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Characterisation of a model for conservation of autochthonous pig breeds on smallholder farms in North Vietnam

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3 Abbreviations

AU	animal unit
F.	Farms
BG	Province Bac Giang
HT	Province Ha Tay
LH	Lang Hong- Pig
MC	Mong Cai- Pig
n	number of observations
NA	Province Nghe An
NIAH	National Institute of Animal Husbandry, Hanoi
NP	Net profit
SD	Standard deviation
SL	Province Son La
TH	Province Thanh Hoa

4 Executive Summary

Problem

For a long time the animal production of Vietnam was based on the utilization of **local genotypes**. However, local genotypes are characterized by a **low productive performance**. The **crossbreeding** and **replacement** of local breeds with imported **high-yielding breeds** in the past aimed at the increase of performance. This led to a severe **decrease** of the **autochthonous breeds** in recent years. Local breeds are not only an important part of the country' s biodiversity, but they are well adapted to inpuextensive production systems. Therefore they represent an **important livestock genetic resource** for the generally **resource poor farmers** of Vietnams remote areas. In addition, they have also **characteristics with potential economic value**. This makes them interesting for future breeding programmes.

To prevent the extinction of local breeds, Vietnam founded the *National Programme on Conservation of the Vietnamese Animal Genetic Resources*. Under the direction of the **National Institute of Animal Husbandry** (NIAH), special sub-programmes were founded for the protection and conservation of certain domestic animal breeds. In contrast to the majority of conservation programmes in other countries most of the conservation programmes implemented by NIAH are conducted **on farm** with **intensive farmer participation**. One of these programmes aims at the conservation of the **I-pig**. This programme intends to combine the **conservation** of the I-pig with the **improvement of the economic situation of the target group**, i.e. **resource-poor farmers** keeping this pig-breed.

Objectives

The objectives of the present study were the following:

- Characterization of the I-pig-programme (organisational structure, breeding and conservation measures and their success, productive traits of the I-pig, efficiency and sustainability of the programme),
- Evaluation of the programmes impact on the economic situation of the participating farmers,
- Survey on the production conditions for other local pig breeds and on their productive and economic characteristics,
- Estimation of the need for conservation programmes measures for other local pig breeds, assessment of the required activities,
- Assessment of the practicability of “on farm” conservation programmes for other local pig breeds.

Data collection

Data collection was carried out from **17th of February** to **15th of May 2000** in **5 provinces** of **North Vietnam** through interviews with key informants and farmers. **102 farmers** in 23 villages of Thanh Hoa, Ha Tay, Bac Giang, Nghe An and Son La were visited. Among them were members of the **3 different ethnic groups** of Kinh, Thai and H'mong. Besides the I-pig (owned by the Kinh people) the following four **local pig breeds** and their crosses (with Landrace-pigs, Large White or Duroc) were studied: Mong Cai-pig, Lang Hong-pig (both owned by Kinh people), Meo-pig (owned by Thai and H'mong people) and Co-pig (owned by Thai people). Except of the Mong Cai population, which is considered to be insecure, these breeds are considered to be under the **risk of extinction**.

The farmers were interviewed following a **questionnaire** on:

- the households **socio-economic conditions**,
- all aspects of **pig production** (pig population on the farm, pig performances, marketing, housing, breeding, feeding, health care management, acceptance of the respective pig breeds by their owners),
- the **I-pig-programme** itself (expectations, opinions, wishes of the participants regarding the programme).

General results: Small - scale pig production in North Vietnam

Most of the farms visited conducted small-scale pig production with one or two breeding sows and a small number of fattening pigs.

The majority of **Kinh** people live **near towns** and therefore have **access to resources** (feedstuff, breeding animals of improved genotype, extension and veterinary-services, alternative income sources and credit facilities) and better **access to the market**. Pig production has here reached a certain level of **intensification**. Fattening and breeding are separated into different units. **Local breeds with higher performance** (Mong Cai) are used to produce F1-piglets by artificial insemination with **exotic boar** (Landrace, Large White). Fattening of F1-piglets is **market-orientated**. **Consumption** of self-produced pork is **not common**.

