.e. bigger and longer body than the local Ban breed.

Implicit prices (demand-driven production system)

Implicit prices for estimates of the restricted MNL model for the demand-driven production system are given in Table 5. A similar analysis could not be conducted for resource-driven and transitional systems as estimated price coefficients were not significant in either of them. The assessment of trait preferences in these systems will therefore require further studies to generate a higher number of observations and eventually using alternative approaches. However, it can be stated that for resource-driven smallholder pig production, adaptability to a fibre-rich diet tends to be the most important trait for pig breeds. Farmers refuse breeds requiring high monetary inputs for feed, probably due to the fact that the income level of smallholders in remote hillside areas is rather low, infrastructure for feed delivery is poorly developed and so is the accessibility to markets.

Table 5: Implicit prices for attribute and attribute levels, restricted sample for demand-driven production system

Attribute	Implicit price VND	SE VND	p-value
Performance traits			
Increase in liveweight (per kg)	3,900**	900	0.0000
Increase in litter size (per piglet)	8,300*	3,500	0.0177
Frequency of illness [a]			
Rarely (once per year)	6,700	-	-
Occasionally (twice per year)	4,200	3,100	0.1727
Often (four to six times per year)	-10,900**	2,500	0.0000
Feed purchase requirements [a]			
No need to buy feed	700	-	-
Protein rich feed	1,000	2,600	0.6816
Energy rich feed	2,600	2,800	0.3476
Protein and energy rich feed	-4,300*	1,900	0.0250
Body conformation/ outer appearance [a]			
Short body, snout and legs	-2,980	-	-
Medium body, snout and legs	3,400	2,600	0.8958
Long body, snout and legs	-420	1,800	0.8151

N of observations: 561; * p<0.05; ** p<0.01; SE=Standard error;
USD1=VND16,300; exchange rate of 1st August, 2004 (OANDA, 2004), rounded at 100
[a] Prices of the baseline level are given as the negative sum of implicit prices of other attribute levels.

Source: Authors' survey

In the demand-driven production system, productive and reproductive performance are the most preferred pig breeding traits, while the importance of adaptive traits is smaller as compared to the preferences of the full sample. The economic value of reproductive potential (VND8300/piglet) and growth potential (VND3900/kg) are approximately three times higher than the values of the full sample (VND3300 and 1300, respectively; cf. Table 3). Such findings are compatible with the stronger market-orientation of demand-driven smallholder pig production that has previously been described by Lemke et al. (2006).

By contrast, disease resistance (-VND10,900 to avoid frequently ill animals) and -VND4300 to avoid all feed purchase are approximately 4 and 6 times less than for the full sample, respectively (-VND40,200 for illness and -VND28,300 for feed, cf. Table 3). This suggests that demand-driven pig farmers have much less concern about incurring

veterinary and feed costs (including overcoming feed shortages), as this investment can be made up through higher outputs. Lemke et al. (2007) report that total veterinary costs equal VND45,000 per household and year in the area of investigation, smallholders in resource-driven systems paying fees more than 10 fold higher than in systems closer to town because of higher transport costs.

2.6 Implications for the development of village breeding programs

The lack of smallholders' participation in the planning and design of livestock breeding programs has been a major cause of the failure of such programs. Particularly in developing countries where livestock production is still mostly subsistence-oriented and livestock fulfil manifold functions, farmers' participation is essential for the development of sustainable breeding programs (Valle Zárate, 1996). In order to determine traits to be improved and breeds to be integrated into future village breeding programs, this paper has quantified smallholders' trait preferences through the use of CEs.

In terms of relative values, it is clear that adaptive traits (disease resistance and adaptability to a fibre-rich diet) are highly ranked by smallholders in resource-driven production systems. Farmers in this production system would clearly benefit from any breed improvement program maintaining and further developing adaptation and from management interventions that focus on reducing disease challenge and using local feed and balanced rations. Given the limitations to fully analyse the transition and resource-driven sub-samples in the present study, the question of whether it is reasonable to integrate the local Ban breed into future village breeding programs or whether to replace it by improved, yet well-adapted breeds, cannot yet be answered conclusively. However, smallholders' trade-offs between important pig breeding traits in the resource-driven production system suggest that further integration of the Ban breed in this system would seem to be useful.

By contrast, breeding programs for demand-driven production systems should concentrate much more on productive traits, while maintaining adaptive and functional traits. The Mong Cai breed will therefore be most appropriate in this production system. Management interventions will be most beneficial when focused on increasing output.

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CHAPTER 3

Modelling of a recording scheme for market-oriented smallholder pig producers in Northwest Vietnam

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3 Modelling of a recording scheme for market-oriented smallholder pig producers in Northwest Vietnam

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3.1 Abstract

Village breeding programmes are being developed by an integrated long-term project for smallholders in Northwest Vietnam to improve pig production in different production systems. In total, 120 smallholders with 169 sows in 5 of the 9 project villages were approached in single person interviews, using a structured questionnaire. Frequency analysis of data on breeding management and ranking of smallholders' trait preferences and selection criteria used for pigs were performed with SAS 9.1, using the FREQ procedure. Survey results indicate that both improved local breeds and exotic genotypes should be incorporated in future village breeding programmes for market-oriented smallholder pig production, improving the reproductive and growth performance as well as the carcass quality. In a next step, a model reflecting the status quo at farms with market-oriented pig production was developed integrating data from farmers' survey and information from the project's current recording scheme. A deterministic approach was used to assess the profitability and genetic merit of the current recording scheme. Modelling results show that the current recording scheme is unprofitable (-33.90 € sow^{-1}). As continued success of village breeding programmes depends on the profitability of breeding measures, the long-term sustainability of the current recording scheme seems unlikely. Genetic gains are achieved in production and carcass quality traits, while a small reduction in reproduction traits can be observed. In a last step, possible effects of increased pig performances on the profitability and genetic merit of the current recording scheme were evaluated. Effects of increased pig performances on the genetic and economic success of the recording scheme are generally limited. Further model calculations are necessary for finding possibilities to improve smallholder pig breeding in a profitable way.

3.2 Introduction

Pig production in Vietnam is expanding at a rapid pace with an average annual growth rate of 5.3% for the period 1995-2005 (GSO Vietnam, 2007). According to the Vietnamese Ministry of Agriculture and Rural Development, the national pig herd will continue to grow from nearly 27 million head (2006) to 33 million head in 2010. Today pork represents 77% of the total meat produced in Vietnam (2.3 million tons in 2006) (GSO Vietnam, 2007). Production is expanding all over the country, boosted by national and international investments. The national government has been strongly promoting the pig production development by releasing a series of policies, targeting industrialisation and modernisation of pig production. Nonetheless, it is estimated that still 80% of the national pig population are kept at smallholder farms (FAO, 2005). In contrast to farms in southern Vietnam where exotic pigs are gradually replacing local breeds, smallholder pig production in the north, particularly in mountainous areas, is still mainly based on local sows. These are mated to exotic boars in order to meet the demand for lean pork. However, the growth rate and carcass quality of crossbred pigs remain poor as compared to exotic breeds. Growth rates of crossbred pigs have been reported at 404 g day^{-1} (19 to 67.5 kg live weight) (Hang, 1998) and 200 g day^{-1} (age 60 to 180 days) (Lemke et al., 2006) and backfat thickness at 3.03 cm (Hang, 1998).

One key entry point to improve smallholder pig production is the development of village breeding programmes. Such breeding programmes have to integrate appropriate pig breeds that can make efficient use of the limited resources and that can perform the multiple roles pigs have for smallholder production (Valle Zárate et al., 2003), besides targeting profit maximisation and improvement of production traits. Therefore, procedures for planning of breeding have to be adjusted to the specific conditions of smallholder pig production with low and unsteady resource availability. The aim of the present study is to evaluate the current recording scheme for market-oriented smallholder pig producers. Evaluation criteria are the annual genetic gain of breeding objective traits and the discounted profit. In a subsequent study, alternative breeding scenarios will be evaluated and compared with the main recording scheme evaluated in this study. Results will support the development of village breeding programmes that are planned to be

implemented in villages in Son La province, Northwest Vietnam, by deriving recommendations for alternative breeding programmes.

3.3 Materials and methods

The bases of this study were numerous interviews conducted in Vietnam and the existing recording scheme implemented on smallholder farms. Information and data from the recording scheme and from the interviews were used to derive a model of the recording scheme. This model was economically and genetically evaluated. In a last step, the model was modified to evaluate possible effects of increased pig performances on the economic and genetic success of the recording scheme.

In the following, the recording scheme and methods used to conduct and analyse the interviews are described. Then the developed model is illustrated, giving an overview about the method and input parameters used.

Existing recording schemes

Research was conducted in the frame of the Uplands Programme, a Thai-Vietnamese-German collaborative research programme. One of the projects in the programme aims at the development of village breeding programmes for different smallholder pig production systems in the Son La province in Northwest Vietnam, i.e. for market-oriented and resource-driven production systems. Production systems differ in distance to towns and markets, resource availability, distribution of pig breeds and production intensity. A detailed description can be found in Lemke et al. (2006). The project has established recording schemes on 177 smallholder farms in a total of 7 villages. Local Mong Cai (MC) and Ban sows are distributed to farmers and make up the female side of the different mating schemes. Through comparative performance testing of the local sows and their offspring (from pure breeding and selected crossbreeding), genotypes with high productive adaptability are to be identified. The main mating scheme at the project farms with market-oriented pig production is crossbreeding between MC sows and Yorkshire sires, besides pure breeding of the MC breed. Data on reproduction, off-take and purchase of pigs, diseases, treatments, losses, and purchase of feed and veterinary products are continuously recorded, in addition to pigs' individual weight and body measures.

Survey in the project villages

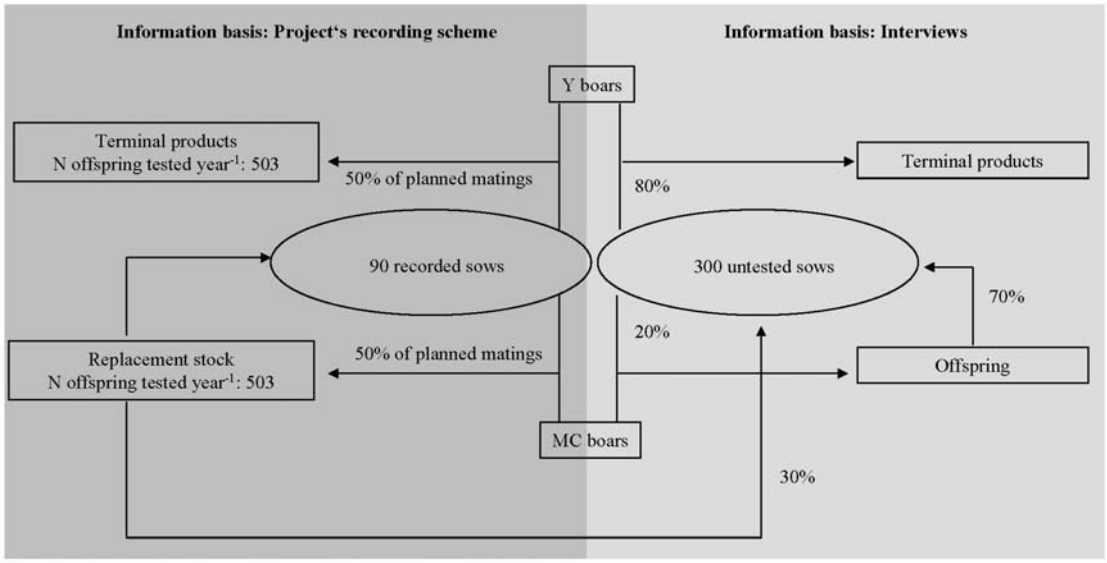
In addition, a survey was conducted in five project villages with market-oriented pig production. In total, 120 smallholders with 169 sows were approached in single person interviews. A structured questionnaire was used to obtain data on the pig herd, smallholders' breeding management, as well as on smallholders' breed and trait preferences, and selection criteria. Smallholders were asked for which traits they prefer a certain sow and boar genotype and to state if they consider a number of predefined traits to be good (=1), average (=2) or poor (=3) for the specific breed or if they do not consider the trait (=4) for this breed. Predefined traits are listed in Figure 7 and Figure 8. The FREQ procedure of the statistical package SAS 9.1 (SAS Institute, Cary, NC) was used for frequency analysis of smallholders' breeding management, trait preferences and selection criteria for pigs. Village and breed differences were evaluated by chi-square test or Fisher's exact test, when the first test was not valid due to low numbers in some cells.

Modelling the existing recording scheme

In a next step, the current main recording scheme of market-oriented smallholder pig producers was modelled and evaluated by a deterministic approach, using the computer programme ZPLAN, Version Z10 (Willam et al., 2008). Based on genetic, biological and economic parameters the annual genetic gain for the breeding objective as well as for single traits and the discounted profit sow^{-1} in the population was calculated for a given investment period by subtracting discounted breeding costs from discounted returns, combining selection index and gene flow methodologies (Hill, 1974; McClintock and Cunningham, 1974). It was assumed that parameters remain unchanged and only one round of selection is considered. Decreased genetic variance due to further selection rounds and inbreeding were ignored. An overview about the costs that incurred for the current recording scheme is also given in Table 6, specified together with their average time of occurrence. Costs were divided into fixed and variable costs associated with selection and breeding. The variable costs are directly related to performance and pedigree recording and only apply to the group of recorded sows and their offspring. The costs were discounted at 2%, and returns at 3%. The investment period was assumed to be 10 years.

Based on the information from the interviews and the project's recording scheme at market-oriented smallholder pig farms, two breeds were considered for the model: the MC as sow breed and the Yorkshire (Y) and MC as boar breeds (Figure 6). Assuming that three quarters of the 681 farm households in the investigated villages keep an average of 1.4 breeding sows and that nearly 60% of these sows belong to the MC breed (also cp. Table 8), the total population of MC sows is 390. The current recording scheme includes 12 boars, 6 MC and 6 Y boars that have been distributed by the project. MC sows are further divided into two groups: the groups of sows that are performance tested by the project (recorded sows) and sows that are not performance tested (untested sows). In accordance with the number of performance tested sows in the project at the time of data collection, the number of recorded sows was set to 90. Thus, the number of untested MC sows used by farm households not participating in the project, amounts to 300 sows.

In the investigated villages, main activities of smallholders include the production of crossbred slaughter animals and selection of purebred MC female breeding stock. According to the project's recording scheme, half of the recorded sows are mated by Y and half by MC boars. For untested sows, the same proportions are 80% and 20%, respectively (cp. Figure 9; results). Genetic gain generated in the group of recorded sows is transferred to the group of untested sows, 30% of replacement stock in the group of untested sows originating from the group of recorded dams. Figure 6shows the general flow chart of the current main recording scheme on farms with market-oriented pig production.



MC=Mong Cai; Y=Yorkshire
See text for a detailed description.

Figure 6: General flow chart of the modelled recording scheme

For the respective MC populations, Hau (2008) calculated 2 litters year^{-1} with an average number of piglets born alive of 9.4 litter^{-1} and an average number of piglets weaned of 8.0 litter^{-1}, resulting in a piglet survival rate of 0.85 until weaning. 70% of the progeny are performance tested, bringing about 503 crossbred and 503 pure tested offspring per year.

According to Roessler et al. (2008), breeding programmes for market-oriented smallholder pig production in Northwest Vietnam should concentrate on the improvement of production traits, while maintaining reproduction rate and adaptation to farm-produced feed. Results of the present study largely support this statement, yet indicating that the reproductive performance of sows should be further improved (Figure 7 and Figure 8; results). A simple breeding objective was defined, considering a limited number of production and reproductive traits, as well as carcass quality traits, reflecting traits of economic importance for market-oriented smallholder pig production. The overall goal is to improve production, carcass quality and the reproductive performance.

Table 6: Selected variables used in the basic breeding programme

Biological-technical parameters		
Average productive lifetime of sows (years)		3.5
Average productive lifetime of boars (years)		2.0
Average age at birth of first offspring (years)		1.0
Average number of piglets born alive (piglets)		9.4
Farrowing interval (years)		0.5
Weaning rate (year^{-1})		0.85
Genetic superiority of Y sires in ADG		0.30 σ_A
Genetic superiority of Y sires in BF		-0.36 σ_A
Genetic superiority of MC sires in ADG		0.15 σ_A
Genetic superiority of MC sires in BF		-0.17 σ_A
Fixed breeding costs (year^{-1}) (€)		
Staff salary (data entry)		2,400
PigChamp software licence		450
Rent rooms		1,800
Variable costs	**Occurrence (years)**	**Euro (€)**
Average costs of recording (sow^{-1}) (30% of salaries) [1]	1.0	19.00
Average costs for measurement/ weighing (piglet^{-1}) (70% of salaries) [1]	0.2	4.16
Purchase costs of boars (per boar^{-1})	0.6	100.00
Costs for artificial insemination	0.6	1.53
Costs for natural mating service	0.6	2.05

Y=Yorkshire; MC:=Mong Cai; ADG=average daily gain; BF=backfat thickness; σ_A=genetic standard deviation

[1] Calculation basis: Staff salaries for measurements and recording data in the field plus farmers' compensation (totalling 475 Euro month^{-1}); 90 recorded sows and 1006 tested offspring year^{-1}

Index equations were constructed and solved in ZPLAN. The user has to specify the breeding objective traits and selection criteria, their economic values, phenotypic standard deviations, genetic and phenotypic correlations and heritabilities. Selection criteria were chosen to represent the traits that are recorded in the recording scheme implemented at farms in the investigated villages. They include average daily gain (ADG), backfat thickness (BF), number of piglets born alive (NBA) and the farrowing interval (FARROW). Genetic standard deviations, economic weights per genetic standard deviation, heritabilities, genetic and phenotypic correlations among traits in the selection index are given in Table 7. Ideally, estimates for genetic and phenotypic parameters should be derived from the respective populations used in the breeding programme. As

these were not yet available for the populations under investigation, estimates were derived from literature (Ducos and Bidanel, 1996; Hermesch et al., 2000; Holm et al., 2004; Peskovicova et al., 2002; Serenius et al., 2004a; Serenius et al., 2004b; Serenius and Stalder, 2005; Tholen et al., 1996a) and, where possible, from studies with MC pigs (Duc, 1999; Van and Duc, 1999). The economic weight for NBA was defined based on results of Roessler et al. (2008). Economic weights for the other traits were then chosen in a way to put more emphasis on NBA and FARROW as compared to ADG and BF, with about 34.5% of the economic weight being on NBA, 24.9% on FARROW, 22% on ADG and 18.6% on BF.

Table 7: Genetic standard deviations (σ_A), economic weights (w, in €) per σ_A, heritabilities (h^2), genetic (below diagonal) and phenotypic (above diagonal) correlations among traits in the selection index

Trait	Unit	σ_A	w * σ_A	h^2	FARROW	NBA	ADG	BF
FARROW	day	7.2	-0.14	0.10		0.10	-0.00	-0.00
NBA	piglet	**0.4**	0.20	**0.10**	0.00		0.00	0.02
ADG	g day^{-1}	**25.5**	0.13	**0.50**	0.00	-0.05		0.40
BF	mm	**2.1**	-0.11	**0.45**	-0.10	0.05	**-0.20**	
BW	kg	2.5	0.00	0.30	0.00	0.00	0.00	0.10

For trait abbreviations see text. Bold figures: values for Mong Cai populations.

For each selection group, the available information sources and selection criteria were defined. The selection index for the group of recorded sows included all four traits. Replacement stock is selected on the individual performance (ADG and BF). The information sources also include available records of ADG and BF of five full-sibs, as well as records of the reproduction (FARROW, NBA) of the dam, for both traits two repeated measurements were assumed. Both Y and MC boars were purchased from large breeding farms in other provinces and no exact information about their genetic potential (e.g. breeding values) was available. Although it can be assumed that both boar breeds have a higher genetic potential for ADG and BF than the MC sows and that Y boars have a higher genetic potential than MC boars (Table 6), their contribution to the genetic gain was not considered for the evaluation of the recording scheme. Annual genetic gains and annual monetary genetic gains were therefore only calculated for the MC sows. Untested sows are selected by physical appraisal on their exterior and body condition (healthy and

strong), being strongly correlated to the body weight (BW). Due to a low genetic correlation of BW with BF, correlated genetic gain for this trait can be expected.