This system requires **high input** (feedstuff, breeding material, veterinary and extension services, transport, artificial insemination, and hired labour). However, it also yields a high output of pig production and thus **high cash-income**. The **net profit** of this production form (difference of output of pig production and variable costs) is high. On the other hand, due to the high costs the **economic efficiency** (quotient of output of pig production and variable costs) is **lower** when compared with pig production in the low-input-system. This type of system can also be found at the participants of the I-pig-programme.

On the contrary **Thai** and **H'mong** people live in remote mountainous areas with **low access to the resources** mentioned above. Pig production is based on the utilization of **local genotypes**; crossbreds with exotic breeds are rare. Production is **less market-orientated**. However it provides some cash income to overcome financial shortages and supplies meat and fat for **home consumption**.

Because of the animals **low performance** the **net profit** is **low** (difference of output of pig production and variable costs). However, the variable **costs** are **low**, too, because of the utilization of farm-by products as feedstuffs and own breeding material. Therefore **average economic efficiency** (quotient of output of pig production and variable costs) is **higher** compared to pig production of the Kinh-farmers.

Special results: I-pig-programme

The **participation** of farmers in the I-pig-programme is based on a **contract** between farmer and programme **manager**, who is employed by NIAH. **Central coordination** is done by NIAH.

Since the foundation of the conservation programme a **slight increase in population** (size of nucleus) has occurred. On the other hand, **inbreeding** has also increased.

The farmers mainly produce **F1-piglets** by artificial insemination of female I-pig with semen of exotic boars that are sold after fattening. Farmers get governmental **subsidies** for **participation** in the I-pig-programme and for **production of pure I-pigs**. Due to these subsidies, they yield a **higher income** when compared to their situation before. On the other hand, income is still lower than those of small-scale farmers in the neighbourhood using other breeds than I-pig.

The I-pig-programme is **not economically viable**. To reach viability it is necessary to **compensate the low performance of I-pig** by a high price for their pork that can be regarded as a special product due to its superior smell, taste and tenderness (this characterisation of quality was widely acknowledged among farmers and key-persons asked). However, although there seems to be a **demand** for meat of special quality among consumers there are no **marketing structures**. Viability is necessary because the subsidies make the I-pig-programme **dependent on political decisions** of the government. However, at the moment **I-pig-conservation is not possible without subsidies** because the improvement of the economic situation due to the governmental **subsidies** is the **main motivation for farmers** to participate in the I-pig-programme. In addition, the **state** should at least partly be **responsible** for the conservation of the country' s biodiversity. But with the **change to market-orientated structure** the **subsidies** could be **reduced**.

Discussion: Conservation of local pig breeds

Nevertheless, **extending the conservation efforts** to other local breeds **makes sense** not only with regard to conservation but also with view to the economic situation of the potential participants. The **Meo-pig** seems to be the most interesting candidate for a “new” conservation programme. The breed is **well accepted** by farmers and has **good economic characteristics**.

However, given certain **shortfalls of the I-pig-programme**, a few **changes** are suggested:

- Choose a bigger founder population from a larger area (to prevent a loss of genetic variability, as it has occurred in the nucleus of the I-pig-programme),
- Keep herd as open nucleus (to facilitate genetic exchange and reduce the level of inbreeding),
- Make breeding and conservation measures more efficient (e.g. by foundation of a stud book),
- Change towards a more market-orientated organisational structure by exploring marketing facilities for pork (alternative ways of marketing like speciality restaurants) and for breeding animals (via auctions, open for non-participants),
- Strengthen a community-based collective leadership (to improve the acceptance of the programme by the target group and thus improve the sustainability of the conservation efforts)..

5 Problem

For a long time the animal production of Vietnam was based on the utilization of local genotypes. Regarding pig breeds, there were more than 10 Vietnamese local pig breeds described. However, local genotypes are characterized by slow growth, low feeding efficiency and early onset of obesity. Therefore, in the 1950s Vietnam began to import high-yielding breeds (Yorkshire, Landrace, Cornwall, Duroc, Hampshire) to improve the performance of local breeds by crossbreeding (NIAH, 1997). Initially also higher performing local breeds, as e.g. the Mong Cai, were supported by the government (so-called Mong Cai-ization). However, meanwhile exotic breeds and their crossbreeds dominate in all over the country. While in 1994 72 percent of the sow-population of North Vietnam consisted of local breeds (THIEN et al., 1996), in 1997 the proportion of sows of local genotype decreased to 45 percent. Among fattening pigs crossbreeds dominated in 1994 as well as 1997 (NIAH, 1997). With so-called „lean meat programmes“ the government tries to increase the proportion of exotic pig breeds. Thus the local breeds are gradually replaced, and meanwhile some of them already disappeared with the exception of remainder populations.