Increased pig performances may have a positive effect on the profitability and genetic success of the current recording scheme for smallholder pig production in the study area, since an increased farrowing and rearing performance reduces replacement rates and consequently leads to higher selection intensities. Thus, following simulation scenarios by Lemke and Valle Zárate (2008), pig performances were increased to 10.5 piglets born alive litter^{-1} and 2.2 litters year^{-1}, reducing the piglet mortality to 5% to evaluate possible effects of increased pig performances on the profitability and genetic success of the current recording scheme.

3.4 Results and discussion

3.4.1 Survey results: Farmers' breed and trait preferences

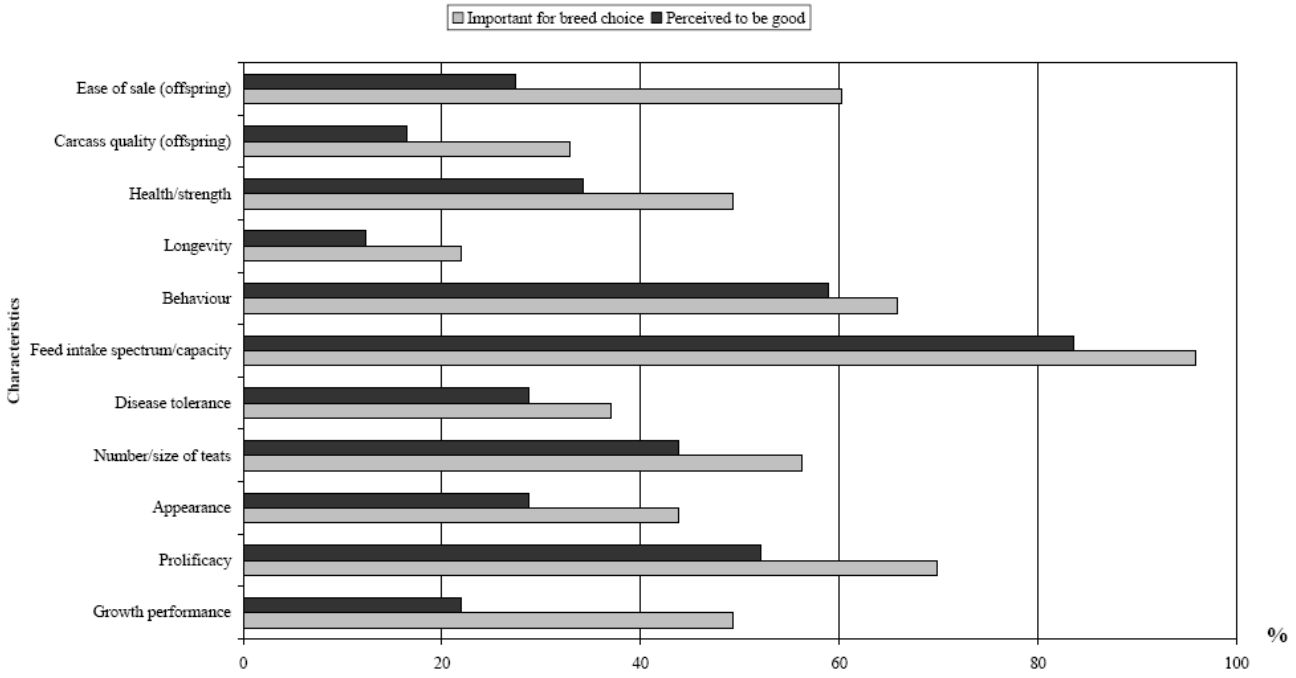
Most smallholders in the market-oriented production system used improved sow genotypes, i.e. the improved Vietnamese MC breed (60%) or exotic genotypes (26%), albeit with considerable differences between villages, giving ranges from 40% to 81% for the MC and from 6% to 51% for exotics (Table 8). These differences may be explained by the farmers' attitude to follow a "trial-and-error" approach, repeatedly changing the breed used for breeding, to find the most appropriate pig breed being well adapted to the local conditions (limited feed resources, low labor input, climatic and housing conditions).

Table 8: Sow breeds kept at smallholder farms (by village)

Village		Ban Bo	Ban Buon	Ot Luong	Na Huong	Bo Duoi	Total
Interviewed hh	N	29	23	23	27	18	120
Sows	N	36	37	26	44	27	169
Mong Cai	%	80.6	73.0	46.2	39.5	55.6	59.2
Ban	%	13.9	5.4	46.2	9.3	7.4	14.8
Exotic genotypes (exotic breed lines & their crosses)	%	5.6	21.6	7.7	51.2	37.0	26.0

hh=households; village differences significant at χ^2=18.56 ** (Mong Cai sows); χ^2=25.09 ** (Ban sows); χ^2=28.55 ** (exotic genotypes)

Smallholders preferred the MC breed for the spectrum of feed intake, including locally produced feed, and its feed intake capacity (96%), as well as for its prolificacy (70%). A considerable number of smallholders, however, wanted the latter to be improved, with only 52% of smallholders perceiving this characteristic to be good (Figure 7).



73 respondents; multiple answers were possible

Figure 7: Smallholders' trait preferences for Mong Cai sows

Smallholders preferred exotic boar genotypes, because these showed a good growth performance (84%) and their offspring were easier to sell (93%). Given the proportions of smallholders perceiving the growth rate and the carcass quality of the offspring to be good (51% and 73%, respectively) (Figure 8), both traits should, however, receive proper attention in future breeding programmes. Crossbreds' improved marketing chances are due to a higher lean meat content in the carcasses, their lean meat percentage ranging between 40.3% and 42.1% (Hang, 1998) compared to percentages between 35.4% and 39.2% for the two MC lines MC_{3000} and MC_{15}, respectively (Duc et al., 2006).

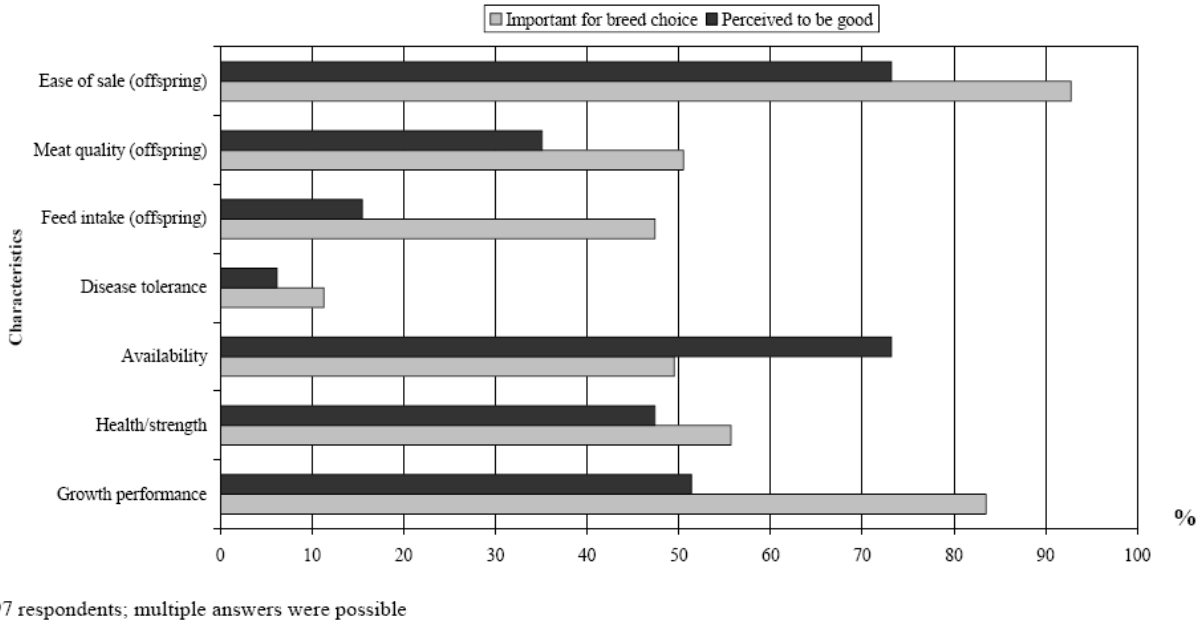


Figure 8: Smallholders' trait preferences for exotic boars

In line with their trait preferences, smallholders considered the adaptability to local feed (overall ranking ranging from 0.17-0.36) as the most important selection criterion for female breeding stock, besides the exterior and the number and size of teats (Table 9). Lemke et al. (2000) also reported that Thai farmers in northern Vietnam considered specific selection criteria for their pigs, such as feed consumption, size, health, beauty, condition, body conformation, and number of teats.

Table 9: Characteristics used to select female breeding stock (by village)

Village		**Ban Bo**		**Ban Buon**		**Ot Luong**		**Na Huong**		**Bo Duoi**	
Respondents	N	18		21		7		16		11	
Body size	[a]/[b]	16.7	0.16	14.3	0.22	-	-	18.8	0.20	9.1	0.17
Exterior	a/b	22.2	0.16	33.3	0.20	57.1	0.36	18.8	0.27	27.3	0.30
Number/size of teats	a/b	5.6	0.13	23.8	0.22	14.3	0.29	12.5	0.22	9.1	0.27
Feed intake spectrum/ capacity	a/b	33.3	0.17	19.1	0.20	28.6	0.36	43.8	0.27	45.5	0.30
Behaviour	a/b	-	0.09	-	0.05	-	-	6.3	0.05	9.1	0.03
Health status	a/b	22.2	0.18	-	-	-	-	-	-	-	0.03
Others	a/b	-	0.11	4.8	0.12	-	-	-	-	-	-

Multiple answers were possible.
[a] Proportion of interviewed households ranking characteristic first. Village differences significant at $p=1.8\times10^{-3}$* (health status; Fisher's exact test).
[b] Index=Σ of (4 for rank 1+3 for rank 2+2 for rank 3+1 for one tick) given for an individual characteristic divided by Σ of (4 for rank 1+3 for rank 2+2 for rank 3+1 for one tick) summed over all characteristics.

3.4.2 Survey results: Farmers' breeding management

Sources for female breeding stock were manifold. Smallholders preferred to buy gilts from other smallholders within the village or from relatives in order to be sure about the gilts' origin and to avoid the import of diseases, with no significant differences between breeds or genotypes (Figure 9). Thus, smallholders avoided to purchase local gilts at the markets. Exotic sow genotypes were frequently own bred (50%), as exotic pigs for breeding were hard to find at the local markets or within most of the investigated villages. Smallholders also obtained local sows by the project (25% of the MC and 16% of the Ban sows), while exotic sows were not distributed by the project.

Sows were predominantly mated with exotic boars to produce crossbred fatteners (88%), with significant differences between sow breeds and genotypes. The mating with exotic boars was more common for MC sows and exotic sow genotypes as compared to Ban sows (88% and 79%, respectively compared to 44%). Local boars were only used to produce purebred replacement stock (9% for MC and 13% for Ban breed) (Figure 9). Lemke et al. (2006) observed already four years earlier for the same area that Large White was becoming the most common boar breed in villages close to towns. Increasing scarcity of purebred MC and Ban replacement stock is being perceived as a problem by the project. In general, smallholders preferred natural mating over artificial insemination (74% and 26%, respectively), mostly using boars kept by a village boar keeper (79%), while the use of boars from outside the village and of an own boar was not common (8% and 10%, respectively) (Figure 9). The proportion of smallholders using artificial insemination was higher in Ban Buon than in the other investigated villages. Smallholders had better access to this service as it was offered by one farmer from within the village. Lemke et al. (2006) mentioned a higher proportion of artificial insemination in Ban Buon due to the village's proximity to a provincial breeding centre. Average fees were estimated at approx. 2.05 € for natural mating and approx. 1.53 € for artificial insemination.

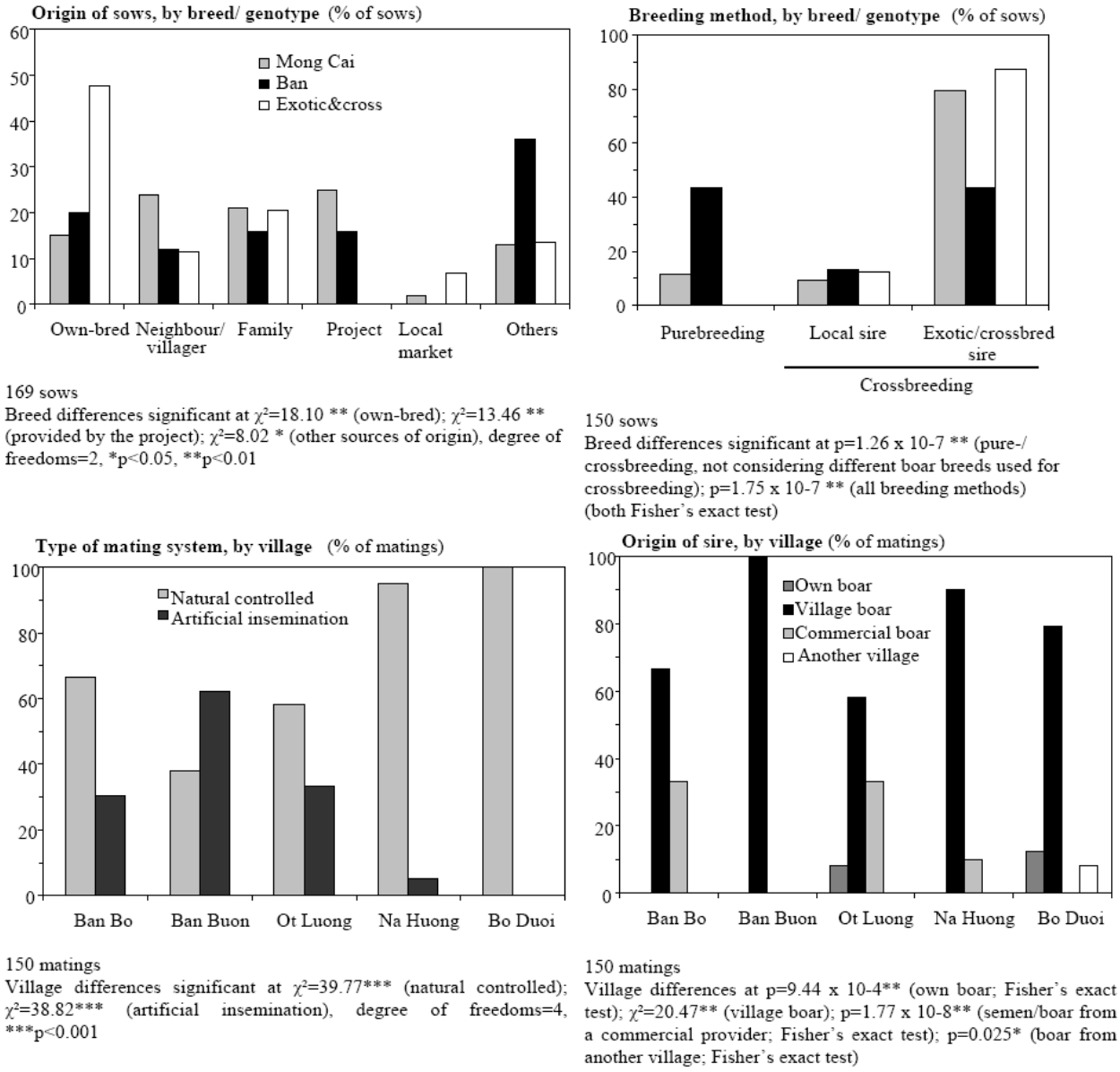


Figure 9: Breeding management at smallholder farms with market-oriented pig production

3.4.3 Modelling results: Genetic and economic merit of the current recording scheme

The annual genetic gains of the single traits for the current recording scheme with present pig performances and assuming increased pig performances are given in Table 10. Annual genetic gains are only presented for the MC breed, since the contribution of the boars to the genetic gain could not be considered due to missing information about their genetic potential. In further research within the project, priority should be given to obtain

actual breeding values, particularly for terminal sires, as they have a shorter genetic distance to the fatteners, thus showing a faster transfer of genetic superiority and leading to high contributions to returns (Wuensch et al., 1998). One possibility to get more detailed information about the genetic potential of boars could be a closer cooperation with breeding centres, selecting boars according to an index correlated with the breeding objective of smallholders. Breeding values could be also obtained through selection of boars from the project village herds (MC breed).

Table 10: Genetic and economic merit of the current recording scheme

Parameters	**Present pig performances[1]**	**Improved pig performances[2]**
*Annual genetic gain (σ_A*100)* [3]		
Farrowing interval	0.40	0.42
Number of piglets born alive	-0.36	-0.37
Average daily gain	11.82	12.54
Backfat thickness	-10.20	-10.82
Annual monetary genetic gain (€)[3]	0.03	0.03
Total returns sow^{-1} (€)	0.30	0.31
Fixed costs sow^{-1} (€)	22.78	22.78
Variable costs sow^{-1} (€)	11.42	11.46
Profit sow^{-1} (€)	-33.90	-33.92

[1] 9.4 piglets born alive litter^{-1} and 2 litters year^{-1}, 15% piglet mortality; [2] 10.5 piglets born alive litter^{-1} and 2.2 litters year^{-1}, 5% piglet mortality; [3] for Mong Cai breed only

Although reproductive and fertility traits were weighted with about 60% in the total merit index, the annual genetic gains for FARROW and NBA are slightly negative, while the annual genetic gains are positive for ADG and BF. A negative sign (reduction) in BF is favourable, since reduced backfat thickness would accompany an increase in lean meat content of carcasses, thus improving the marketing chances of fatteners. Positive genetic gains in ADG and BF may be attributed to high heritabilities of both traits, while one reason for the unfavourable annual genetic gains in NBA and FARROW could be that fertility and reproductive traits are generally lowly heritable. Possible solutions to avoid a negative genetic development in reproductive and fertility traits may be to increase the economic weights of these traits to find a better balance between production and reproduction traits, or to consider other traits, e.g. stay ability, in addition to conventional production and reproductive traits (Tholen et al., 1996b). Putting more emphasis on NBA

and FARROW may, however, result in lower values for ADG and BF, and including more traits in the total merit index would lead to higher costs associated with performance recording and data management. Restricting genetic gains in production traits may therefore be a better alternative for minimizing a reduction in reproductive traits than including more traits in the total merit index.

A positive effect of increased pig performances on the genetic success can be only observed in ADG and BF. By contrast, the annual genetic gain in NBA and FARROW is even lower (however on very low level) when assuming increased pig performances. The overall annual monetary genetic gain of the current recording scheme based on present and improved pig performances is very low (0.03 €).

Modelling results indicate that the breeding programme reflecting the current recording scheme for market-oriented smallholder pig production is economically not profitable (-33.90 € sow^{-1}), increased pig performances having no effect on the profitability. Both the high negative profit and relatively low annual genetic gains may be explained by the small population size that leads to a high fixed costs burden, and the low selection intensity.

3.4.4 Further study

Continued success of village breeding programmes depends on the profitability of breeding measures. The current recording scheme implemented at smallholder farms in the market-oriented production system is economically unprofitable and its long-term sustainability seems uncertain, even with increased level of sows' reproductive performance.

A further study therefore focuses on the development of alternative breeding schemes that are evaluated with ZPLAN. In a first alternative breeding scheme, breeding objective traits and selection criteria are adjusted to account for the feed intake capacity and spectrum of feed intake of pigs. These are traits that smallholders commonly select for, because feed is the major cost component of smallholder pig production in the area (84% of variable costs) (Lemke et al., 2007). They are, however, difficult to measure under prevailing production conditions and thus are not recorded in the current recording scheme. Including feed intake in the total merit index would therefore lead to higher costs

associated with performance recording and data management. Higher costs should not be ignored in optimizing breeding schemes for smallholder production systems, as these are a significant barrier to the adoption and sustainability of any beneficial breeding programme. Taking all this into consideration, the restricted selection index approach is used, restricting the genetic gain in ADG. Because this trait is positively correlated to feed intake (Rauw et al., 2006), the correlated genetic response of feed intake is expected to be limited too. A second alternative breeding scheme is developed to consider a two-way and three-way crossbreeding system with the local Ban breed. The aim is to derive possible linkages between different production types, i.e. resource-driven and market-oriented pig production. Since financial and technical capacities of smallholders to continue the current recording scheme after the project's completion are limited, investigations are needed in how far cooperation and integration with other institutions having the necessary financial resources and technical know-how may enable the long-term sustainability of future village breeding programmes.

3.5 Acknowledgements

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CHAPTER 4

Breeding and supply chain systems incorporating local pig breeds for small-scale pig producers in Northwest Vietnam

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4 Breeding and supply chain systems incorporating local pig breeds for small-scale pig producers in Northwest Vietnam

Herold, P., Roessler, R., Willam, A., Momm, H., Valle Zárate, A.

4.1 Abstract

Besides the improved local Mong Cai breed, the local Ban breed is the most predominant pig breed used by resource-poor smallholders in remote mountainous areas of Northwest Vietnam. It copes well with adverse local husbandry conditions and is well adapted to smallholders' low-input production strategy. In contrast to other pig breeds in more market-oriented production systems where pigs are mainly kept for income generation, Ban pigs in subsistence-oriented production systems still perform multiple, mostly non-market functions. Different functions of pigs result in different smallholder breed and trait preferences for pigs that have to be considered in developing village breeding programmes for pigs in Northwest Vietnam.

Following model calculations reflecting the most prominent breeding scheme of smallholders in more market-oriented production systems (Yorkshire x Mong Cai), further model calculations are performed considering two basic breeding schemes integrating the local Ban breed: (1) a simple two-breed crossbreeding scheme between Yorkshire and the local Ban breed (Y x B) and (2) a stratified breeding scheme combining the Yorkshire, Mong Cai and Ban breeds, and linking different production systems, i.e. market-oriented and subsistence-oriented. Four traits in the breeding objective are considered: average daily gain, backfat thickness, litter size and farrowing interval. In a next step, the basic breeding schemes are adjusted restricting the body weight, putting more emphasis on reproductive than on production traits or reducing the number of breeding objective traits, respectively. Furthermore, possibilities how to organise breeding and supply chains in remote areas in the uplands of Northern Vietnam are assessed.

For all modelled breeding schemes, genetic gains are low and discounted breeding profits are negative. The Y x B-scheme shows the highest overall genetic gain. This scheme already exists in an un-organised way and would therefore not require particular organisational setups. A stratified crossbreeding system could help building links

between villages in more remote areas and close to the market, and thus, overcome critical organisational aspects like poorly developed infrastructure, poor access to input and output markets as well as information. It is further suggested to establish short food supply chains together with organised breeding systems to integrate smallholder farmers into already existing value chains for local pig products.

The successful implementation of village breeding programmes and the establishment of short food supply chains will require technical and financial support by the government or other public or private institutions. The long-term success of village breeding programmes and short food supply chains depends on many factors that need further investigation, e.g. the technical appropriateness of breeding programmes to assure genetic gains and economic success, a realistic organisational set-up of breeding programmes considering sufficiently large pig populations and numbers of participant smallholders, a proper embedding of village breeding programmes in regional and national structures as well as tapping special markets and quality control systems.

CHAPTER 5

Optimising the organisation of smallholder pig breeding in mountainous areas in Northwest Vietnam

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5 Optimising the organisation of smallholder pig breeding in mountainous areas in Northwest Vietnam

Roessler, R., Herold, P., Momm, H., Valle Zárate, A.

5.1 Abstract

Village breeding programmes using appropriate pig breeds are currently developed to help improving smallholder pig production in the Son La province in Northwest Vietnam. The success and long-term sustainability of such breeding programmes depend on the organisational feasibility of breeding measures under given environmental conditions. This study evaluates the organisational feasibility of village breeding programmes and possibilities for their integration into provincial, regional and national structures. An institutional analysis is used to provide a descriptive assessment of breeding institutions in Vietnam. Information was collected from group discussions with small pig producers in Son La and interviews in various public and private institutions across northern Vietnam, complemented by information from legal documents. Findings of this study suggest that breeder cooperatives at village level could be a promising option to improve smallholder pig breeding and to ensure the sustainability of village breeding programmes, tightening the relatively weak links to other breeding institutions and counterbalance commercial farms and public breeding institutions. The successful creation of breeder cooperatives will require the support by the government, including more rigorous enforcement of political measures, clear assignment of responsibilities and financial support.

5.2 Introduction

In the mid 1980s, the government of Vietnam abandoned the path of collectivisation and adopted measures to liberalise and privatise the economy including agriculture. In the course of this transformation, a wide range of political and economic reforms have been carried out, leading to considerable changes, also in the pig breeding system. Many state-owned breeding farms and enterprises, particularly those at district level have been liquidated (Vu, 2003), others have been restructured and privatised (MARD, 2005), new forms of producer cooperatives have been built, crossbreeding with imported breeds has

been widely introduced at small household farms, and small to medium-sized private farms have developed (Lapar et al., 2003).

Main development incentives, however, focus on the Red River Delta and areas surrounding big cities in order to meet the demand of the growing urban population and to supply pigs for export (MARD, 2000; Prime Minister's Decision 166/2001/QD-TTg). By contrast, smallholders in the northern mountainous province Son La face problems to intensify their production and to meet the regional demand for pork. The majority of pig breeding systems in Son La are small private operations with the majority of the pig population being kept at small household farms (81%), while larger breeding farms providing pig breeds are absent (DARD, 1999). Village breeding programmes using appropriate and adapted pig breeds are currently developed to help improving smallholder pig production (Roessler et al., 2009). The success and long-term sustainability of such breeding programmes depend on the organisational feasibility of breeding measures under given environmental conditions. Thus, the process of planning of breeding includes an analysis of breeding organisation.

This study aims at evaluating the feasibility of village pig breeding programmes in mountainous areas in Northwest Vietnam. It focuses on the evaluation of pig breeding organisation at village level. Specific objectives are to evaluate factors at district, provincial and national level that have an effect on the organisation of pig breeding at village level. Based on these results, recommendations are developed for improving structures of pig breeding organisation at village level.

5.3 Material and methods

5.3.1 Study area, selected villages and institutions

This study covered in total nine provinces in northern Vietnam, with main focus in Son La province. Eight villages were selected in Son La province, differing in distance from the provincial or district capital (close, far), ethnic affiliation (Black Thai, Hmong) and production type (market-oriented, subsistence-oriented) (Table 11). In all investigated villages, a research project of a Thai-Vietnamese-German collaborative research programme is implemented targeting at the development and implementation of village breeding programmes. In total, 26 groups with on average five smallholder pig producers

were approached in the survey. Pig producers were randomly selected from a list of all pig producers keeping sows that has been provided by the village head of each village.

Table 11: Characteristics of investigated villages and number of group discussions (by village)

Village	Bo	Buon	Co	Na Huong	Bo Duoi	Ot Luong	Tong Tai A'	Pa Dong
Group discussions (N)	4	2	5	3	3	2	3	4
Production type	Market-oriented						Subsistence-oriented	
Distance to provincial or district capital	Close					Far		
Ethnicity	Black Thai						Hmong	

In addition to the groups of smallholder pig producers, a further 51 persons were approached in nine northern provinces, including Son La province. In total, 31 persons were from the public sector, belonging to 16 public institutions (central and local ministries, public companies, national research institutes and universities, public service providers and other institutes) and 20 persons were from the private sector (Table 12). The private institutions can be assigned to the following categories: Private boar keepers, (semi-) commercial farms, pig traders, foreign-invested companies, joint ventures and producer cooperatives.

Table 12: Categories and numbers of institutions approached in the survey

Category	Sum	Category	Sum
Public institutions	*16*	*Private institutions*	*18*
Central and local ministries	3	Private boar keepers	8
Public companies	4	(Semi-)commercial farms	5
Public service providers	5	Pig traders (local market)	2
National research institutes/ universities	2	Joint venture (with foreign company)	1
Other institutions*	2	Foreign-invested company	1
		Producer cooperative	1

* Rural Development Centre (RUDEC), Provincial Farmer Association (Son La province)

Excluding groups of pig producers participating in group discussions.

5.3.2 Methodological approaches

The research primarily consists in an analysis of the actual structures of the organisation of smallholder pig breeding in Northwest Vietnam. It is limited to a case study of the organisation of smallholder pig breeding in villages in Son La province (Figure 10). The study employs two different approaches: the institutional economics approach and the contingency approach, using the term "organisation" to refer to a system of institutions (for a detailed description of this concept please refer to Picot et al. (2008; p. 26 f.)) and assuming that the organisational structures of the institution of smallholder pig breeding at village level are dependent on certain external (competitors, customers, societal and cultural conditions, etc.) and internal (size, activities, etc.) factors (Vahs, 2007; p. 43 f.). Accordingly, the analysis of the actual structures in Northwest Vietnam is extended to other relevant institutions involved in the organisation of pig breeding at different levels. A further extension of the research includes the desk study comprising a screening of legal documents (laws, governmental and ministerial decisions), reports and project descriptions as well as information from the internet.

Data collection was realised from April until December 2006 and September until December 2007. Data were gathered by an informal way in 26 group discussions with smallholder pig producers in Son La province (Figure 10), addressing key issues, including a general description of the organisation of pig breeding at village level and an identification and characterisation of forms of farmer organisation with activities related to pig production, as well as an identification of influencing factors and linkages to other institutions involved in the organisation of pig breeding.

Data collection	**Group discussions (using guideline)** 26 group discussions with small-scale pig producers in 8 villages Son La province	**Personal interviews (using guideline)** 66 interviews with 51 persons (31 from public, 20 from private sector) 9 northern provinces	**Desk study (secondary data)** Legal documents, national programmes, reports, internet
Data analysis	Mainly qualitative	Mainly qualitative	Qualitative
Focus	Description and analysis of pig breeding organisation at village level A) Internal structures (primary organisation of pig breeding, farmer organisations, participation, objectives and activities) B) External factors (framework conditions, e.g. supply of breeding animals, linkages to other institutions)	Identification and description of institutions involved in pig breeding at different levels (village, district, provincial, national, global) A) Organisational structures B) Framework conditions C) Flows of animals, information, etc. D) Linkages between institutions	Complement information obtained in group discussions and personal interviews

Figure 10: Visualisation of materials and methods

In addition, 66 informal interviews with 51 persons from other institutions at different levels were conducted to back and complete the information gathered in the group discussions. Like for the group discussions, a guideline was used for these interviews, focusing at gaining an insight into the structure of the respective institution, animal numbers and flows, information flows and decision making, as well as major external factors (legal environment, policies, financial support, competition, networks and partnerships).

Information obtained in informal interviews and group discussions were recorded in field notes. Structured protocols of every group discussion were entered in Microsoft Excel and categorised matching the categories of the guideline used for the group discussions: primary organisation, farmer organisations, framework conditions (e.g. supply of breeding animals, technologies and trainings) and linkages to other institutions (Figure 10). Data were analysed qualitatively for content, complemented by a descriptive, quantitative analysis, using within and across village comparison. Field notes of interviews were processed into Microsoft Word and mainly analysed qualitatively. Categories considered for analysis of data from personal interviews were: organisational structures, information and animal flows, framework conditions, e.g. legal regulations, market conditions, linkages to other institutions. The use of different methods for data collection provided the opportunity for cross-validating results.

5.4 Results

In the following, the organisational structures of pig breeding will be described, starting with institutions at the village level (household farms, village boar keepers and farmer groups), followed by institutions at district, provincial, national and global level, directly and indirectly influencing smallholder pig breeding at village level.

5.4.1 Pig breeding institutions at village level

Household farms

Results from group discussions show that small household farms with an average of one to two sows predominate. Only in one of the investigated villages, two larger household farms, each with five sows and one boar, have been established in recent years. Both farms have improved housing (farrowing crates for lactating sows, infrared heat lamps for newborn piglets, nipple drinkers, etc.). Other producers in the village stated in group discussions that they would like to follow these examples but lacked funding to purchase and feed exotic sows and to build improved stables, thus still keeping their pigs in pens with concrete floor and concrete or bamboo walls and roofs made from straw, tiles or asbestos. In villages with subsistence-oriented pig production, pigs are penned in relatively large enclosures, using local woods and bamboo, temporarily roaming in the village.

Sows mostly originate from household farms within the same village (six villages) and from other villages or are own-bred (three villages each) (Figure 11). By contrast, the purchase of breeding sows from the town market only occurs occasionally (two villages). Pig producers participating in the group discussions argued that they avoid to purchase sows from the town market as these are imported from lowland areas being less adapted to local conditions (climate, feeding) than local sows, are difficult to transport and as their origin is unclear (two villages each). Some sows used at one of the mentioned larger household farms originate from the Agricultural Promotion Centre (APC) of the district Agricultural Extension Station (AES) in Mai Son.

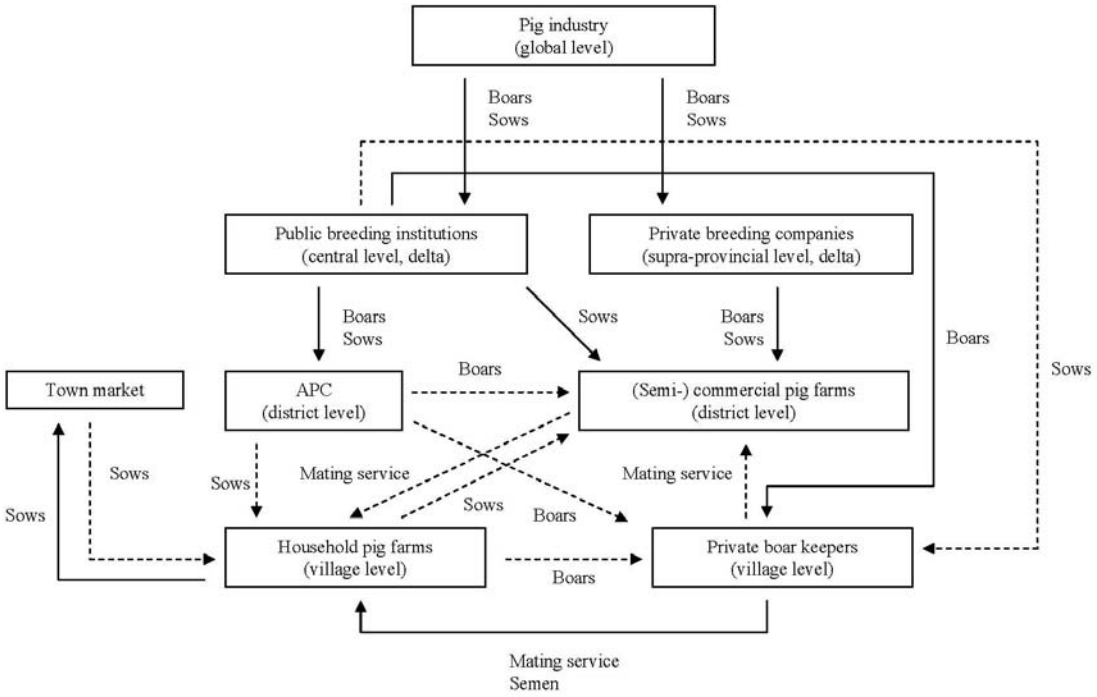

Figure 11: Origin and flows of sows and boars (semen) between breeding institutions

Group discussions in the investigated villages could not clarify if the supply of breeding sows is sufficient. While producers in Ban Buon stated that the supply of sows is sufficient, producers in two other market-oriented villages (Ban Bo and Ban Co) often mentioned that it is difficult to find breeding sows. In the three other villages with market-oriented pig production, the view about the supply of breeding sows was not uniform (four group discussions where pig producers stated that the supply is sufficient, three group discussions in which pig producers perceived the supply as insufficient). Pig producers in the villages with resource-driven pig production stated not to know about the market demand and supply of pigs, including sows.

Farmer groups

Different types of farmer organisations in the investigated villages could be identified in group discussions (Table 13). In all investigated villages, at least one of the common socio-political village groups of mass organisations like the Women's Union and the Farmers' Association exist. According to the provincial Farmer Association of Son La, the main responsibility of provincial associations is to ensure that national directives are realised on local level. Decision 166/2001/QD-TTg encourages the cooperation between

the State Bank of Vietnam and the farmer organisations like the Farmers' Association and Women's Union in order "to spread the model of reciprocal assistance groups that are expected to provide such institutions broader access to bank loans". Accordingly, group discussion participants stated that the main function of such groups is to enable members to gain access to micro-credits, either directly from the group or from the bank, groups serving as a link between individual farmers and banks. In two of the investigated villages, farmers stated, however, that funds raised through village groups are not sufficient to cover the needs of farmers. Regular meetings of members also provide the possibility to exchange experiences and information.

Table 13: Types and functions of farmer organisations in the investigated villages

Type of farmer organisations	Functions of farmer organisations
Common political village groups (8 villages)	Access to micro-credits Exchange of experiences and information
Village agricultural extension club (2 villages)	Improvement of technical skills by regular meetings and through study tours Training on new technologies/ breeding for club head and members Access to new technologies and micro-credits
Pig production group (1 village)	Exchange of experiences and information Source of breeding animals

Another type of farmer organisation identified in two of the investigated villages is the village agricultural extension club (Table 13). Village agricultural extension clubs are a new form of a state-induced farmer organisation, that are either set-up by the provincial Agricultural Extension Centre (AEC) or the district Agricultural Extension Station (AES) with the aim to increase household economies and improve small-scale livestock production. Nearly 300 extension clubs and farmer groups are reported having been set-up in Son La province (Jansen, n.d.). Benefits as perceived by pig producers include improved technical skills through regular meetings and study tours to other villages; training on new technologies and breeding organised for club heads or members; access to technologies and micro-credits. Club members in one village stated, however, that they would prefer to have more training courses open to all club members, dealing with topics such as epidemics, husbandry techniques and breed selection.

In one of the investigated villages, pig producers have set-up a pig production group (Table 13). At the time of the survey, it had approximately 60 members, representing one quarter of all villagers. In regular meetings, the club members share their experiences and information, particularly on pig marketing. The club was also mentioned as a source for breeding animals. Pig producers' attitude towards village groups is generally positive (confirmed in 11 of 18 group discussions). Only in one village, the attitude towards farmer groups is clearly negative, since farmers do not perceive any advantages from being member of the existing farmer organisations. In the two investigated Hmong villages, the opinion of farmers towards farmer groups is heterogeneous. In one village, farmers believe that village groups would not help to improve their pig production (three of four group discussions), because the set-up and operation of groups would need money, while farmers would not get any support. By contrast, farmers in the other Hmong village seem more open with regard to the establishment of farmer livestock groups (two of three group discussions), mentioning that such groups could help farmers to meet regularly to exchange information (e.g. about pig sales) and to improve their pig production. However, they regard the establishment of such groups as difficult due to a limited knowledge and motivation of farmers.

In the villages with market-oriented pig production, the attitude towards cooperatives or collective farming structures are in general positive (seven of 12 group discussions). Perceived advantages are risk sharing, labour sharing, better access to land and loans, farmer-to-farmer learning, specialisation of farmers, lower input prices e.g. for animal feed, better access to extension services and possibilities for technological transfer. In three group discussions, farmers stated that cooperatives would not help to improve their pig production. Arguments against cooperatives include lack of experiences, land, feed and labour to run intensified practices of production, and strong regulations on production and management. Farmers also feared that they would lose independency in their decision-making and that outputs would not be shared according to inputs. Pig producers in the two Hmong villages did not express any opinion about cooperatives, this topic having been addressed in seven group discussions.

(Village) boar keepers

Results of the group discussions show that in all investigated villages at least one village boar is available either used for natural mating (all villages) or for artificial insemination (AI) (two villages). In addition, pig producers in villages with market-oriented pig production use boar and AI services from boar keepers of other villages and Son La town and from private commercial farms (five villages and one village, respectively) (Figure 11). In another village, farmers themselves regularly conduct AI for their sows, purchasing the semen from private boar keepers in the provincial capital. By contrast, farmers in the two Hmong villages do not have access to other mating services due to their remoteness.

Eight boar keepers used by smallholder farmers in the investigated villages have been approached in interviews. All boar keepers own one to three boars, mainly from exotic breed lines. Two village boar keepers also use the local Mong Cai and/ or Ban breed that have been provided by the project implemented in these villages. Most of the boars originate from public farms in the delta region, while only two village boar keepers stated having purchased her boars from the Agricultural Promotion Centre (APC) and a small household farm in Mai Son district. The APC sells 20 boars for breeding per year (interview: Agricultural Promotion Centre, Mai Son district, 2006). Most of the interviewed boar keepers offer AI service and sell semen, only three offer natural mating service. Main customers are smallholder pig producers from the investigated districts. In addition, two boar keepers provide their services to (semi-) commercial farms. All boar keepers stated that the cooperation between each other is rather strong, with a regular exchange of information and sometimes also semen. Yet, the competition is perceived having been increased in the last years.