Depletion of the variety of local breeds in favour of high-yielding breeds is for two reasons a precarious development: Local breeds may have a broad spectrum of genetic variability und thus may have traits with unpredictable economic value that make these breeds interesting for future breeding programmes. In addition, they are well adapted to input-extensive production systems. Therefore they represent an important livestock genetic resource for the resource-poor farmers of Vietnams remote areas.

To prevent the extinction of local breeds, Vietnam founded as early as 1985 the *National Conservation Strategy*, aiming at the sustainable use of natural resources (NIAH, 1997). In 1990 the *National Programme on Conservation of the Vietnamese Animal Genetic Resources* followed. It can be described as a master programme for conservation measures. Leading and executing institution is the National Institute of Animal Husbandry (NIAH) in Hanoi. The programme explicitly favours “on farm“ conservation of local breeds with intensive farmer participation (THUY, 1999, pers. communication). The intention is to connect the conservation of the respective breed with an economic benefit for the participating farmers. For each breed that is to be conserved there exists an own sub-programme within the master programme (At the moment 19 sub-programmes exist for different domestic animal species; NIAH, 1997). One of the conserved breeds is the I-pig.

6 Working hypotheses

- The "on farm" conservation programme for the I-pig protects the breed from extinction and enables an increase of the population size on a long-term basis.
- At the same time it connects the conservation of the breed with the improvement of the economic situation of the participating farmers. The conservation programme is economically viable.
- The conservation programme works sustainably and has advantages over the conservation of the same breed “on station“.
- Other local breeds are also worth to be conserved. They have special traits like adaptation to climate, disease resistance or adaptation to input-extensive management conditions. These traits are very important because they determine the efficiency of the pig production in smallholder systems. The disappearance of the local breeds would be of disadvantage for the economic situation of the farmers.

7 Objectives

- Characterization and analysis of the existing structures of the conservation programme for the I-pig
- Assessment of possibilities to extend the programme to other local breeds on smallholder farms in North Vietnam
- Evaluation and development of the model for conservation of autochthonous pig breeds

8 Material and methods

8.1 Material

Data collection was carried out from 8th of February 2000 to 15th of May 2000 in the 5 North-Vietnamese provinces Son La, Nghe An, Thanh Hoa, Ha Tay and Bac Giang. A total of 102 farmers in 23 villages were interviewed. The farmers were members of three different ethnic groups (Kinh, Thai, H'mong). The survey included 5 different local pig breeds as well as high-yielding breeds and their crosses, as far as available. The following table shows an outline of the study's material.

Table 1: Outline of the study's material

Province	Ethnic group	Number of vil-lages visited	Number of farmers visited	Preferred pig breeds
Thanh Hoa	Kinh	8	21	I Pig, Mong Cai
Ha Tay	Kinh	1	15	Mong Cai, white F1 ¹
Bac Giang	Kinh	1	9	Lang Hong
Nghe An	Thai	2	17	Co, black F1 ²
Son La	Kinh	3	15	Mong Cai, black F1
	Thai	7	22	Meo, black F1
	H'mong	1	3	Meo
Total		23	102	

Different production forms (sow keeping, fattening, combined sow keeping and fattening, boar keeping in combination with fattening or sow keeping) and farms of different size and intensity were investigated. The production form, pig breeds and the owner's ethnic group for the investigated farms are listed in table 2.

Table 2: Production form, pig breed and owner's ethnic group for the i nvestigated farms

Owner's ethnic group	Kinh	Kinh	Kinh	Thai	Thai	H'mong
Pig breed	MC	I	LH	Meo	Co	Meo
Number of farms	35	14	9	22	17	3
Production form						
Sow-keeping	22	6	8	14	13	2
Fattening	4	5	0	4	2	0
Sow-keeping and fattening combined	7	2	0	2	2	1
Boar keeping comb.	2	1	1	2	2	0

The contribution of the farms to different intensity levels is shown in table 14.