Besides private boar keepers, neither provincial AI stations nor public boar farms exist in Son La province, since former provincial breeding farms have been dissolved (Sub-Department of Animal Health, Son La township, 2006). Local authorities wish to build a district pig breeding farm in Song Ma district, however doubting about the realisation due to a lack of funding. The former breeding centre in Mai Son district is said to be re-organised into a semi-governmental farm (interviews: DARD, 2006; AES Song Ma district, 2006).

5.4.2 Institutions at district and provincial level

Private (semi-) commercial pig farms

Besides private mating service providers, some private, small- to medium-size commercial pig farms have been developing in Son La province in recent years (interviews: SDAH of Son La township and Farmer Association of Son La province, 2006). The establishment of private commercial pig breeding and production farms producing lean meat pigs is promoted by the provincial People Committee's Decision 257/QD-UB on "Incentive policy on commercial agriculture production in Son La province (2005-2010)" and by the provincial Department of Agriculture and Rural Development and its Livestock Production Development Plan for the years 2000-2010 (DARD, 1999). The exact number of such farms in the province could not be identified, yet the number can be assumed small as more than 90% of the provincial pig population are still kept at small household farms (DARD, 1999). In total, five private (semi-) commercial pig farms have been visited in Son La township and Mai Son district, representing over 70% of all private commercial farms in the investigated districts (interviews: SDAH of Son La township, 2006; private commercial farms, 2006 and 2007). According to the above decision, the support of large-scale keeping of lean-meat pigs requires that any institution (including enterprises, economic organisations, cooperatives, cooperative unions of domestic and foreign economic sector which are established and operate under Vietnamese law, households and individuals from Son La and other provinces) keeps at least 30 sows or 100 fatteners. Three of the five visited farms fulfil these requirements and registered as commercial farm (Table 14). Four of the visited farms have own boars and the fifth farm is planning to use the boars from its affiliated farm in the same district. Annual production figures reach 240 and 360 (small farms) and more than 1,000 (small to medium-sized farms). For the largest farm, more than 5,000 produced pigs per year can be assumed.

Table 14: Characteristics of (semi-) commercial pig farms in Son La province (by farm size)

Farm size	Small	Small to medium	Medium
Farms (N)	2	2	1
Commercial sows (N)	18-20	40-60	350
Own boar(s) (% of farms)	100.0	50.0	100.0
Fattener pigs at time of visit (N)	<100	>100	n.i.*
Produced pigs (N per year)	240-360	>1,000	n.i.*

* Stock numbers for fattener pigs and production figures are not available, but can be estimated at more than 100 fattener pigs kept at the time of the visit and more than 5,000 produced pigs per year.

Results from interviews show that sows used at (semi-) commercial farms mainly originate from large public and private companies in the delta region, but also from household farms in Son La province and the delta region (Figure 11). A small number of sows are from own replacement. Boars are generally purchased from the large private Thai company Charoen Pokphand located in Ha Tay province close to Hanoi (three farms), only one farm purchased boars from the APC in Mai Son district. Boars are mostly only for internal use, only the largest farm uses its boars (AI) for other private semi-commercial and small household farms (result from group discussions in one of the villages and from interviews with farm owners of two semi-commercial farms).

Town market

Market-oriented smallholder pig producers have different production and marketing strategies, either fattening weaned piglets on the own farm and selling them for slaughter five to six months after weaning (four villages), or weaners are sold for fattening to other small household farms in the same or neighbouring villages or in Son La town (two villages). According to small pig producers, it has become increasingly difficult to sell crossbred pigs for slaughter and the prices are decreasing because of increasing inflow of fattening and slaughter pigs from the lowlands (two villages), because of animal diseases or because of a high fat content of the pigs (one village each). Unlike crossbred slaughter pigs, local Ban pigs are easier to sell as the demand for local pork increased after having been promoted at the agricultural trade fair in Son La town in 2006 (one village). Group discussions in the investigated villages could not clarify if small pig producers are able to

supply an adequate amount of fattener pigs. Average production figures reported by pig producers vary between eight and 20 pigs per year and farm household (market-oriented production system) and five to ten pigs per year and farm household (resource-driven production system). While pig producers in two villages (one group discussion for each village) stated that they produce enough pigs, producers in four other villages with market-oriented pig production complained that they are not able to produce enough fattener and slaughter pigs (in total nine group discussions in four villages). Pigs produced on household farms in the investigated villages with resource-driven production are mainly used for home consumption and hence rarely marketed. Thus, farmers stated that they do not know about the market demand and supply of pigs.

Two pig traders could be identified at the market in Son La town and have been approached in different interviews. According to local authorities (interview: SDAH Son La town, 2006), no other selling points exist in Son La town and Mai Son district. Both interviewed pig traders introduce F1 crossbred pigs (exotic x MC) for fattening, occasionally also selling them for breeding, and MC sows for breeding. On average 100 pigs are introduced per transfer, four transfers taking place per month, MC sows representing 10 to 15% of the pigs. Pigs are collected from household farms in Hai Duong province in the delta and mainly sold to household farms in and close to Son La town.

Public and private extension services

Agricultural extension activities are relatively new in Vietnam, only starting in 1993 (Government Decree 13/CP). According to this decree, extension activities are undertaken by both, the public agricultural extension system and voluntary organisations. The current public extension system is divided into different layers from the central level to the provincial and district level to disseminate technical advances and new technology packages (demonstration models) and experiences to farmers. In some areas, the public extension system further spreads to communal extension agents. Demonstration models have been established in total in 48 provinces targeting at the improvement of breeds by introducing exotic sows and boars, pig feeding, housing and marketing (interview: National Agricultural Extension Centre, 2006; Decision 118/2003/QD/BNN).

Smallholder pig breeding in the investigated villages is supported by various public and private service providers. Besides extension and training provided by the mentioned research project (all investigated villages), pig producers in most of the investigated villages have also access to training on new technologies and breeds (six villages) and new forms of agricultural cooperatives (one village) organised by other institutions, mainly the district AES (four villages), the provincial Agricultural Extension Centre (AEC), the district People Committee or the Sub-Department of Animal Health (one village each). Constraints as perceived by small pig producers are however that training courses are not taking place regularly (three villages), that small pig producers do not get any practical advice and financial support to apply new technologies (two villages). In one village each, smallholder pig producers stated that topics are not relevant or applicable to the respective production system due to limited financial resources, that the number of participants is limited and that training is only accessible for the head or the members of the agricultural extension club. Small pig producers would like to have a stronger support either from the public or the private area (three villages) or only from the public area (two villages).

Other institutions supporting smallholder pig breeding in the investigated villages include private animal health workers (three villages). Their main functions are to carry out vaccination campaigns (two villages) and treatment of sick animals (one village). Personal contacts to village animal health workers (one village) as well as to staff from the district veterinary station (one village) or the Sub-Department of Animal Health (three villages) also play an important role for smallholder pig producers in obtaining and disseminating information related to pig production (diseases, breeds, feed, current prices). In addition, farmers seek advice from drug selling points (two villages). Other information sources are the TV (three villages), books and newspapers (one village each). Information is further shared across extended families and with other farmers in the village (five villages).

Provincial development plan and policies

According to the Agriculture and Rural Development Plan of the Son La province for the period 2006 to 2010, the main targets for the pig production are to increase the number of pigs from 476,000 in 2005 to 584,000 in 2010 with an annual growth rate of 4.1% to

meet the high local demand for meat that will further increase also due to the workers from the large hydro-power plant that is currently built in the province. Thus, the Decision 257/QD-UB supports the development of large-scale keeping of lean meat pigs in the Son La province, investors being provided with favourable treatments: exemption from land use taxes, compensation for clearing land and a 100% support of interest rate of loans to build stables, state funding to develop essential infrastructure items, e.g. electricity and roads, free AI service and free vaccination against common diseases in the first year of the project and a 100% support of interest rate of loans to buy sows (in the first year of the project) and fattener pigs (for the first six months). Farm managers of the registered (semi-) commercial farms that have been visited confirmed to be exempt from land use taxes and to get compensation for land clearing (three farms) and assured to get free vaccination for pigs or technical advice from the Sub-Department of Animal Health (two farms).

On the other hand, the provincial development plan recognises that the main production will be still from smallholders. Demonstration models have been established by the AES at small household farms in Son La township in March 2007, participating farmers receiving subsidies for the purchase of breeding females (60% for the first 30 kg of gilts) and for feed costs (40% of feed costs for 100 kg of feed per sow). According to the AES (interview), the success of the model seems however questionable as model farmers have faced problems with the disease management, exotic sows tending to be more susceptible to prevailing diseases (58 of the 60 sows that were introduced from a public breeding farm in Ha Tay province recently died due to diseases). Another research project targeting at developing smallholder pig breeding is implemented by the Agricultural Promotion Centre (APC) of the district AES in Mai Son. This project covers 30 households in four villages in different communes, each household farm keeping three to four exotic sows, originating from the nucleus managed by the APC. According to the implementing body, the continuation of the project, however, seems unlikely. Given reasons are unavailable further funding and the failure of the majority of household farms to keep exotic sows. Major problems faced by household farms were the disease management and high input costs for feeding. In the investigated villages, no

demonstration models for pig production or breeding could be identified through group discussions.

5.4.3 Institutions at national level

Although the private sector is gaining importance with nearly half of the 125 great grandparent (GGP) and grandparent (GP) farms across Vietnam being private farms (2005), the national government still has a strong influence on the pig breeding through national and provincial policies and strategies as well as national research institutes and public breeding companies.

National policies and directions for pig breeding and production

The Government of Vietnam and MARD have started paying increasing attention to the development of pig production and breeding since the last two decades, issuing a considerable number of legal documents. National policies and directions clearly concentrate on the transformation of pig production from small-scaled and dispersed forms to concentrated and commercial ones to meet the local and export demand, targeting at reducing the number of pigs kept traditionally from 70% in 2005 to 60% in 2010 and changing the pig breed structure by increasing the proportion of exotic sows from 9.6% in 2005 to 19.2% in 2010 and 26.6% in 2015; encouraging the importation of improved breeds and the establishment of GP and PS farms with exotic sows and of institutions producing breeding pigs for exports are encouraged; and providing preferential investment policies (Decision 17/2006/QD-TTg; Decision 166/2001/QD-TTg; Decree 14/CP; DLP, 2006; MARD, 2000). Yet, the use and conservation of local pig breeds are also promoted by national policies, foreseeing some areas for special local pigs in the Western Highland, East-Southern and West-Northern region, developing brands and geographical indications; and reinforcing the selection and improvement of local pigs such as Mong Cai or Lang pigs (Decision 17/2006/QD-TTg; Decree 14/CP; DLP, 2006). Small research projects are implemented targeting at the in situ conservation of local breeds, e.g. for the Muong Khuong and Mong Cai in Lao Cai province (start in 2005) and the Tap Na in Cao Bang province (NIAH), the Lung Pu in Ha Giang province (joint project of the NIAH with the French Agricultural Research Centre for International Development) and the Mong Cai and Ban breeds in Son La province (joint project of

NIAH and the University of Hohenheim in Germany). Hitherto, major conservation programmes are however only implemented in provinces in the delta region, e.g. for the I pig (conservation farm managed by the NIAH), the Lang Hong, the Phu Khanh and the Mong Cai (interviews: NIAH, 2006 and 2007; Thuy Phuong Pig Research Centre, 2006).

National policies also encourage new forms of farmer organisations to increase farmers' income, promoting the establishment of cooperatives, pig production collectives and association of livestock production farms as well as the cooperation between enterprises and farmers (especially contract farming) (Decision 166/2001/QD-TTg; Law 18/2003/QH11; DLP, 2006). Accordingly, a pilot project has been implemented in the delta province Hai Duong since 2002 to improve the pig and pork marketing chain, enable small producers to reduce production costs and improve product quality and sales through the use of exotic sows (interviews: RUDEC, 2006 and 2007). In Bac Giang province, on the decision of the local Department of Agriculture and Rural Development and the provincial Agricultural Extension Centre, a cooperative was established in 2004 to help local farmers to sell their products and control the quality of the pigs. Unlike the cooperative in Hai Duong province, the main focus is on the distribution of Mong Cai breeding sows and boars. Sows and boars are selected from in total 30 cooperative members and assembled at a central collection point, quality checked, vaccinated and further sold for breeding (interview: Bac Giang cooperative, 2007).

Some important legal documents that specifically regulate the pig breeding in Vietnam are the Ordinance on Livestock Breeds (Ordinance 16/2004/PL-UBTVQH11), the Decree 14/CP and the Joint Circular 04/2004/TTLT/BTC-BNNTPNT, directing state policies on livestock breeds and defining responsibilities for the state management of livestock breeds; prescribing conservation, research and selection, production and marketing of livestock breeds; providing for conditions that breeding farms have to fulfil and for investments and governmental subsidies; and defining a wide range of terminologies in animal breeding. Reported subsidies to public GGP farms amount to 2 million VND per boar and year for a total of 300 boars annually supplied to local breeding institutions (interview: National Centre for Pig Breeding and AI, 2006). Other important decisions by the MARD are the Decision 07/2005/QD-BNN on the management and use of boars, the Decision 05/2005/QD-BNN promulgating the regulation on the publication of quality

standards of agricultural products and goods and the Decision 66/2002/QD-BNN promulgating economic and technical criteria for domestic animal breeds subject to quality standard.

National research institutes and public breeding companies

According to the Government Decree 86/2003/ND-CP, the Ministry of Agriculture and Rural Development (MARD) is responsible for the governmental management over agriculture, rural development and public services nationwide, being the representative of the state ownership in public enterprises. The multiple tasks and functions of the MARD are performed by a number of institutions under management of the MARD. These functional units are generally classified into professional departments, research units, service delivery units and production units according to their main functions and activities.

The Department of Livestock Production (DLP) as one of the professional departments of the MARD is mainly responsible for legislation and state management of pig breeds and pig breeding at national and local scale, e.g. breeding planning, development of national plans and guidelines for pig breeding related scientific research and trade promotion (interviews: Dong Trieu breeding farm, 2006; NACEPIG, 2006; NOPICO, 2006 and VINALIVESCO, 2006; Hanoi Livestock Breeding Company, 2007; Decision 71/2005/QD-BNN). The National Institute of Animal Husbandry (NIAH) is the most important national research institute for animal sciences. It has two pig research centres, the Thuy Phuong Pig Research Centre and the Tam Diep Research Centre. At these centres, the national leanisation programme is implemented, being based on different crossbreeding schemes (from two- to five-way crossbreeding) using great grandparent (GGP) pigs from five lines of the former UK company PIC (last imports in 2005), three imported US lines (last imports in 2006) and lines imported from Canada (2003/04, 2005), Belgium, Denmark and Spain (interviews: NACEPIG, 2006; NOPICO 2006; Thuy Phuong, 2006; VINALIVESCO, 2006; NIAH, 2007), as well as two grandparent (GP) lines from the France Hybrids Company located in South Vietnam. It aims at increasing the number of high-quality breeding animals, upgrading GGP, GP and PS farms and developing a pyramidal breeding system (NIAH, 2003). NIAH produces and distributes breeding stock, providing 250 trained AI boars and 800 trained natural mating boars as

well as 3,000 grandparent gilts and 3,000 parental gilts per year (interviews: National Centre for Pig Breeding and AI, 2006; NIAH, 2006; Thuy Phuong Pig Research Centre, 2006; NIAH, 2003). The Vietnam National Livestock Corporation (VINALIVESCO) is one of the most important public pig production units with seven pig production companies across the whole country, providing PS sows and breeding boars to public and private institutions, including smallholder household farms (300 to 400 sows per year). The total number of sows used at all pig production companies of VINALIVESCO amounts to 15,000, of which 2% are GGP and 8% GP. To meet the increasing demand for pork in the Red River Delta, VINALIVESCO plans cooperation with groups and cooperatives of local farmers to extend the production of commercial stock, planning to provided breeds, feed, technologies and technical advice to farmer groups, enabling them to meet the prescribed conditions and standards. Other activities of VINALIVESCO include e.g. the maintenance of the nucleus herds, participation in the planning of livestock development, import and export of animals (breeding and commercial stock), supply of extension service and training of technical workers, cooperation and joint ventures with economic and scientific bodies (interviews: VINALIVESCO, 2006; National Centre for Pig Breeding and AI, 2006 and Northern Pig Breeding Company, 2006).

From the in total 15 breeding companies and 2 research farms on national level (under governmental administration), the public pig breeding system further spreads to breeding farms and AI stations on provincial level (under administration of the provincial People's Committees). In the whole country, in 2005 there were 51 farms under provincial management (interview: DLP, 2007). The total number of registered boar breeding units for AI amounted to more than 450 in 2006, with around 4,200 boars producing nearly 5.7 million doses of semen per year. In order to further develop the AI system and increase the AI rate, the national directions target at establishing new AI stations across the whole country and increasing the number of boar quality testing stations (DLP, 2006). It is further planned to establish a breeding centre in Ha Nam province (interviews: Tam Diep Pig Research Centre, 2006), and multiplier farms in Thai Nguyen and Hai Phong provinces (interview: Thuy Phuong Pig Research Centre, 2006). There are also plans to set-up a breeding association, including NIAH and other public breeding institutions to

further improve the pig breeding system in Vietnam (interview: Hanoi Livestock Breeding Company, 2007).

Private breeding companies

In addition to public breeding companies, there are many large private farms with more than 100 GP (31 of in total 65 farms) or 100 PS sows (118 of in total 195 farms), mainly in southern Vietnam and the delta region in northern Vietnam (interview: DLP, 2007). Twelve companies are foreign invested, four of which totally foreign invested with a remarkable annual supply of pig breeds (interviews: DLP, 2007; NIAH, 2007). The largest company is the Thai Charoen Pokphand (CP) Group with 50,000 sows and 600 boars, including 3,600 GGP stock. The group mainly produces PS sows for about 30 large farms in various provinces in Vietnam, each with around 600 sows. Exact production numbers could not be obtained in personal interviews. CP is also engaged in contract farming operations with small household farms and medium private farms. Contractors get technical advice on housing and feeding of commercial stock, animals, feed, vaccines and medicine are provided and output marketed (interview: CP group, 2007). In Central Vietnam, the profit of contract farmers amounts to 500 VND/kg pig live weight (personal communication N.T. Von, 2006). Another foreign invested company operating in southern Vietnam is San Miguel Limited Company. It has 13,000 sows (including 1,000 GGPs) and 300 boars, with a total pig population of about 100,000 and monthly sales of 1,500 pigs (DLP, 2006). For the coming years, San Miguel is planning contract farming with small household farms, the CP group being perceived as most important competitor (personal communication G. Austria, 2006). The France Hybrids Company of the Glon Group is also located in Dong Nai province close to Ho Chi Minh City. It has 600 sows (400 GGP and 200 GP sows) and 110 boars and monthly produces 7,500 semen doses and about 100 boars (DLP, 2006). The forth foreign invested company is a franchise for JSR Genetics stock (UK) established together with the largest Korean pig breeding company Darby Genetics. JSR provided 500 grandparent pigs in 2006, allowing Darby to open its second pig farm in southern Vietnam. PS gilts and Duroc terminal sires are supplied to Hanpork Breeding Company that is located close to the Darby CS farm. In total, Hanpork has 1,000 PS sows producing pigs for the finishing unit (DLP, 2006; JSR, 2006). In order to encourage foreign investment into the livestock

sector, the government offers foreign investors a lower corporate tax of 10% for livestock investment projects (compared with a 28% corporate tax rate for other kinds of investments) and unlimited leasing periods for rural land dedicated to livestock production (Bundesagentur für Außenwirtschaft, 2006; Foreign Affairs and International Trade Canada, 2006). The Duc Viet Limited Company is a private German Vietnamese joint stock company, located in Hung Yen province. It plans to establish a pig breeding farm with 2,500 sows, with satellite farms managed by local farmer cooperatives to ensure the supply of high quality slaughter pigs for the domestic and export market (interview: Duc Viet Company, 2006).

5.4.4 Pig markets and industries at global level

Vietnam became a member of the WTO in January 2007 and considerable changes are expected to occur in Vietnam's economy. According to experts on national level, the WTO membership will have several effects on the pig breeding sector. The public breeding institutions will have to improve breed quality and standards and to increase capacities. Price stability has to be achieved and environmental issues (e.g. waste water pollution) have to find special attention in future livestock planning. The competition in the pig sector is expected to further increase due to foreign companies that will increasingly invest in Vietnam, while other companies, including national ones are prone to collapse, also due to a reduction in governmental subsidies (interviews: DLP 2006 and 2007; NIAH, 2007; VINALIVESCO, 2007) (personal communication L.V. Ly, 2006).

5.5 Discussion and recommendations

Although national and provincial policies clearly focus on the modernisation of the pig sector and promote the establishment of large-scale commercial farms for lean meat production, the pig breeding and production in northern provinces like Son La is still mainly conducted on a small scale (81%) (DARD, 1999), restricted to small household farms with one to two sows that produce five to 20 pigs for fattening and slaughter per year. The numbers of (semi-) commercial pig farms in the northern provinces like Son La is still low as compared to other provinces, particularly in the Red River Delta. Here, the importance of the traditional smallholder pig production systems has been already decreasing, their share only accounting for 20% in Hai Duong province and 30% in Ha

Tay province, while semi-commercial farms with 20 to 60 pigs produced per farm and year and more than 60 pigs produced per farm and year represent 36% of all farms types in Hai Duong and 60% of all farm types in Ha Tay (Lapar et al., 2003). Due to public assistance in the form of tax reductions and other financial supportive measures, the numbers of such kind of farms will probably further increase in the future. (Semi-) commercial farms however also face problems such as limited land resources to expand their production and problems to closely link the production to the market (Lapar et al., 2003). Besides, links to traditional and new extension suppliers tend to be limited.

Breeding sows used at small household farms mostly originate from unimproved village herds. Small pig producers try to avoid purchasing breeding stock at the town market or from other sources. The same has been reported by Lemke et al. (2006). Although sows at the town market are mainly of the Mong Cai breed that is generally preferred by small pig producers due to its prolificacy and its feed intake spectrum and capacity (Lemke et al., 2006; Roessler et al., 2009), pig producers argue that Mong Cai sows from the town market are less adapted to local conditions, as originating from the delta region. Nevertheless, a small number of Mong Cai gilts are regularly transferred from the delta to Son La, obviously because the local production of Mong Cai sows does not cover the local demand and due to the absence of provincial breeding centres. Until 1997, such centres were the only source for Mong Cai sows in the investigated area (Lemke and Valle Zárate, 2008). Breeding animals at (semi-) commercial farms in the Son La province are usually obtained from large private breeding operators that apply professional breeding schemes. Thus, the genetic quality of sows entering (semi-) commercial farms can be expected higher than that of sows used by small pig producers.

The importance of the local Mong Cai as sow breed for smallholder pig breeding is generally still high, more than 99% of reproducing sows are of the Mong Cai breed in Son La, 94% in Hai Duong, 80% in Thai Binh (DARD, 1999; own unpublished data). This might be also due to the fact that efforts to introduce advanced technologies together with exotic sows to smallholder production systems have often failed in the past. For instance, a demonstration model and a pilot study implemented by local authorities in sub-urban areas in Son La province have not been as successful as expected due to a lack of assistance in veterinary care and funding for improved feeding for exotic sows as well

as limited governmental funding preventing the continuation or expansion of the pilot study. Lapar et al. (2003) reported about unsuccessful examples of state programmes from other provinces in Hanoi and Hai Duong, arguing that these large-scale breeding programmes had a strong focus on technical aspects of breeding and production, while neglecting marketing aspects including smallholders' skills and knowledge, disease risks and farmers limited capacities to respond to such risks, smallholders' limited resources to sustain high production costs and the importance of adequate field tests. The same authors also present a more successful example from Ha Tay province where models of exotic pig breeding have been adopted, however, with limited results.

Despite the recognition of the importance of local breeds in national and provincial policies, particularly for mountainous areas, programmes and studies to conserve local pig breeds are limited to a few breeds and regions. Drucker et al. (2006) identified a considerable number of agricultural subsidies that improve the competitiveness of exotic breeds and their crosses over local breeds and forecast that without mitigating measures local breeds will become extinct. Furthermore, neither breed improvement nor conservation programmes are uniform across the provinces (ASPS, 2002). Thus, already Huyen et al. (2005) concluded that the long-term sustainability of conservation programmes for local pig breeds in Vietnam is doubtful.

Networks of technical staff and demonstration farms in Vietnam also target at improving the supply of certified boars and AI services to small pig producers (Hai, 1996). As a consequence, the keeping of boars at small household farms in the investigated area has become uncommon in villages close to towns since the 1980s, being mainly limited to remote villages with no access to public AI services first provided by a provincial breeding centre and later provided by the Extension Department (Lemke and Valle Zárate, 2008). Results of the present study show that the public AI services are no longer in place, resulting in an increase in the number of private boar and AI service providers based at village level. At least one village boar is available in each village, either used for natural service or AI. Besides, small household farms use the AI service provided by (semi-) commercial pig farms. Boars are mainly from exotic breed lines originating from public breeding companies and stations in the delta region.

In addition to demonstration models and pilot projects, training courses are organised for small pig producers and farmer organisations by different extension services. In the Son La province, mostly public service providers organise training courses, mass organisations like the Women's Union and the Farmers' Organisation playing an important role in the knowledge transfer, particularly to poor farmers. This is in accordance with small pig producers' preferences for trainings and technologies provided by public bodies, regarded as more sustainable due to a lower competition. Like for the demonstration models, shortcomings have been identified for training courses not accounting for smallholders' limited financial resources and limited technical and managerial skills to apply new technologies, and often not responding to farmers' needs. Thus, small pig producers are demanding a stronger financial and technical support for their pig production and breeding from public bodies.

In recent years, the concentration process in the international pig breeding sector has resulted in few globally acting breeding companies. In Western Europe, public breeding institutions have been systematically reduced and in North America public breeding no longer exists. Vietnam is one of the few countries (along with China and Cuba) that have established public breeding programmes for pigs, besides importing composite breed lines from international livestock breeding companies (Gura, 2008). Imports of breeding pigs by public breeding companies and research institutes have already started in the late 1950s and still continue in order to improve the quality and productivity of the national pig herd. Importers include PIC, CP Thailand, the Dutch TOPIGS (export via TOPIGS international in Canada and the US) and the United Kingdom Pig Breeding Association (Nhien, 2004). In 2007, the number of foreign invested companies in Vietnam reached 12, the most important companies being CP Thailand, San Miguel Limited Company, France Hybrids Company and a franchise of JSR Genetics and Darby Genetics.

In 2007, Vietnam accessed the WTO with the objective to increase exports with an annual export target of 40-50,000 tons of pork (McLeod et al., 2003). Vietnam's pork exports are still mainly suckling pigs to other Asian countries, pork exporters being rewarded with 280 VND per one US Dollar of exports. This kind of subsidies will be stopped after three years since the WTO accession because of the commitments to WTO members (Nguyen et al., 2006). It is widely recognised that the WTO accession would

bring about both opportunities and threats to the Vietnamese pig sector. The public breeding institutions will have to improve breed quality and standards and increase capacities, price stability has to be achieved and environmental issues have to be addressed. The retailing system will have to be modernised, as international retailers will be interested in exploring the local market, production costs have to be reduced to make Vietnamese pork competitive at the global market and sanitary standards have to be improved (McLeod et al., 2003; Nguyen et al., 2006), along with systems of traceability and quality assurance. Nguyen et al. (2006) forecast that local producers will compete with foreign producers and will have to adapt to changes before imported pork enters the market. So far, it seems that local producers have not been able to adapt to the changes, this year's imports of pork and poultry meat bringing large difficulties for local farmers. According to the Ministry of Agriculture and Rural Development (MARD), low import taxes are one of the reasons for high import volumes. Thus, the MARD has officially asked the Prime Minister to adjust the import taxes on livestock products and animal feed in order to protect the domestic livestock industry (ThePigSite News Desk, 2008).

Recent developments in the pig sector in Vietnam, such as increased foreign investment, changes in consumption and distribution patterns, trends toward large commercial production systems and increasing importance of export markets bear the risk of a potential exclusion of small-scale pig producers from benefits achieved through the economic growth of the pig sector. Thus, new forms of farmer organisations such as new style cooperatives and extension clubs, and institutional innovations such as contract farming have been increasingly promoted to solve technical and market problems faced by individual farmers (Binh et al., 2007; Costales et al., 2005a).

The organisation of breeders into cooperatives or associations is regarded essential for community-based breed development (Köhler-Rollefson, 2000). In Vietnam, farmer organisations proved to help in providing different types of services to smallholders, decreasing input costs through collective purchases and responding to smallholders' needs (Binh et al., 2002; Tuy, D.T., 2002). Small pig producers in the Son La province are formally organised in agricultural extension clubs and a pig production group, besides a number of common socio-political village groups. The membership in such groups enables small pig producers to gain access to micro-credits and new technologies, to

regular exchange of experiences and information and to gain access to training. Even though not organised in cooperatives, small pig producers in Son La also recognise similar advantages for this kind of farmer organisation, in addition to risk and labour sharing, better access to land and extension services, specialisation, lower input prices and possibilities for technology transfer. Yet, small pig producers in the Son La province tend to have limited knowledge of the new concept of cooperatives, reflected in stated disadvantages like no independence in decision making, regulation of production and management and unequal distribution of outputs. As pig producers mentioned a lack of experiences and practical advice to set-up cooperatives, it seems to be of utmost importance to support small pig producers in Son La province to gain knowledge about the new concept of cooperatives and to provide practical support in setting-up cooperatives or other types of farmer organisations. Binh & Thai (2002) and Thai et al. (2002) underline the importance to develop links to researchers and state organisations in order to coordinate collective actions, institutionalise and acquire legal recognition and overcome constraints such as weak technical and managerial capacities and capabilities in commercial and contractual negotiations of farmer cooperatives.

The development of contract farming is regarded as another potential institutional arrangement to integrate small pig producers into value chains. Accordingly, contract farming has recently considerably spread in Vietnam. The Charoen Pokphand (CP) Corporate is one of the most important integrators in Vietnam, with 500 contractors for pigs and chicken (Asian Development Bank, 2005; p. 53 f.). Levels of interdependence are varying according to contracts, from low to high provision of inputs and services by the integrator and from high to low levels of investments by the contract grower (Costales et al., 2005b). In the case of CP in Vietnam, the company provides breeds, feeds and veterinary medicine, while the contract grower has to provide land and build stables. In most cases, contract growers need to borrow capital (Asian Development Bank, 2005). Contract farming in Vietnam tends to bypass small pig producers, as mostly large-industrial farm types are engaged in contract growing with the CP Corporate. The same has been reported for contract growing in China (Guo et al., 2005). Although contract farming is often presented as a “win-win” relationship, providing stability and good incomes to contract growers, a case study from Thailand shows that contract farming may

bear risks for contract growers, such as low and unstable incomes, debts and insecure dependence on integrators (Delforge, 2007).

In concluding, the findings of the present study show that pig breeding activities of smallholder pig producers are not isolated but are directly and indirectly influenced by a number of other breeding institutions at district to global level. In optimising the organisation of smallholder pig breeding, it is important to tighten the links to other institutions, particularly public breeding institutions. Breeder cooperatives at village level might tighten the currently weak links of smallholder pig producers to other breeding institutions at other levels and counterbalance commercial farms and public breeding institutions. The latter can be also considered as an important competitive political aim. Breeder cooperatives may also be a promising option to ensure the sustainability of village breeding programmes. The establishment of such cooperatives could also help providing cooperative members (and other pig producers) with breeding animals from the preferred local Mong Cai breed, enabling members to participate in the breeding progress and to share and improve their knowledge with respect to breeding work, as well as allowing members for additional income through the sale of breeding animals. The marketing of breeding animals within and outside breeder cooperatives requires however coordinated action to have an effective flow of breeding animals. The Producer Association Schwäbisch-Hall in Germany and the De Hoever Producer Union in the Netherlands are examples for successful coordination and integration of smallholder pig breeding and production into vertical networks, capturing value from regional products, counteracting large-scale commercial farms and influencing politics and public opinion (BESH, 2009; Wiskerke and Roep, 2007).

The successful creation of breeder cooperatives will require the support by the government. Although there is the commitment of the government for developing smallholder pig breeding to reduce poverty and to develop rural areas, efforts have been limited in practice in the past. It is important to rigorously enforce political measures already initiated, particularly those targeting at conserving well-adapted local breeds; to recognise and protect breeds; to clearly assign responsibilities in the ministries and to provide earmarked funding and loans as long as the economic independence of breeder cooperatives has not yet been reached. Finally, it should not be ignored that

organisational structures of breeder cooperatives are constantly affected by rapid changes in the pig breeding sector and of its relevant institutions. Thus, breeder cooperatives and other, particularly public breeding institutions have to continuously adapt to changing situations, possibly requiring taking targeted influence, a challenge that can be optimised through the proposed change in the organisational structures of smallholder pig breeding at village level.

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CHAPTER 6

General discussion

6 General discussion

The overall objective of this study was to identify an appropriate design for sustainable village breeding programmes for different smallholder pig production systems in marginal mountainous areas in northern Vietnam, considering functions of pigs for smallholders and logistic determinants. The thesis consists of four papers designed to achieve this general objective. In the following sections, major findings of the four papers are discussed in the study context (6.1), including the definition of breeding objectives and breed choice (6.1.1), design of appropriate breeding schemes (6.1.2) and the organisation of the breeding programme (6.1.3). Thereafter, the methodological approaches are critically discussed (6.2). The last section will present general conclusions and recommendations for the development of village breeding programmes (6.3)

6.1 Design of village breeding programmes

Systematic approaches to breeding planning have been scientifically developed in the 1960s and 1970s (e.g. Börner, 1980; Fewson, 1969; Jacubec and Fewson, 1970; Niebel and Fewson, 1979a-d; among others). The planning of breeding follows a logical sequence of steps: After describing the production system(s), the breeding objective(s) as well as the selection and breeding methods are defined and breeds are chosen. The next steps comprise the estimation of population and genetic parameters as well as economic values and the establishment of an evaluation system. Based on defined selection criteria, mating decisions for selected animals are made. The final step is to set up a system of disseminating the genetic progress to other levels in the breeding system (Harris et al., 1984; Valle Zárate, 1996).

By contrast, the concept of village breeding programmes constitutes a very young and innovative approach. Village breeding programmes are defined as breeding programmes carried out by communities of smallholder farmers (villagers), often at subsistence level (Sölkner et al., 1998). Under low-input production conditions, breeding is constrained by adverse climatic conditions, low and unsteady resource availability (primarily feed), disease risk and poor access to input and output markets (Devendra et al., 1997; Olivier et al., 2002; Valle Zárate et al., 2003). Other constraints are lack of recognisable regional

breeding structures and of systematic exchange of breeding stock between farms (Valle Zárate, 1996). The development of sustainable livestock breeding programmes for marginalised areas in developing countries is therefore very complex. Contrary to the classical "profit-oriented" approach, the primary aim in a breeding programme for smallholder conditions is to minimise the risk for the farmer. Here, the aim of the planning process should be to minimise breeding costs, while achieving acceptable genetic gain in important breeding traits (Sölkner et al., 1998). Since the implementation of breeding programmes also depends on the feasibility of essential breeding measures under given environmental conditions, the process of planning always includes an analysis of the breeding organisation.

6.1.1 Breeding objectives and breed choice for smallholder pig breeding programmes

In the past, many breeding programmes that have been developed for low-input production systems in the developing world failed, since little attention has been paid to the definition of appropriate breeding objectives. The multi-purpose functions and uses of livestock breeds in traditional production systems have been often fully ignored (Olivier et al., 2002; Sölkner et al., 1998). Mismatches between the programme's breeding objectives and those of the farmers have arisen from limited involvement of local farmers in the development and implementation of breeding programmes (Olivier et al., 2002; Sölkner et al., 1998; Valle Zárate, 1995) and from difficulties inherent in accounting for many of the important non-market values and functions of livestock in smallholder systems (Ouma et al., 2004).

According to Lemke et al. (2007), functions of pigs for smallholders in the investigated villages in northern mountainous Vietnam include market and non-market functions. While in the more market-oriented pig production system, the most important function of pigs is income generation, pigs in the more subsistence-oriented system fulfil mostly non-market functions. Due to these differences, it was not unexpected that smallholders' breed and trait preferences also differ (chapter 2 to 4). Heterogeneity in preferences based on different functions of livestock for small livestock keepers in different production

systems have been also reported for East Africa (Ouma et al., 2007) and Mexico (Scarpa et al., 2003a).

Differences in breed and trait preferences between smallholders in different production systems have implications for the breeding programme's breed choice and breeding objectives. Smallholders in the subsistence-oriented production system highly value adaptive traits (adaptation to fibre-rich diet related to a high feed intake spectrum and capacity, disease tolerance) (chapter 2 and 4). Those are traits for that local Ban pigs are highly appreciated in low-input production systems in Vietnam (Anh and Dung, 1994), their feed intake spectrum and capacity being perceived as being well developed. Accordingly, Ban pigs are still the most dominant pig breed in the investigated villages with subsistence-oriented production (chapter 4).

Although adaptive traits, particularly the feed intake spectrum and capacity, are also important pig breeding traits for smallholders in the market-oriented production system, performance traits are more highly valued (chapter 2 and 3). The improved Vietnamese Mong Cai breed combines both, good performances and high adaptability (Duyet and Duong, 1996), thus representing around 50% of all reproducing sows in the Son La province (DARD, 1999) and around 59% of all sows on the investigated market-oriented smallholder farms (chapter 3). In Vietnam, lean pork consumption in urban areas has been increasing and is already more than twice as high as in rural areas (Cuong, 2004), consumers being willing to pay relatively higher prices for lean pork (Anh et al., 2005). Following this trend in consumer preferences, smallholders in the market-oriented production system in Son La province mostly use crossbreeding of local Mong Cai sows with exotic boars. Mating with exotic boars is considered to improve carcass quality and thus marketing chances of crossbred offspring (chapter 3). Yet, carcass characteristics of Mong Cai crossbreds are still poorly meeting the demand for lean meat as compared to pure exotics (26.9 mm backfat and 20.9 mm backfat for LW x MC and pure LW, respectively) (Duc et al., 2002). Also the majority of smallholders in the present study consider these traits to be poor in Mong Cai sows, indicating that the carcass characteristics should be improved in future village breeding programmes (chapter 3). Hau (2008) evaluated carcass characteristics of Ban and Mong Cai pigs in Son La province, showing that the backfat thickness and fat yield of Ban pigs is higher than that

of Mong Cai pigs. Ban keepers appreciate their pigs for their higher fat content. However, the carcass quality has a lower rank for Ban keepers than adaptive traits (chapter 4) and should therefore not be overemphasised in future breeding programmes.

In this context, it has also to be taken into account that in contrast to consumer preferences in urban areas, fatty animals are preferred in rural areas, since pig fat is still widely used for cooking (Anh et al., 2005). Niche markets have been developing for pork from local breeds and regional production in both urban and rural areas (Cuong, 2004). In Son La province, Ban pigs yield higher farm gate prices than LW x MC crossbreds (on average 15,100 VND compared to on average 14,500 VND per kg liveweight, respectively) (Huong et al., 2007) and smallholders in Son La province have good opportunities to market their local Ban pigs (chapter 5).

6.1.2 Breeding schemes

In general, different tools can be considered for genetic improvement in livestock breeds: selection within breeds (or breed lines), crossbreeding or a combination of both (Kinghorn, 1992; Newman and Davis, 1996). In commercial pig production, in general, selection and crossbreeding are combined to achieve the highest level of performance, not only in temperate regions, but also in tropical environments. Through crossbreeding, the efficiency of breeding operations is improved due to heterosis and complementary effects (Payne and Wilson, 1999; p. 585f.). Static terminal crossbreeding systems are used, with lines or breeds having superior genetic merit for reproduction to provide females and lines or breeds that are superior for production traits to provide males. Strengths of lines or breeds are combined in the offspring that have high genetic potential for production and the sow herd has high merit for reproductive traits (Bourdon, 1997; p. 384ff.). In Vietnam, a national leanisation programme is implemented at public institutions, being based on different crossbreeding schemes (from two- to five-breed crossbreeding) using imported great grandparent pigs from various western countries. Exotic sows have been introduced at small household farms with the aim to integrate small farms into the national breeding scheme. In many cases, however, the introduction of new breeds and advanced technologies proved to be inappropriate due to a lack of assistance to

smallholders with regard to feeding, disease management and marketing, missing field tests and limited funding (chapter 5; Lapar et al., 2003).