The farms were not selected at random but primarily according to the available pig breeds. In addition, the chairman of the respective village was involved in the selection. The farms, which keep local breeds seem to be among those with lower income. On the other hand the village chairman probably chose farms, which are economically more successful or farmers, with whom he maintained good relations. This must be considered when concluding from and/or generalising the statistical means presented.

Further information regarding structure of data collection are shown in table 9, appendix.

¹ White F1: Crossbreds between Mong Cai and exotic breeds (Yorkshire, Large White, Landrace)

² Black F1: The following crossbreds: Cornwall x Meo, Cornwall x Mong Cai, Mong Cai x Co

8.2 Methods

8.2.1 Background information

At the beginning of the data collection a literature search was done in Vietnamese libraries. Information on the performance of different genotypes (local pig breeds, commercial pig breeds, crossbreeds) under the climatic and management conditions in Vietnam was collected. In addition, information on the risk of extinction of the local breeds and on the conservation measures was collected.

For additional information, interviews with key persons were conducted (see section 10).

8.2.2 Recording household data

Farmers were interviewed on quantitative household data following a standardised questionnaire. The opinions of the farmers toward their breeds were inquired with semi-structured questions in non-standardized form. Each interview had an average duration of about 45 min.

Questions included the following focal points:

- Number of family members, family composition by age (grandparents, children, adults)
- Land tenure and cultivated areas for different crops
- Domestic animals (types, numbers)
- Pig population (breeds, numbers, sex, age, utilization, origin)
- Income from alternative sources (non-farming activities)
- Availability of credits
- Feeding management
- Farmers consumption behaviour regarding meat/ fat
- Fattening and marketing strategy
- Buying and selling of pigs
- Reproductive performance of sows
- Disease frequency, types of disease, health-care strategies
- Breeding management
- Attitude of the farmers toward their pig breeds

Participants in the I-pig-programme were additionally asked the following questions:

- Attitude toward the conservation programme, wishes or ideas for its improvement

Pigs of different breeds were photographed. The shoulder height of adult animals (>1 year) was measured.

The interviews were held in English. An interpreter translated into Vietnamese. If necessary, a second interpreter translated from Vietnamese into Thai or H' mong.

8.2.3 Definitions and formulas

The following definitions and formulas were used for calculation of results:

Net profit (NP) = • proceeds - • variable costs

→ Proceeds = proceeds from selling fattening pigs or piglets as well as service fees

→ Variable costs = costs for animals, feedstuffs, drugs, vaccinations, service fees, transport, hired labour, buying and rearing of breeding sows

To compare the net profit (NP) of different farms, the net profit was divided by the number of animal units. This was simple in case of sow keeping, where 1 sow equals 1 animal unit. In case of fattening the number of animal units depends on the fattening period. It was determined as follows:

Animal unit (AU) = number of breeding sows + number of fattening pigs x (fattening period in month/ 12)

Efficiency = $\frac{\bullet \text{ proceeds}}{\bullet \text{ variable costs}}$

Piglets, born = Number of piglets born in the last litter of the sow

Piglets, weaned = Number of piglets weaned in the last litter of the sow

Mortality (percent) = $(\text{piglets weaned} / \text{piglets born}) \times 100$

Litters/ year = Total number of litters until present/ age of the sow

This formula represents in as much a simplification as it does not consider the period necessary for raising the sow to sexual maturity. Hence, it over-estimates the reproductive performance of early maturing breeds and under-estimates that of late-maturing breeds

Productive life of breeding sows = average age of sows when died, sold or slaughtered

Life performance: kg piglet, weaned = $\text{litter/ year} \times \text{piglets weaned/ litter} \times \text{weaning weight}$

Life performance: number of piglets, weaned = $\text{litter/ year} \times \text{piglets/ litter, weaned}$

Life performance was estimated for each investigated breed from the sows' average reproductive performances (performances were taken from the results of the own investigation for the sows of the different breeds)

Average daily gain for the fattening period (g/day) = $(\text{slaughter weight} - \text{buying weight}) / (\text{slaughter age} - \text{buying age})$

Average daily gain for the life period (g/day) = $\text{slaughter weight} / \text{slaughter age}$ (for own progeny)

9 Results and discussion

For the understanding of the following section it is helpful to know the general conditions of pig production with local breeds on smallholder farms in North Vietnam. A description of these conditions is given in the appendix (section 12.1).