For low-input production systems in developing countries, selection within local livestock breeds is a viable option for breed improvement, when local breeds have a high productive adaptability (Olivier et al., 2002). This means that breeds are well adapted to harsh and unfavourable production conditions, yet being reasonably productive (Horst, 1994). However, despite the potential for improvement through selection in well-adapted local breeds, crossbreeding of local with exotic livestock breeds has been often preferred to achieve faster genetic gain (Olivier et al., 2002). Kosgey et al. (2006) concluded that benefits of crossbreeding with exotic breeds in the tropics have been often overestimated, crossbreeding with exotic breeds being in many cases unsystematic and less efficient than breeding systems with local breeds. Also in Vietnam, crossbreeding between local and exotic breeds has been widely introduced at small household farms to increase the productivity of pigs (Lapar et al., 2003). In recent years, research has been initiated in Vietnam with regard to crossbreeding between local pig breeds, yet such breeding programmes are still very limited in number and scope (chapter 5).

The most predominant breeding scheme at household farms in the market-oriented production system in Son La province is crossbreeding of local Mong Cai sows with exotic boars (chapter 3; Lemke et al., 2006). This was the first studied breeding scheme. According to Lemke et al. (2007), crossbreeding between exotic boars and MC sows in the market-oriented production system yields higher gross margins than breeding with the local Ban breed in the more subsistence-oriented system, due to a higher liveweight output that compensates for higher production costs e.g. for feeding. Yet, LW x B crossbreeding yields the highest net benefit when comparing different pure- and crossbreeding schemes with MC and Ban under resource-driven production conditions of remote villages and also results in a considerable liveweight output (Lemke et al., 2006 and 2007). Thus, Lemke et al. (2006) concluded that crossbreeding between local Ban sows and exotic boars might be a promising production alternative for smallholder pig production in more remote villages in the investigation area. Accordingly, the second studied breeding scheme characterised crossbreeding between Yorkshire boars and Ban sows (chapter 4).

A stratified breeding programme between the different production systems is proposed as one possible alternative breeding scheme for smallholder pig production (chapter 4). Local breeds are pre-selected for maternal traits, reproduced in the low-input, subsistence-oriented production system and transferred to the market-oriented production system relatively far from town. Crossbred sows are created from mating Ban sows to MC boars in market-oriented yet remote villages and then used to produce fattening pigs from mating local F1 sows with exotic sires in the market-oriented production system close to town, where also the marketing takes place. A combination of pure- and crossbreeding for production in low-input systems and for the conservation of local genetic resources as a promising solution for assuring sustainability through economic success has also been emphasised by Olivier et al. (2002).

Comparing the economic and genetic success of the studied breeding schemes, all breeding schemes lead to a relatively high negative profit and low or even negative genetic gains. This results from the small population sizes and low selection intensities, low reproductive performances of sows, the high proportion of purebred matings to provide replacements, high replacement rates and high breeding costs (chapter 3 and 4). It is important to overcome these system-immanent shortcomings in order to ensure the sustainability of breeding and recording schemes. One possibility could be to extend the existing on-farm performance testing schemes (OPTS) to more smallholders, possibly even in further villages. At the time of the study (2007), the number of smallholders that participated in the OPTS amounted to 233 in a total of nine villages and with a total of 130 MC and 110 Ban sows. According to Baker and Gray (2003), a closed nucleus (comparable to the structure of the groups of recorded and untested sows in the studied breeding schemes) should include a minimum of about 150 breeding females and five breeding males. The studied two-breed crossbreeding schemes (Y x MC and Y x B) do not reach this minimum on the female side and would therefore probably result in an increased rate of inbreeding and thus in a decrease in the genetic variation (chapter 4). Increasing the number of recorded sows would result in larger selection intensities and lower inbreeding rates, thus leading to a higher genetic progress per generation (Baker and Gray, 2003), but would also require a more extensive performance recording. Despite reduced costs per recorded sow, overall costs for data management may increase.

Extending the OPTS would also require the active participation of a larger number of smallholders. And a more extensive data management system would need a stronger technical and financial support, particularly after the project's completion. Here, the cooperation with other institutions, e.g. national research institutes, universities or public institutions at provincial or district level, may support the successful continuation of the OPTS. Yet smallholders' assistance needs should be on a diminishing scale to ensure the long-term sustainability of breeding and recording schemes. In the long run, additional income generated through sales of culled and breeding animals should enable smallholders to run the breeding and recording scheme without financial support and to make them self-sustained (Rege et al., 2001). In general, assumed genetic correlations between reproductive traits and ADG and BF are negligible (ranging between -0.1 and 0.05); thus it was expected that a simultaneous selection for traits should be possible without any antagonism. Nevertheless, the genetic gain in the reproductive traits is generally negative (chapter 3 and 4). In contrast to the average daily gain and the backfat thickness that are both highly heritable (0.5 and 0.45) (Duc, 1999), reproductive traits have a low heritability (0.1 for both farrowing interval and number born alive) (Tholen et al., 1996a; Van and Duc, 1999) which might partly explain the generally negative genetic trend in both reproductive traits (chapter 3 and 4). A strong focus on reproductive traits in the selection index will lead to genetic gains even if only low in the local pig populations (chapter 4). Besides, it can be expected that a focus on reproductive traits in the local population will lead to high crossbreeding effects, also maternal effects, when crossing with genetically superior sire breeds. By contrast, the effect of improved pig performances on the genetic success of breeding schemes is largely limited (chapter 3).

The aims of the studied schemes were to improve the growth rate and backfat in crossbred offspring and to improve the reproductive performances of sows. The breeding objective was kept as simple as possible and not too complex, using only a restricted number of selection traits that can be easily and accurately measured and are sufficient heritable (Valle Zárate, 1996), and reflecting smallholders' trait preferences for pigs (chapter 2 to 4). All the traits that were considered in the studied breeding schemes are bi-monthly recorded in the OPTS (chapter 2 and 3). Adaptability traits (feed intake spectrum and capacity and health) that are of major importance particularly for Ban keepers in the

subsistence-oriented production system in the study area (chapter 2 and 4) were not directly included as selection traits. These traits are difficult to measure and costs associated with measuring them may be high; thus direct selection for feed efficiency or other adaptability traits may neither be appropriate for nor feasible in breeding schemes in Son La province. Therefore indirect selection for feed efficiency traits would be a more practical approach for smallholder breeding schemes taking the average daily gain and body weight as measurements for the ability of the animals to deal with the available feed and to withstand harsh production conditions, benefiting from a moderately high positive genetic correlation between these traits. In this context, it is important to consider that the feed requirements for maintenance will probably also increase. In view of smallholders' low-input production strategy, the increase in body weight should be however limited. A restriction on the body weight would also have a positive effect on the farrowing interval as has been shown for the Y x B crossbreeding scheme (chapter 4). The reproductive performance of sows is one of the most important pig breeding traits, particularly for market-oriented smallholder farmers in Son La province, and should be further improved in future village breeding programmes (chapter 2 and 3). The reproductive performance of sows can be either improved by increasing the litter size or by decreasing the farrowing interval; both traits were included in the studied breeding schemes (chapter 3 and 4). In view of the unsteady availability of feeding resources particularly in the more remote, subsistence-oriented production system, it is important to define an appropriate litter size. Thus, decreasing the farrowing interval might be more reasonable for smallholder pig breeding in the more remote, subsistence-oriented production system (chapter 2 and 4).

Certainly, crossbreeding schemes and particularly stratified breeding schemes are more complex than solely purebreeding schemes, requiring particular organisational setups. However, modelling of purebreeding schemes was neglected in the present study since attempts to return to purebreeding in local pigs do not seem promising. Following general trends in pig production in Vietnam, smallholders in Son La province have already moved to crossbreeding between local and exotic breeds, though poorly organised and coordinated (chapter 4). Research is needed to assess the effective demand for local pig

products on specific markets and to define the optimum output size for crossbred slaughter pigs, considering slaughtering and transport capacities.

6.1.3 Organisation of smallholder pig breeding

For the successful implementation of village breeding programmes, it is important to take different aspects into account, including technical and organisational issues (Wurzinger et al., 2008). The breeding progress in low-input production systems in the tropics is also limited because of lacking breeding organisation and recognisable regional breeding structures (Horst, 1994; Valle Zárate, 1996).

The concentration process in the international pig breeding sector has resulted in few globally acting breeding companies. Vietnam, besides Cuba and China, is one of the few countries that have established public breeding programmes for pigs (Gura, 2008). Different public breeding institutions are involved in the organisation of pig breeding in Vietnam, including the governmental, central ministries and provincial departments, research institutes and universities, breeding companies and many others. Although there is a clear trend towards privatisation, the state still has a strong influence on the pig breeding sector (chapter 5), and the links between public institutions use to be strong (Roessler et al., 2008a). By contrast, the links of smallholder farmers to public institutions are quite weak, smallholder farmers calling for a stronger support by the state (chapter 5).

In Vietnam, cooperative farming is considered as an appropriate institutional innovation and new forms of cooperatives have been increasingly established to overcome barriers to market participation of smallholders and to improve smallholders' access to support services and breeds (Lapar et al., 2006; Phong et al., 2004). Cooperatives might therefore help tightening the relatively weak links of smallholder farmers to public as well as private breeding institutions (chapter 5). The organisation of smallholder farmers in cooperatives or associations is regarded essential for community-based breed development (Köhler-Rollefson, 2000) and can thus also ensure the sustainability of future village breeding programmes in Son La province. In Kenya, the Meru Goat Breeders Association could help to manage breeding programmes, to provide breeding animals to members and non-members in the villages, and to supply breeding stock to be

marketed outside villages (Peacock, 2005). In India, cooperatives for goats and sheep functioning as open nucleus herds have been recommended to produce breeding rams that are then sold to farmers (CALPI, 2005) and farmers in Bolivia have formed a marketing and breeder organisation, building a central mating station, with the aim to improve fibre production in llamas (Wurzinger et al., 2008).

In Son La province, like in the whole of Vietnam, smallholders are organised in a number of village farmer groups. These are mainly traditional socio-political groups of mass organisations like e.g. the Women's Union or the Farmers' Association, but to smaller amount also new types of farmer groups such as agricultural extension clubs. Main functions of traditional groups include access to micro-credits and the exchange of experiences and information, those of new forms additionally include access to new technologies and trainings and source of breeding animals (chapter 5). According to Peacock (2005), other purposes of farmer groups and organisations are e.g. access to veterinary services and feed, product collection and market access. Although traditional village groups do not perform any activities directly related to pig breeding and production, they may form the basis for the transformation into cooperatives because of their relatively high degree of organisation and the generally positive attitude of smallholders towards these groups. Given smallholders' limited knowledge about the concept of new cooperatives (chapter 5) and the weak technical and managerial capacities and capabilities in commercial and contractual negotiations of farmer cooperatives (Thai et al., 2002), it is important to support smallholders in setting-up of cooperatives.

The construction of short food supply chains in combination with breeder cooperatives could be a promising option to create functioning marketing networks for local pigs. In such short food supply chains, it is important to add value, not only through making the chain links transparent for the consumers but also through propagating the use of local, adapted breeds as well as the regional organisation (chapter 4). Through the certification of product origin and implementation of product traceability mechanisms value added might be created as has been also concluded for supply chains and networks for local poultry varieties in Hanoi (Ifft et al., 2008 and 2009). The Producer Association Schwaebisch-Hall in Germany and the De Hoever Producer Union in the Netherlands are examples for successful coordination and integration of smallholder pig breeding and

production into vertical networks, capturing value from the marketing of regional products (BESH, 2009; Wiskerke and Roep, 2007).

Contract farming is considered as another possible institutional arrangement to integrate smallholder farmers into the market and to provide them support services for their pig breeding and production. However, the integration of smallholder farmers in formal contracts with large-scale company integrators such as CP is still very limited in Northern Vietnam (Costales et al., 2006) and not existent in Son La province (chapter 5). For the Philippines a reason that small-scale pig producers are not widely involved in contract raising is the required high minimum number of piglets to be grown by the contractors (Tiongco et al., 2008). This might also be a reason for a low involvement of small-scale pig producers in contract farming in Vietnam. It also seems questionable if contract farming will gain high acceptance in Vietnam, since vertically integrated farming operations are considered less appropriate to the national development goals than cooperative farming (Stanton, Emms & Sia, 1996).

6.2 Methodological discussion

The principle methods used in this study included choice experiments in form of an in-person survey instrument (6.2.1), document analysis, informal (unstructured) interviews and group discussions (6.2.2), structured interviews (6.2.3) and simulation (6.2.4). In the following sections, methods are critically discussed in the overall study context.

6.2.1 Choice experiments

Pigs in smallholder pig production systems in Vietnam have many non-income and socio-cultural functions. For the present study, it was therefore assumed that profit functions would not be appropriate to derive economic values for pig breeding traits in smallholder production systems because of a possible exclusion of important traits from the breeding objective. Recently, stated preference techniques have been increasingly used to define breeding objectives for production systems where functions of livestock are embedded in traits that are seldom traded in any market (e.g. Edel and Dempfle, 2006; Scarpa et al., 2003b; Tano et al., 2003; Wurzinger et al., 2006). In the present study, choice experiments (CE) as one of the stated preference techniques have been used to assess the

importance of functions and traits that are relevant for smallholders in different production systems (chapter 2). Contrary to the contingent valuation method, another stated preference technique, the use of CE enabled to derive relative trade-offs between traits and trait levels. This information was used as a basis to define the relative importance of breeding objective traits (chapter 3 and 4).

The use of CE in this study revealed some limitations. Mc Fadden's Pseudo-R^2 was used to measure the overall fit of the MNL models. According to Louviere et al. (2000), the Pseudo-R^2 should be above 0.1 to accept the model, whereas a value between 0.2 and 0.4 is considered as an extremely good fit. The value for the overall model is 0.21, just above the lower margin given above, and the value for the model reflecting the market-oriented system is 0.11, being considerably lower than that of the other two systems. It has been argued that attributes included in the CE did not equally well reflect each of the three production systems (market-oriented, transitional, subsistence) and that other breeding attributes which were not included in the CE study may also be important characteristics of breeding sows for smallholders in the market-oriented production system (chapter 2). However, trait preferences presented in chapter 3 could not confirm this explanation, showing that the most important pig breeding traits for smallholders in the market-oriented production systems are actually those that have been included in the CE study. Thus, the low Pseudo-R^2 is more likely to be due to the relatively small number of observations for this model as compared to the other models.

It is surprising that many of the attribute levels are not significant (feed requirements, body conformation) although attributes and their levels have been selected within focus group discussions in the investigated villages. Non-significance of coefficients may arise from the complexity of attributes that could not be adequately addressed in the CE. Unrealistic or missing illustrations may also, in part, explain the non-significance of some traits and trait levels. Simple drawings have been used to illustrate traits and trait levels and it may have been difficult for participants in the CE to differentiate different levels in certain traits, e.g. body conformation. More realistic pictorial illustrations, such as three-dimensional images or photograph-like illustrations could have improved respondents' understanding of the characteristics (Vriens et al., 1998), but were rejected to avoid that smallholders' choices are based on recognised breeds only.

The present study shows that econometric modelling was a suitable method to derive economic values of important pig breeding traits for market-oriented smallholder production. By contrast, no economic value could be derived for traits in the subsistence-oriented production system because of non-significant price coefficients. Yet, the relative importance of different pig breeding traits in this type of production system could be defined. How to incorporate information from the CE into breeding objectives still remains a challenge and needs to be developed in a systematic way in further studies.

6.2.2 Informal (unstructured) interviews and group discussions, document analysis

Informal (unstructured) interviews

Unlike semi-structured and structured interviews, unstructured interviews do not contain standardised questions. An interview guide (a general outline of key issues and questions to be discussed) can be used as an "aide mémoire", but does not need to be followed exactly. In unstructured interviews, the interviewer has the highest flexibility since the type and range of answers are not predefined (Vahs, 2007; p. 465f.). Thus, unstructured interviews are particularly relevant for explorative studies (Kühl and Strodtholz, 2002).

In the present study, unstructured interviews were conducted with persons of different breeding organisations (both public and private) and at different levels (from village to national level), assuming that they offer a potential source of rich data in the field of pig breeding organisation (chapter 5). A guideline was used to address certain key issues and questions relevant to the organisation of pig breeding. Mainly qualitative, i.e. purposive and snowball sampling techniques, have been used to select persons for informal (unstructured) interviews. Selection was based on the criterion that persons are involved in and/or are influencing the organisation of pig breeding in Northern Vietnam. In a first step, possible organisations and interviewees were identified through internet search and informal talks with experts as well as through group discussions with smallholder farmers. In later stages of the study, mostly snowball sampling was used. In several cases, further interviews with the same person were conducted to discuss certain key issues in-depth or to touch upon other key issues not yet addressed.

Although informal interviews did not permit all interviewees to cover all relevant issues, the experiences and knowledge of interviewees in the field of pig breeding gave a comprehensive insight in the organisation of pig breeding in Northern Vietnam.

Some major challenges that were experienced while conducting fieldwork in Vietnam included a lack of transparency, particularly in public institutions. According to Lloyd et al. (2004), structures and institutions have been shifting and undergoing considerable changes in the process of the transition from centrally planned to open market economy, resulting in complex relations and interactions between institutions which were not easy to understand as foreign researcher during short term stays. A still sensitive topic was the work in some areas in Son La province, particularly those bordering the Lao PDR and the remote Hmong villages. Therefore, access to some research sites and data largely depended on the assistance from provincial and partner institutions. Moreover, repeated animal disease outbreaks, including foot and mouth disease in 2006 and 2007 and porcine reproductive respiratory syndrome in 2007 largely restricted movements of the researcher and visits of breeding institutions. Some research questions, e.g. related to the administrative, legal and political environment as well as leadership and membership were perceived as politically sensitive and therefore required special sensitivity.

Group discussions

Besides informal interviews, group discussions with smallholders were conducted to explore the pig breeding organisation at village level and to identify other institutions influencing smallholder pig breeding. Like for the informal interviews, an interview guide (a general outline of key issues and questions to be discussed) was used for group discussions with smallholder farmers to allow for flexibility.

According to Liebig and Nentwig-Gesemann (2002), groups are central units of the qualitative research organisation, with a broad spectrum of methods applied. The most widely applied methods are focus group discussions and informal group discussions. Groups can consist of a minimum of two participants, but should not exceed a maximum of ten participants (Liebig and Nentwig-Gesemann, 2002). In the present study, the average number of group discussion participants was six, with a maximum of eight participants.

The major strength of using group discussions in the present study was found in the possibility to explore smallholders' ideas and attitudes and to obtain in-depth information with regard to smallholder pig breeding organisation. Group discussions permitted to better understand the complexity and differences in smallholders' ideas and attitudes and to further discuss them more in-depth with participants. In addition, group discussions allowed for saving time as compared to single person interviews.

Disadvantages of group discussions include the possibility that one or few group discussion participants dominate the discussion and that participants come or leave the discussion. Although great effort was made in the present study to ensure that all participants contribute to the discussion, it could not be avoided that one or few participants were dominating discussions, particularly those who are the head of or occupy important positions in village groups, hindering others to express their opinions. Furthermore, discussion of smallholders' attitude and ideas of cooperatives was in some cases sensitive, particularly in those villages where smallholders have no or only limited experiences and knowledge about cooperatives, particularly new types. Finally, the interpretation in group discussions caused more difficulties than in single person interviews.

The present study was limited to a case study of the organisation of smallholder pig breeding in villages in Son La province and thus only reflects a small sample. It is further acknowledged that group discussions did not permit all groups to cover all relevant issues and questions in detail. Hence, the data collected from different group discussions were obviously different, and therefore not always comparable; this may raise issues of reliability and validity for data collected in this way.

To increase the reliability and validity of data and to compensate for missing or hard-to-access data, triangulation of methods was used, covering a wide range of different persons and institutions and drawing on information from document analysis.

There are other limitations that apply for both, informal interviews and group discussions. Note-taking made it possible for the interviewer to return to statements made earlier by the respondent and group discussion participants. A general limitation is a potential bias

on the researcher's side while deciding which information to note. Data analysis was rather time consuming because of the qualitative, open-ended nature of the data.

Notwithstanding the inherent limitations of informal interviews and group discussions, the findings of the present study may help guide further, more in-depth research of organisational structures of pig breeding in Vietnam and elsewhere.

Document analysis

A document analysis, mainly comprising legal documents, was used to complement and triangulate data collected in informal interviews and group discussions. A systematic approach was used for the document analysis as suggested by Vahs (2007; p. 457f.). A first screening of documents gave a general overview and helped identify institutions and persons for interviewing. Furthermore, information obtained through the document analysis allowed for targeted questions in interviews and group discussions. Available documents were later sorted and criteria for further analysis could be defined. In a next step, selected documents were analysed following the defined criteria. Data from this more in-depth analysis completed data obtained from interviews and group discussions.

More than 60 legal documents were screened to obtain data, of which 18 were used for more in-depth analysis. A general limitation of the document analysis is that documents might describe a wanted target rather than the actual situation, and that documents might no longer be valid. Interviewing was used to confirm data obtained through document analysis and to clarify whether or not legal documents were still in force. Finally, it has to be acknowledged that the list of legal documents is far from complete. Nevertheless, great effort was made to ensure that the most important documents related to organisational aspects and development of pig breeding were included in the in-depth analysis.

6.2.3 Structured interviews

Structured interviews were used to obtain detailed information about smallholders' breeding management as well as breed and trait preferences. A standard set of questions were asked to all interviewees in single-person interviews. Standardised quantitative data allowed for easy analysis and comparison of answers. Based on previous studies, terms (selection traits, functions, etc.) were predefined to limit the scope for the interviewee to

answer questions in any detail. Compared to group-based methods such as group discussions or group interviews, the advantage of single-person interviews was the possibility to avoid one or a few smallholders influencing the answers of others. In some cases, however, other family members or smallholders were present during the interview which might have influenced answers of the interviewee. Most of the interviews were conducted by the researcher herself. This enabled a higher flexibility, allowing for putting further questions and scrutinising some issues more closely. A disadvantage of single-person interviews was that data collection was rather time consuming as compared to data collection through group discussions.

6.2.4 Simulation of breeding schemes with ZPLAN

Before investments into costly breeding strategies are made, it is crucial to conduct a detailed analysis of the expected genetic and economic response (Wollny, 1995). According to Nakimbugwe (2005), computer simulation is a useful tool for a system analysis. This study used computer simulation to model existing and alternative breeding schemes and to analyse their genetic and economic efficiencies. Simulation was realised with the computer programme ZPLAN (Willam et al., 2008) that is based on the selection index procedure and gene flow method (Hill, 1974; McClintock and Cunningham, 1974).

This programme was used because it considers different populations and/ or different tiers such as nucleus, multiplier and production levels. Deterministic simulation allows for multi-trait selection and is fast and flexible and needs less computing capacity as compared to stochastic (probabilistic) simulation (Nitter and Graser, 1994; Willam et al., 2008).

Another computer programme using deterministic simulation is SelAction. Like ZPLAN, it predicts selection response for a wide range of population structures and breeding strategies for different livestock species, and is based on the selection index theory. It also predicts the rate of inbreeding, however, only for breeding schemes with discrete generations (e.g. fish, poultry) and single-stage selection. Thus, this programme feature was not applicable for the evaluated breeding schemes. SelAction also accounts for reduced genetic variance due to selection (Bulmer effect) (Rutten et al., 2002), a feature that is still not available in ZPLAN (Wurzinger et al., 2008). Yet, ZPLAN has an

important advantage over SelAction, as it also predicts the economic efficiency of breeding schemes. Since it has been proven that small livestock keepers rarely adopt costly schemes (Makokha, 2002, cited after Kosgey et al., 2006), it was considered critical in this study to determine the economic efficiency of breeding schemes in addition to the genetic efficiency.

Despite the mentioned advantages, deterministic simulation also has some limitations that apply to this study. Thus, information about the variance of response to selection is not as adequate as from stochastic simulation, and information about the risk inherent in the breeding scheme is lacking. This information is however of particular importance for breeding schemes with small populations and small selection groups (Nitter et al., 1994) as is the case in the present study. Other information that would have been important for optimising breeding strategies for smallholders in the investigated villages includes information about the development of inbreeding and relationship, since the rate of inbreeding in Ban populations in the investigated production systems has been reported to be already high ($\Delta F>2.4$) (Lemke et al., 2006). In the last years, the inbreeding rate could be reduced by a regular exchange of boars between the project villages; yet breeding planning for these villages should concentrate on further reducing the inbreeding rate. Other relevant effects that could not be directly considered in ZPLAN include crossbreeding effects (e.g. heterosis or hybrid vigour). A method to account for these effects would have been to include crossbreeding performance as additional trait in the selection index (Wuensch et al., 1998).

Since ZPLAN was developed to optimise breeding under intensive production conditions, it does not yet consider non-market values. To overcome this limitation, choice experiments (CE) were used to derive economic values for market and non-market traits. These were still only partly included in the definition of breeding objectives and breeding programme evaluation. Besides, a breeding scheme with restriction on body weight was evaluated to account for smallholders' low input production strategy. High increases in average daily gain would lead to a higher demand of the pigs on amount and quality of feed and would not be in line with the persistency of the system (chapter 4).

Future production conditions have to be considered when defining breeding objectives (Graser et al., 2006). This increases the uncertainty of the definition of breeding objectives, particularly in countries where the economy is strongly influenced by the government or undergoes drastic changes, as is the case in Vietnam (chapter 5). Pig production in Vietnam has been changing tremendously in the transition from planned to market economy and national plans to change the structures of the pig production sector from the traditional, small household production to a more industrialised and export-oriented production will certainly have further impact on the development of smallholder pig production in Vietnam (chapter 5), making the prediction of future production conditions even more complicated.

In ZPLAN, the breeding profit is calculated by reducing breeding costs from returns. Breeding costs are the costs directly related to recording and running the breeding programme and are divided into fixed and variable costs, while returns describe the total returns per sow in the whole population that can be expected from the genetic improvement of all traits in the breeding objective in the group of recorded sows over the given investment period. Additional income of smallholders generated through the sale of offspring both for breeding and fattening, as well as the sale of semen from superior boars can not be considered in ZPLAN; thus, the breeding profit may be underestimated.

Finally, breeding scheme evaluations are based on many assumptions, which might influence the genetic and economic merit of breeding schemes. The choice of assumptions is arbitrary, thus alternative assumptions could always be argued for. This study used information from the project's on-farm recording scheme, other publications from the project and own survey data to model the existing breeding schemes as realistically as possible. However, population-specific estimates for genetic and phenotypic parameters were not yet available for simulation and it seemed to be justified to start with standard parameters from literature. These have been obtained, where possible, from other MC populations. In the future, the standard parameters should be gradually replaced by those obtained in the population under study; however, considerable time will be needed to accumulate pedigree-structured performance records as basis for the parameter estimation.

In this context, it must be stressed that the values obtained by ZPLAN should not be interpreted as absolute values, but should be used as basis to support decision making in the development and optimisation of breeding schemes. The strength of ZPLAN was mainly found in its flexibility and the relative comparability of different breeding schemes.

6.3 General conclusions and recommendations

This study provides essential information on pig breeds and traits that should be incorporated in future village breeding programmes for different smallholder production systems in Vietnam. Pig breed and trait preferences of farmers are heterogeneous and to a certain extent system specific. Smallholders in the market-oriented production system mainly prefer the Mong Cai sows for its feed intake capacity and prolificacy, the prolificacy being perceived as not fully exploited yet. Crossbreeding with exotic boars is carried out for the production of lean meat fatteners. By contrast, Ban pigs are still predominantly used in the subsistence-oriented production system. Future breeding programmes should much more concentrate on maintaining adaptability traits than on improving production and carcass traits.

Logistic determinants of smallholder pig breeding indicate that there are several constraints that smallholder pig breeding is facing. These have to be taken into account when developing village breeding programmes. Financial and technical capacities of smallholders to sustain performance recording and breeding programmes are in general limited. Thus, breeding schemes for smallholder pig production should be as simple as possible. In addition, the integration of smallholder pig breeding in provincial, regional or national structures is decisive to ensure the long-term sustainability of village breeding programmes. Another decisive factor is the development of marketing channels. Although there is still a considerable governmental influence on current pig breeding systems in Vietnam, smallholders' links to national and provincial policies and institutions are rather limited and their integration into the market still low. Breeder cooperatives at village level could be a promising option to tighten the relatively weak links to other breeding institutions, smallholders being generally open to organise in cooperatives (farmers groups or communities). Yet, the organisational degree of farmers

in production cooperatives has so far not developed strongly. The successful creation of breeder cooperatives will require the support by the government, including more rigorous enforcement of political measures, clear assignment of responsibilities and financial support, as long as the economic independence of breeder cooperatives has not yet been reached. Stratified breeding programmes in combination with short food supply chains could help to build links between villages and small pig populations and to strengthen smallholders' integration in the not yet formalised specialised supply chain for local pig products, however they will require considerably higher degrees of organisation, logistics and animal movements with all of these factors increasing the risks of a breeding scheme.

An important outcome of the present study is to have developed a tool for comparing alternative breeding schemes and for identifying weak points within breeding programmes. As to the researcher's knowledge, it was the first attempt to develop a model of existing smallholder breeding schemes in Vietnam. Due to missing information on costs and prices, no economic calculations were performed. Besides, population-specific parameters for modelling breeding schemes could not be obtained due to insufficient data. Next steps should therefore include economic calculations and estimation of population-specific parameters once sufficient data is available. Based on this information, a gradual refinement of the model will be necessary. The studied breeding schemes for small household farms in Son La province might serve as an example for household farms in other provinces in northern Vietnam. Yet, out-scaling and up-scaling of breeding planning procedures developed for the research area in Son La province to other areas are needed to provide evidence of the general applicability to village breeding programmes.

In concluding, the setting-up of breeding programmes for small-scale pig producers in the Northwestern mountainous province Son La requires special attention and support given the existence of a wide variety of functions of pigs, reflected in different production objectives as well as breed and trait preferences, and logistic (i.e. organisational, financial and technical) constraints of smallholder pig breeding at village level.

CHAPTER 7

Summary

7 Summary

7.1 Summary

In Vietnam, substantial changes in the national pig breeding system have occurred in the transformation process from centrally planned to market economy. Development incentives mainly focus on intensification and commercialisation of pig production. Still, the majority of the national pig herd is kept on smallholder farms. In marginal areas in Northwest Vietnam, options for intensification are largely limited by low and unsteady resource availability. Besides, there are various other problems that have to be solved for successfully integrating smallholders into an intensified pig production: High quality breeding animals have to be imported from other provinces, the growth rate and carcass quality of crossbred pigs remain poor as compared to exotic breeds, and smallholders' integration in the market is poor. Thus, attempts have to be made to increase production efficiency through improved resource utilisation, improving breeds towards high productive adaptability, i.e. high performances under unfavourable production conditions.

In the frame of subproject D2 of the special research programme (Sonderforschungsbereich 564) of the University of Hohenheim, village breeding programmes are currently developed to improve smallholder pig production in the Son La province in marginalised areas in Northwest Vietnam. Although systematic approaches on the planning of breeding have been scientifically developed in the 1960s and 1970s, the concept of village breeding programmes for low input production systems constitutes a very young and innovative approach. In the past, a significant number of village breeding programmes failed, indicating that the success and long-term sustainability of village breeding programmes depend not only on technical appropriateness, but also on the organisational feasibility under given environmental and structural conditions. The development of tools to characterise multipurpose functions, and the development of methods to optimise the breeding planning procedures for low input production systems are needed to develop sustainable village breeding programmes.

The overall objective of the present study is to identify an appropriate design for sustainable village breeding programmes for different smallholder pig production systems in marginal areas in Northwest Vietnam. Specific objectives are to identify the

contribution of important pig breeding traits to the breeding objective and to evaluate smallholders' breed preferences. Different pig breeding schemes are evaluated with regard to their logistic and socio-cultural feasibility, costs and sustainability. Furthermore, the study attempts to identify possibilities for the integration of village breeding programmes into provincial, regional and national structures and for the organisation of breeding and supply chains.

The study was carried out following a step-wise approach, using a wide range of methods. A choice experiment (CE) was applied in Son La province across 140 households involved in pig breeding in order to identify the importance and trade-offs for a list of adaptive and production traits. NLOGIT 3.0/ LIMDEP 8.0 econometric software was used for econometric analysis of CE data. Smallholders' breed and trait preferences were further investigated approaching 188 smallholders in structured interviews. Frequency analysis (SAS 9.1) was used for data on breeding practices and breeds used, and ranking of smallholders' trait preferences was performed. Based on these data and on information from an on-farm performance testing scheme that is currently implemented in the villages under study, deterministic simulation models of three basic crossbreeding schemes were developed and genetically and economically evaluated with the software package ZPLAN. These included two two-breed crossbreeding schemes and a stratified crossbreeding scheme linking different smallholder production systems and combining local and exotic pig breeds. The basic breeding schemes were adjusted assuming higher pig performances, restricting the body weight, putting more emphasise on reproductive than on production traits and reducing the number of breeding objective traits, respectively. The organisation of smallholder pig breeding in Son La province and its links to other breeding institutions from village to national level were analysed in a qualitative survey in nine provinces in Northern Vietnam in two consecutive years, approaching smallholders in 26 group discussions (Son La province) and a further 51 persons from public and private breeding institutions in nine Northern provinces in 66 interviews. A desk study on the organisation of pig breeding and short food supply chains complemented data obtained in the surveys.

The findings of the CE study indicate that smallholders highly value both, adaptive and performance traits, particularly in the subsistence-oriented production system in remote

areas. Performance traits were more highly valued in the market-oriented system close to markets and towns. These findings have implications for breed choice and breeding objectives. Both, improved local breeds and exotic genotypes should be incorporated in future village breeding programmes for market-oriented smallholder pig production, improving the reproductive and growth performance as well as the carcass quality. By contrast, breeding programmes for subsistence-oriented pig production should much more concentrate on maintaining adaptive traits in the local Ban breed while improving production traits to an optimum level. Ban pigs are besides Mong Cai the predominant breed in investigated households. They are valued by smallholders for their feed intake spectrum, feed intake capacity, disease tolerance, health, growth rate and carcass quality.

Model calculations with ZPLAN show that under current assumptions mimicking the status quo in the project villages both, two-breed crossbreeding schemes, reflecting currently existing breeding schemes of smallholders in the study area, and more sophisticated stratified crossbreeding schemes yield low genetic gains in production traits and lead to negative genetic trends in reproduction traits. Discounted profits are highly negative due to considerably high breeding costs. Only a restriction on body weight would lead to a desirable genetic trend in the farrowing interval. In a stratified crossbreeding scheme with a strong focus on farrowing interval and minor focus on average daily gain, the farrowing interval would be reduced only slowly. By contrast, effects of increased pig performances on the genetic and economic success of breeding schemes would be generally limited.

Logistic determinants of smallholder pig breeding indicate that there are several constraints that have to be taken into account when developing village breeding programmes. Links of smallholders to other breeding institutions, both public and private, are generally weak. Thus, interactions with large commercial breeding companies or national research institutes are largely limited and smallholders' access to breeding support services and agricultural extension services are mainly limited to service providers at district and communal level. For the successful implementation of village breeding programmes it is decisive to tighten the currently weak links to other breeding institutions by integrating smallholder pig breeding in provincial, regional or national structures. Due to a generally positive attitude of smallholders towards new types of

agricultural cooperatives and national incentives to increase the number of such cooperatives, breeder cooperatives at village level are proposed to tighten the relatively weak links to other breeding institutions and to ensure the sustainability of village breeding programmes. Existing farmer organisations at village level are characterised by a relatively high degree of organisation and may serve as a basis to build breeder cooperatives.

It is further concluded that a stratified breeding scheme together with a short food supply chain are an option to build links between remote and close-to-market villages. The size of the currently too small pig populations has to be increased and critical organisational aspects like poorly developed infrastructure, poor access to input and output markets and information have to be overcome. Financial and technical capacities of smallholders to sustain performance recording and breeding programmes and to build cooperatives and short food supply chains are still limited. Therefore, implemented breeding schemes must be as simple as possible and financially and technically supported by the government or other institutions in the implementation phase. Breeding costs must be substantially reduced.

Another important result of the study was the development of a tool to comparatively evaluate alternative breeding schemes. The mapping of the breeding schemes shows that planned breeding in the Son La region is possible. Next steps should include economic calculations and estimation of population-specific parameters to gradually refine the developed model. Furthermore, out-scaling and up-scaling of breeding planning procedures to other areas are needed to provide evidence of the general applicability of village breeding programmes. There remains the need to assess the effective demand for local pig products on specific markets and to define the optimum size of the breeding population and the output size for crossbred slaughter pigs, considering slaughtering and transport capacities.

7.2 Zusammenfassung

Der Übergang von einer zentralen Planwirtschaft in eine freie Marktwirtschaft hat in Vietnam zu grundlegenden Veränderungen im Bereich der Schweinezucht geführt. Entwicklungsmaßnahmen zielen hauptsächlich auf die Intensivierung der Schweineproduktion ab; jedoch wird geschätzt, dass ein Großteil des nationalen Schweinebestandes weiterhin auf kleinbäuerlichen Betrieben gehalten wird. In marginalen Gebieten in Bergregionen Nordwestvietnams sind die Möglichkeiten einer Intensivierung der Schweineproduktion hauptsächlich durch eine geringe und unregelmäßige Ressourcenverfügbarkeit stark begrenzt. Daneben gibt es zahlreiche andere Hemmnisse, die für eine erfolgreiche Integration von Kleinbauern in eine marktorientierte Schweineerzeugung überwunden werden müssen: hochwertige Zuchttiere müssen aus anderen Provinzen eingeführt werden, die Wachstumsleistung und Schlachtkörperqualität von Kreuzungsmasttieren ist niedrig verglichen mit Hybridmasttieren auf kommerziellen Großbetrieben, und die Einbindung der Kleinbauern in Märkte ist schwach. Eine Lösung stellt hier die Erhöhung der Produktionseffizienz durch eine verbesserte Ressourcennutzung dar, was durch eine züchterische Weiterentwicklung von Genotypen mit einem hohen produktiven Adaptationsvermögen realisiert werden kann.

Das Teilprojekt D2 des Sonderforschungsbereichs 564 der Universität Hohenheim befasst sich langfristig mit der Entwicklung dörflicher Zuchtprogramme, um die kleinbäuerliche Schweineproduktion in der Provinz Son La in den Bergregionen Nordwestvietnams zu verbessern. Obwohl zuchtplanerische Forschungsansätze und –methoden bereits in den 1960er und 1970er Jahren entwickelt wurden, ist das Konzept dörflicher Zuchtprogramme für extensive Haltungssysteme ein relativ neuer und innovativer Ansatz. Der langfristige Erfolg und Nachhaltigkeit solcher Programme ist von der technischen Angemessenheit und organisatorischen Machbarkeit unter gegebenen Rahmenbedingungen abhängig. Hier ist eine methodische Weiterentwicklung notwendig, um die vielfältigen Funktionen von Tieren in kleinbäuerlichen Produktionssystemen zu charakterisieren und zuchtplanerische und zuchtorganisatorische Forschungsansätze für die Entwicklung nachhaltiger dörflicher Zuchtprogramme zu optimieren.

Ziel der vorliegenden Arbeit war, die technische Angemessenheit und organisatorische Machbarkeit alternativer dörflicher Schweinezuchtprogramme für Kleinbauern in unterschiedlichen Produktionssystemen in Nordwestvietnam zu bewerten. Schwerpunkte waren die Ermittlung kleinbäuerlicher Rasse- und Merkmalspräferenzen für Schweine, die genetische und ökonomische Bewertung alternativer Zuchtmethoden und die Durchführung züchtungsorganisatorischer Untersuchungen, um Möglichkeiten aufzuzeigen, wie dörfliche Zuchtprogramme in bestehende regionale und nationale Strukturen und Wertschöpfungsketten eingebunden werden könnten.