9.1 Characterization and analysis of existing structures in the conservation programme for the I-pig

9.1.1 Foundation and historical development of the I-pig-programme

The I-pig originated from the province Nam Ha in the Red River Delta and was in the past common in the whole North of Vietnam. In the course of the so-called "Mong Cai-ization" the I-pig population was strongly reduced. In 1989 only 463 sows were counted in Hoang Hoa district, the centre of the breeding region (THUY, pers. communication). At this time the NIAH initiated conservation measures to prevent the breed from extinction. Governmental financial support was granted starting from the year 1991.

Unfortunately no data exist on the total population of the I-pig in Vietnam: Due to the expected costs, surveys were only conducted in single provinces. In 1989 two boars and 20 sows of the sub-species I-mo were selected from all I-pigs in the villages Quang Giao and Quang Xuong (TANG & CUONG, 1994; THUY, pers. communication). Thus the effective population size in the nucleus amounted to $7,3^3$. At the beginning of the 1990's the co-operation between NIAH and farmers faced increasing problems such as. As a result the conservation programme in Q. Xuong and Q. Giao was resolved in 1994. 20 sows and two boars from the former nucleus were removed to Hoang Hoa, where they established the new nucleus.

The total number of I-pigs in the nucleus increased slightly since the beginning of the conservation efforts. Presently (6/2000) the nucleus consists of 36 sows and six boars, managed by 28 families. Thus the effective population size rose to 20,6. However, all six boars descend from the same father (five of them are sons of the respective boar, the youngest boar is a grandson). The boars are used for service since June/ July 1999. At the end of 1999 the first pure-breed piglets were born. 20 of the 36 sows descend from the two boars of the founder population, so that the genetic variability in the population is very small. The population of the conservation programme forms a closed nucleus. Two boars and two sows stay for safety reasons on a farm near Hanoi. However, the majority of the nucleus is located in the district Hoang Hoa, province Thanh Hoa.

The NIAH plans the conservation of I-pig semen and - on a long-term basis - the conservation of embryos. DNA samples as basis for planned gene mapping are already kept at the NIAH. In order to decrease the inbreeding level in the nucleus NIAH tries to find I-pigs both in remote regions of the province and in foreign zoos, however so far without success.

9.1.2 Target group of the conservation programme for the I-pig

Farms with higher economical potential rather invest in commercial breeds with high performance than in local breeds. However, farms with lower economic potential cannot afford to purchase and maintain high-yielding commercial breeds and therefore depend on local breeds. They probably can be won for participation in a conservation programme.

The NIAH intends to combine conservation of the breed with the improvement of the economic situation of participating farmers. On the one hand NIAH sees itself within the social responsibility. According to the manager (CUONG, pers. communication), farmers may participate only as long as they belong to the target group (resource-poor farmers). When their economic situation has improved the privileges of the conservation programme should benefit other resource-poor farmers. However, such a "change" did not take place so far, so that further details of the change-procedure are not known. Both "very rich" and "very poor" farmers are excluded from participation (CUONG, 2000), the first, "because they do not need",

³ Effective population size N_e : $1/N_e = 1/4N_m + 1/4N_f$ where N_m is the number of male and N_f is the number of female individuals in the population (PIRCHEP, 1994)

the latter, ‘because they cannot afford to keep pigs’ (that means that they cannot afford to buy feedstuff or build sufficient stables). Additionally, the NIAH and the managers are afraid that ‘very poor’ farmers could sell the animals which they get free-of-charge ‘in order to get some cash’ (CUONG, 2000). The participants are supplied with breeding animals, vaccination and extension service free of charge. This provides certainly a small advantage in competition for them. As farmers adopt conservation measures best if they obtain an economic benefit, this procedure probably increases the acceptance of the programme.

9.1.3 Management of the conservation programme for the I-pig

Within the scope of the *National Conservation Programme* the NIAH founded about 19 programmes for protection of different domestic animal breeds. Each of these programmes has its own manager(s).

In case of the I-pig-programme, responsible managers are on the one hand representatives of the ‘Women’s Union Thanh Hoa’ (WU) and on the other hand Mr. Cuong, who works as a lecturer at the Hong Duc-University Thanh Hoa. Each of them is responsible for a certain group of participants. The lecturer directly contacts the farmers or the village chairmen.

In case of the WU the procedure is more difficult, because all decisions have to be transmitted from the province administration via district- and communal level to the chairmen and women farmers. Additionally, in using the administrative channels involved with working through the WU, more money is spent on administration and thus is lost for utilization in the I-pig-programme.

The annually granted budget for all conservation measures lies between 300 and 400 million VND (21,400 – 28,600 USD). The I-pig-programme receives about 20 million VND (1430 USD) per annum (THUY, pers. communication). This sum of money is divided on:

- The salary of the managers,
- The money that is contributed to farmers to balance the economic loss due to keeping I-pig,
- Vaccination of all pigs belonging to participating farmers,
- Buying animals.

Sometimes the programme receives additional funds from other sources (like international co-operation projects).

The managers visit the farmers several times per month; the responsible scientist from NIAH visits them only sometimes. The high frequency of managers’ visits may be the result of the attempt to do all the best for the pigs and to protect them from any danger. However, another incentive for the frequent visits may also be the income of the managers, because income is calculated per workday.

At the beginning of their employment the managers participate in a training course, in which the basics of animal husbandry and of conservation biology are taught. Half-annual meetings of all managers at the NIAH are used for deepening of the knowledge as well as for reporting.

9.1.4 Organisational structure of the conservation programme

When a farmer is newly admitted to the I-pig-programme, manager and farmer make a contract for the duration of one year, which is usually extended annually after the first year and can be dissolved only in mutual agreement. For the contract period the pig becomes property of the farmer. The management is left to the farmer, with exception of certain guidelines to be followed, which are partly specified in the contract and partly mediated orally as an advice by the manager. The attendance of the manager with the farmers serves for extension, control and data collection. Actually common training courses for all participants were intended, however, they are not held.

The contract regulates:

- All financial aspects (subsidies, purchase of purebred female piglets, vaccinations free of charge),
- Mating of I-sow with I-boar upon advice of the managers,
- Vaccinations,

- Obligation of the farmers to responsible management and duty to inform the manager on all problems.

As it is common among Kinh-farmers, I-sows are inseminated with semen of exotic boars. Crossbred piglets are sold after fattening. The farmer receives the complete proceeds; he does not pay any fee or tax to managers or NIAH.

Serving I-sows with I-boar takes place only upon advice of the manager. At weaning the manager will buy the piglets (predominantly female piglets) in order to deliver them as breeding animals free of charge to interested farmers that match the conservation programme's target group concept. Selection of breeding animals is based on conformation characteristics.

Pigs, which the manager does not buy, will be fattened and sold by the farmers. Male piglets are occasionally killed right after birth because they are regarded as useless and unprofitable.

The farmers receive a financial remuneration within the framework of the conservation programme. This includes a balance for the reduced income and should be used for the supply of the pigs (purchase of feedstuffs, mineral fodder, medicine):

- For a sow 600.000 VND/ year (42,9 USD),
- For a boar 120.000 VND/ month (8,6 USD),
- For a newborn male piglet 50.000 VND (3,6 USD),
- Purchase of all female piglets at weaning age at a price that is 2000 VND/ kg higher than that for F1-piglets (with an average price in Thanh Hoa of 12.600 VND/ kg that corresponds to 14,600 VND or 1.04 USD/ kg)

Concerning the subsidies, there are two problems:

The Women's Union grants "its" farmers a smaller remuneration than Mr. Cuong. Larger sums of money are used on their administrative levels and are therefore not available for the conservation programme. The NIAH regards this circumstance critically and considers the management by the WU as a temporary solution. The management will probably be handed over to Mr. Cuong in future.