Die Arbeit wendete ein umfangreiches Methodenspektrum an. 140 sogenannte „Choice Experimente“ (CE) wurden mit Kleinbauern in der Provinz Son La durchgeführt, um kleinbäuerliche Merkmalspräferenzen für lokale Schweinerassen zu ermitteln. Die CE Daten wurden mit Hilfe des Programms NLOGIT 3.0/ LIMDEP 8.0 ökonometrisch ausgewertet. Kleinbäuerliche Rasse- und Merkmalspräferenzen wurden in 188 strukturierten Interviews mit Kleinbauern weiter untersucht. Deskriptive und Frequenz-Analysen von Daten aus strukturierten Interviews erfolgten mit dem FREQ Verfahren des Statistik-Paketes SAS 9.1 (SAS Institute, Cary, NC). Basierend auf Daten aus der ökonometrischen und biometrischen Datenanalyse und auf Informationen des vom Teilprojekt D2 implementierten betriebsbasierten Leistungsprüfungssystems wurden deterministische Modelle entwickelt. Die Modelle simulierten bestehende (Einfachkreuzungen) und alternative Kreuzungszuchtsysteme in den Projektdörfern (stratifiziertes Drei-Rassen-Kreuzungssystem) und wurden mit Hilfe des Zuchtplanungsprogramms ZPLAN ökonomisch und genetisch ausgewertet. In einem nächsten Schritt wurden die Effekte verbesserter Leistungen von Schweinen, einer Begrenzung des Körpergewichts, einer stärkeren Gewichtung der Reproduktionsmerkmale sowie einer Reduzierung der Zuchtzielmerkmale von vier auf zwei Merkmale untersucht. Zuchtorganisatorische Untersuchungen fanden in insgesamt neun Provinzen in Nordvietnam in zwei Erhebungsperioden statt, mit Schwerpunkt in der Provinz Son La. Die Befragungen umfassten 26 Gruppendiskussionen mit Kleinbauern in der Provinz Son La und 66 informellen Interviews mit 51 Personen aus staatlichen und privaten Züchtungsinstitutionen. Ergänzend zu den Befragungen fand eine Dokumentenanalyse zur Zuchtorganisation und kurzen Lebensmittelketten statt.

Die Auswertung der CE Daten zeigt, dass die Rasse- und Merkmalspräferenzen zwischen Kleinbauern in unterschiedlichen Produktionssystemen stark variieren. Während für Kleinbauern in eher subsistenzorientierten Produktionssystemen neben Leistungsmerkmalen besonders eine hohe Anpassungsfähigkeit von lokalen Schweinerassen wichtig ist, verdeutlichen die Rassepräferenzen und Zuchtstrategien in marktorientierten Produktionssystemen die Bemühungen der Kleinbauern, den Anteil von Hochleistungsrassen zu erhöhen. Für Kleinbauern in diesen Produktiosnsystemen sollten in zukünftigen dörflichen Zuchtprogrammen sowohl verbesserte Lokalrassen als auch importierte Hochleistungsrassen integriert werden, mit dem Ziel, die Reproduktions- und Wachstumsleistung der Schweine zu verbessern. Im Gegensatz dazu sollten Zuchtprogramme für Kleinbauern in subsistenzorientierten Produktionssystemen die Verbesserung von Lokalrassen und deren hohes produktives Adaptationsvermögen umfassen.

Die Zuchtplanungsmodellierungen in ZPLAN zeigen, dass die auf der Basis der Ist-Situation untersuchten Einfachkreuzungen sowie das komplexere, stratifizierten Drei-Rassen-Kreuzungssystem zu einem geringen Zuchtfortschritt in den Produktions- und Schlachtkörperqualitätsmerkmalen und zu einem negativen genetischen Trend in den Reproduktionsmerkmalen führen. Der erzielte diskontierte Züchtungsgewinn ist aufgrund der hohen Züchtungskosten negativ. Nur eine Begrenzung des Körpergewichts kann den negativen genetischen Trend in der Zwischenwurfzeit umkehren. Auch in einem stratifizierten Kreuzungszuchtsystem mit einer stärkeren Gewichtung der Zwischenwurfzeit und einer geringeren Gewichtung der täglichen Zunahmen kann die Zwischenwurfzeit leicht verbessert werden. Verbesserte Leistungen von Schweinen haben kaum Einfluss auf den ökonomischen und genetischen Gewinn von den untersuchten Zuchtsystemen.

Logistische Determinanten der kleinbäuerlichen Schweinezucht verdeutlichen, dass unterschiedliche Hemmnisse überwunden werden müssen, um dörfliche Zuchtprogramme erfolgreich zu implementieren. Die Bindungen von Kleinbauern zu anderen Züchtungsinstitutionen, sowohl staatliche als auch privat organisierte, sind eher marginal. Es gibt kaum Interaktonen von Kleinbauern mit großen Zuchtunternehmen oder staatlichen Forschungsinstituten und der Zugang von Kleinbauern zu tierzüchterischen

Dienstleistungen und Beratungsdiensten ist beschränkt. Für die erfolgreiche Implementierung dörflicher Zuchtprogramme ist es entscheidend, die derzeit schwachen Verbindungen von Kleinbauern zu anderen Züchtungsinstitutionen zu stärken und Kleinbauern in bestehende regionale und nationale Strukturen einzubinden. Aufgrund einer generell positiven Einstellung der Kleinbauern gegenüber neuen landwirtschaftlichen Genossenschaftsformen und aufgrund nationaler Entwicklungsmaßnahmen, die auf die Erhöhung der Anzahl solcher Genossenschaftsformen abzielen, wird hierfür die Etablierung von Züchtergenossenschaften auf Dorfebene empfohlen. Bestehende Bauernvereinigungen auf Dorfebene weisen einen hohen Organisationsgrad auf und könnten als Basis für die Bildung von Züchtergenossenschaften dienen.

Es werden außerdem stratifizierte Zuchtprogramme in Kombination mit kurzen Lebensmittelketten (Short Food Supply Chains) vorgeschlagen, um Verbindungen zwischen Kleinbauern in stadtnahen und entlegenen Dörfern aufzubauen. Die derzeit zu kleinen Schweinesubpopulationen müssen vergrößert werden und außerdem kritische organisatorische Aspekte wie z.B. eine schlecht entwickelte Infrastruktur und ein begrenzter Zugang zu Input- und Outputmärkten sowie Informationen überwunden werden. Die finanziellen und technischen Kapazitäten der Kleinbauern für die Fortführung der Leistungsprüfungen und Zuchtprogramme und für die Bildung von Genossenschaften und Lebensmittelketten sind weiterhin begrenzt. Es ist daher entscheidend, den Aufbau dörflicher Zuchtprogramme so einfach wie möglich zu halten. Außerdem ist die finanzielle und technische Unterstützung von Seiten des Staates oder anderer Institutionen in der Implementierungsphase wichtig. Außerdem müssen die derzeit hohen Züchtungskosten deutlich reduziert werden.

Ein weiteres wichtiges Ergebnis der Studie war die Entwicklung eines Werkzeuges zur vergleichenden Bewertung alternativer Zuchtsysteme. Die Studie zeigt, dass organisierte Züchtung in der Provinz Son La möglich ist. Die nächsten Schritte sollten wirtschaftliche Berechnungen und Schätzungen populationsspezifischer Parameter beinhalten, um das Modell schrittweise zu verbessern. Darüber hinaus sind ein Out- und Upscaling von Zuchtplanungsmodellierungen auf andere Regionen notwendig, um die allgemeine Anwendbarkeit dörflicher Zuchtprogramme zu belegen. Es müssen die effektive

Nachfrage nach lokalen Schweinefleischerzeugnissen auf bestimmten Märkten und eine optimale Größe der Zuchtpopulationen und der optimale Output an Kreuzungs-Masttieren untersucht und Schlacht-und Transportkapazitäten berücksichtigt werden.

7.3 Tóm tắt

Ở Việt nam, những thay đổi quan trọng trong hệ thống giống lợn quốc gia diễn ra trong quá trình chuyển đổi từ nền kinh tế thiết lập từ trung ương sang nền kinh tế thị trường. Sự phát triển mạnh chủ yếu tập trung vào chăn nuôi lợn thâm canh và thương mại. Tuy vậy, phần lớn đàn lợn quốc gia được nuôi bởi các nông hộ nhỏ. Ở các vùng núi sâu xa thuộc Tây Bắc Việt nam, sự lựa chọn cho thâm canh chăn nuôi lợn chủ yếu bị hạn chế bởi sự thiếu và kém bền vững của các nguồn lực. Bên cạnh đó, có rất nhiều vấn đề khác cần phải giải quyết cho sự thành công của việc mở rộng phát triển chăn nuôi lợn thâm canh đến các nông hộ nhỏ: Các giống cao sản phải nhập từ các tỉnh khác, tỷ lệ tăng trọng và chất lượng thịt xẻ của lợn lai còn kém so với các giống lợn ngoại, và sự thâm nhập vào thị trường của các hộ dân còn kém. Do đó, những nỗ lực nhằm tăng hiệu quả chăn nuôi lợn thông qua việc tận dụng hiệu quả các nguồn lực sẵn có, tăng năng suất thích nghi, có nghĩa là đạt năng suất cao trong các điều kiện chăn nuôi khó khăn, là cần thiết.

Trong khuôn khổ của dự án nhánh D2 của chương trình nghiên cứu (SFB 564) của trường đại học Hohenheim, các chương trình giống tại bản đã được phát triển nhằm tăng năng suất chăn nuôi lợn trong điều kiện nông hộ của tỉnh Sơn La, vùng núi Tây Bắc Việt Nam. Mặc dù các nghiên cứu tiếp cận một cách hệ thống về sự thiết lập chương trình giống đã phát triển trong các thập kỷ 60-70, khái niệm về các chương trình giống tại bản phục vụ cho các hệ thống chăn nuôi có đầu tư thấp vẫn còn là những nghiên cứu mới mẻ. Trước kia, một số lớn các chương trình giống tại địa phương đã thất bại, đã chỉ ra rằng, sự thành công và sự bền vững lâu dài của các chương trình giống địa phương không chỉ phụ thuộc vào sự thích hợp của kỹ thuật, mà còn phụ thuộc vào tính khả thi của việc tổ chức chương trình giống trong các điều kiện môi trường và cơ sở hạ tầng cụ thể. Sự phát triển của các công cụ nhằm khai thác các đặc điểm về các chức năng đa tác dụng, và sự phát triển của các phương pháp nghiên cứu nhằm tối ưu hoá việc thành lập chương trình giống cho các hệ thống chăn nuôi đầu tư thấp là cần thiết cho việc phát triển các chương trình giống bền vững tại bản.

Mục đích của nghiên cứu này nhằm xác định một mô hình thích hợp cho các chương trình giống bền vững tại cộng đồng bản của các hệ thống chăn nuôi nông hộ khác nhau ở vùng sâu xa miền Tây Bắc Việt Nam. Các mục tiêu cụ thể bao gồm: xác định sự đóng

góp của các tính trạng quan trọng về giống trong mục đích công tác giống, và sự đánh giá thị hiếu về giống lợn của người chăn nuôi. Các chương trình giống khác nhau được đánh giá về tính khả thi liên quan đến văn hoá - xã hội và các vấn đề về hậu cần, chi phí, và tính bền vững. Hơn nữa, nghiên cứu này nhằm xác định triển vọng cho sự mở rộng các chương trình giống cộng đồng tại bản đến các tổ chức thuộc tỉnh, vùng và quốc gia và phát triển thành một tổ chức giống và các chuỗi cung cấp.

Các phương pháp tiếp cận khác nhau được áp dụng trong nghiên cứu này. Thử nghiệm lựa chọn (CE) được áp dụng trong tỉnh Sơn La, trên 140 hộ dân tham gia vào chương trình giống nhằm xác định và cân nhắc theo mức độ quan trọng nhằm đưa ra một danh sách các tính trạng sản xuất và thích nghi. Phần mềm thuộc toán kinh tế NLOGIT 3.0/ LIMDEP 8.0 được sử dụng cho việc phân tích về kinh tế các số liệu của CE. Sở thích về giống và tính trạng của người chăn nuôi đã được triển khai đánh giá thêm trên 188 nông hộ bằng phương pháp phỏng vấn với bảng câu hỏi chuẩn. Các phân tích tần suất (SAS 9.1) được áp dụng phân tích số liệu về giống và các hoạt động về giống, đồng thời các lựa chọn của người dân về các tính trạng cũng được đánh giá xếp loại. Dựa vào những số liệu và thông tin này từ chương trình kiểm tra năng suất cá thể tại nông hộ, là chương trinh được thực hiện tại các bản trong nghiên cứu này, các mô hình của 3 kế hoạch lai giống cơ bản được phát triển và đánh giá về di truyền cũng như kinh tế bằng phần mềm ZPLAN. Các kế hoach giống này bao gồm hai kế hoạch lai hai giống và một kế hoạch lai giống phân tầng liên kết với các hệ thống chăn nuôi nông hộ khác nhau và kết hợp các giống lợn địa phương với lợn ngoại. Các kế hoạch giống cơ bản đã được điều chỉnh cho năng suất của lợn cao hơn đi đôi với việc giới hạn về trọng lượng, chú trọng nhiều đến các trính trạng sinh sản hơn các tính trạng sinh trưởng và giảm số lượng của các tính trạng trong mục tiêu chương trình giống. Sự tổ chức của hoạt động về giống lợn của nông hộ trong tỉnh Sơn La và mối liên kết của nó với các cơ quan hoạt động về giống khác từ mức độ bản đến quốc gia đã được phân tích trong một cuộc điều tra định tính ở 9 tỉnh phía Bắc Việt Nam trong hai năm liền nhau, tiếp cận với các nông hộ trong 26 cuộc thảo luận nhóm (tỉnh Sơn La) và 51 người khác từ các cơ quan hoạt động về công tác giống tư nhân và nhà nước ở 9 tỉnh miền Bắc Việt Nam trong 66 cuộc phỏng vấn. Nghiên cứu về sự tổ chức của hoạt động về giống lợn và các chuỗi cung cấp thực phẩm ngắn đã được thực hiện từ các số liệu thu được trong các đợt điều tra.

Kết quả của nghiên cứu CE chỉ ra rằng các nông hộ đánh giá cao cả hai tính trạng thích nghi và sản xuất, đặc biệt trong hệ thống chăn nuôi định hướng tự cung tự cấp ở vùng sâu. Các tính trạng sản xuất đã được đánh giá cao trong hệ thống chăn nuôi định hướng theo thị trường ở vùng gần chợ và thị xã. Các kết quả này có liên quan đến sự lựa chọn giống và mục đích công tác giống. Cả giống lợn địa phương cải tiến và các kiểu gien lợn ngoại cần được đưa vào các chương trình giống cộng đồng trong tương lai trong hệ thống chăn nuôi lợn nông hộ định hướng thị trường nhằm tăng năng suất sinh sản và sinh trưởng cũng như chất lượng thịt xẻ. Trái lại, các chương trình giống cho hệ thống chăn nuôi tụ cung tự cấp nên tập trung nhiều hơn vào duy trì các trinh trạng thích nghi ở lợn Bản địa phương trong khi cải thiện các tính trạng sinh trưởng đạt đến mức tối ưu. Lợn Bản cùng với lợn Móng Cái là hai giống phổ biến ở các nông hộ điều tra. Chúng được người chăn nuôi đánh giá cao về tính phàm ăn, khả năng tiếp nhận thức ăn, tính chống chịu bệnh tật, sức khoẻ, khả năng sinh trưởng và chất lượng thịt xẻ.

Mô hình tính toán với ZPLAN chỉ ra rằng trong các điều kiện hiện tại như các bản trong dự án, các kế hoạch lai hai giống, đã phản ánh các kế hoạch giống hiện hành của nông hộ trong vùng nghiên cứu, và các kế hoạch giống phân tầng phức tạp hơn đạt sự thu nạp di truyền thấp ở các tính trạng sinh trưởng và dẫn đến xu hướng di truyền âm ở các tính trạng sinh sản. Sự giảm lớn về lợi nhuận là do giá cao của công tác giống. Sự hạn chế về thể trọng sẽ dẫn đến xu hướng di truyền mong đợi ở khoảng cách lứa đẻ. Ở kế hoach lai giống phân tầng với sự tập trung vào khoảng cách lứa đẻ và ít quan tâm đến tăng trọng, khoảng cách lứa đẻ sẽ chỉ giảm chậm. Trái lại, những ảnh hưởng của việc tăng năng suất về mặt di truyền và kinh tế của các kế hoạch giống nhìn chung sẽ bị hạn chế.

Các yếu tố hậu cần của công tác giống tại nông hộ chỉ ra rằng có một số khó khăn cần lưu ý khi phát triển các chương trình giống tại địa phương. Mối liên kết của nông hộ với các tổ chức cơ quan hoạt động về giống, cả tư nhân và nhà nước, nói chung còn yếu. Vì vậy, sự tương tác với các công ty giống thương mại hoặc các viện nghiên cứu về giống phần lớn bị hạn chế và sự tiếp cận của nông hộ đến với các dịch vụ trợ giúp về giống và các dịch vụ khuyến nông phần lớn chỉ hạn chế ở các nhà cung cấp dịch vụ trên phạm vi huyện và xã. Để đạt được sự thành công của việc thực hiện các chương trình giống tại cộng đồng, sự khắc phục mối liên kết yếu giữa nông hộ và các cơ quan giống là cần thiết bằng cách hội nhập công tác giống nông hộ đến các tổ chứctrên phạm vi toàn tỉnh, vùng

và quốc gia. Nhìn chung do người dân có thái độ tích cực đối với các loại hình hợp tác nông nghiệp mới và sự khích lệ trên cả nước nhằm tăng loại hình hợp tác như vậy về các nhà cung cấp giống tại bản được cho rằng nhằm làm mạnh hơn mối liên hệ với các cơ quan giống khác và đảm bảo sự bền vững của các chương trình giống cộng đồng. Các tổ chức hiện có của người dân tại phạm vi bản được đánh giá ở mức độ tổ chức cao và có thể hoạt động như một nền tảng xây dựng nên hiệp hội của các nhà cung cấp giống.

Tóm lại, kế hoach giống phân tầng cùng với chuỗi cung cấp thực phẩm ngắn là một sự lựa chọn để xây dựng nên mối liên kết giữa các bản vùng sâu và các bản gần thị trường. Quần thể quá nhỏ của đàn lợn hiện tại phải được nhân lên và các khía cạnh quan trọng về tổ chức như cơ sở hạ tầng nghèo nàn, sự tiếp cận đến các nguồn đầu vào và đầu ra của thị trường và thông tin còn nghèo nàn, phải được khắc phục. Khả năng về tài chính và kỹ thuật của nông hộ để thực hiện việc theo dõi ghi chép và các chương trình giống ổn định và để thành lập các hiệp hội và các chuỗi thực phẩm ngắn vẫn còn hạn chế. Vì vậy, các kế hoạch giống khi thực hiện phải thật đơn giản và cần được hỗ trợ của chính phủ hoặc các cơ quan khác về tài chính và kỹ thuật. Cần thiết phải giảm giá cho chi phí công tác giống.

Một kết quả quan trọng khác của nghiên cứu này là sự phát triển của công cụ để đánh giá so sánh các kế hoạch giống với nhau. Việc lập sơ đồ các kế hoạch giống chỉ ra rằng các việc thiết lập các chương trình giống ở Sơn La là khả thi. Các bước tiếp theo cần bao gồm các tính toán về kinh tế và sự ước đoán về các chỉ số quần thể đặc biệt để dần chọn lọc và phát triển mô hình. Hơn nữa, quá trình phổ biến các chương trình giống đến các vùng khác là cần thiết để cung cấp bằng chứng về sự áp dụng trên diện rộng của các chương trình giống cộng đồng. Nhu cầu về các sản phẩm lợn địa phương ở các thị trường đặc biệt cần phải được đánh giá và xác định kích thước tối ưu của quần thể giống và kích thước đầu ra cho lợn lai lúc xuất chuồng cũng như khả năng mổ và vận chuyển cần phải cân nhắc.

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