The second problem is caused by the fact that the subsidies must be paid before or at the time of weaning (according to contract). However, sometimes the government makes the budget available too late. That can make the farmers kill their I-pigs as it has happened in the past.

The guidelines, given orally by the manager, include the following issues:

- Hygiene (reminder for vaccination and worming),
- Feeding (energy content, use of protein supplements, special feeding of boar, piglets, preparturient sows, feeding hygiene, water supply),
- General management (housing and management of boar or sow, age of castration),
- Housing (climate and hygiene in the stable).

The farmers do not always follow these guidelines, partly due to a lack of cash or time, partly due to laziness.

9.1.5 Production technique

9.1.5.1 Management conditions and shortcomings

The participants of the conservation programme, with a few exceptions, possess only one I-pig. In addition they possess either a breeding sow (Mong Cai) or fattening pigs (Mong Cai crossbreeds), rarely both. Housing and management of I- and MC- sows are identical despite of their different performance potential: The sows are housed in pens, which are often extremely dirty. The piglets usually run free. Stables are solid buildings made from concrete and bricks. The walls are half-open and therefore freely accessible to the chickens. The chickens pick parasite eggs and larvae from the pigs skin and in that process cause a lot of small wounds, especially in the skin of older I-pigs. I-pigs have a quite phlegmatic character and therefore do not defend themselves.

Feeding is based on household and kitchen waste and vegetable (water plants, banana stem, sweet potato leaf, etc.). Two of the interviewed farmers also feed grass. Feedstuffs with high energy-content are rice bran (10,69 MJ/ kg DM) and maize (11,66 MJ/ kg DM, energy content according to FÖRSTER, 1998, pers. communication). Fish or soybeans are fed only by 26,7 percent of the interviewed farmers.

The mortality among adult pigs is low; in 1999 it amounted to 1,6 percent. Because the conservation programme bears the vaccination costs, almost all I-pigs (93,4 percent) and also most of the MC-sows and fattening pigs are vaccinated (73,3 percent). Reasons, why some farmers do not have their pigs vaccinated were already described above. On the other hand, mortality of piglets is extremely high; it can reach up to 50 percent. Piglet death is most often caused by accidents or diarrhoea.

It is often quoted that local livestock breeds are more resistant to diseases. This must be regarded with caution as a multiplicity of mal founded studies or reports faces only few well founded studies (for instance, farmers consider I-pig to be resistant against FMD, but until now there exists no scientific investigation to verify this supposition). Regarding diseases caused by inadequate management, the I-pig seems to be a little bit more robust. This was the opinion of some farmers, who already kept both, I-pigs and exotic pig breeds. On the other hand, the I-pig seems to be rather susceptible to skin diseases (own observation during farm visits). In addition, reproduction disorders occur quite often (see below).

In the absence of more detailed investigations the question of disease resistance remains yet unclear.

9.1.5.2 Reproductive and productive performance

The average performance of the I-pig, sub-species I-mo, as determined from the interview results, are specified in table 3.

Table 3: Performances of the I-pig (mean \pm SD)

Parameter	Mean \pm SD	Number of animals
Litters/ year	1.4 \pm 1.0	5
Piglets/ litter, born	7.6 \pm 2.1	5
Piglets/ litter, weaned	5.6 \pm 2.7	5
Mortality of the piglets (percent)	27.5 \pm 23.0	5
2-month= weaning weight (I x Exot) (kg)	5.3 \pm 0.4	2
Productive life of sows (year)	10.0 \pm 4.4	6
Estimated life performance (number of piglets, weaned)	78.4	
Estimated life performance (kg of piglets, weaned)	415.5	
Average daily gain, pure I-piglets (g/ day)	166.7	1
Average daily gain, crossbred I-piglets (g/ day)	110.6 \pm 0.8	2

KHANH & HIEN (1963) determined a higher reproductive performance of sows "on farm", namely 9.5 born and 8.7 weaned piglets with a 2-months-weight of 4.4kg for the sub-species I-pha and 9.7 born and 7.1 weaned piglets with a 2-months-weight of 4.5kg for the sub-species I-mo. LANG & THAP (1983) determined „on station“ even 10.9 born and 10.1 weaned piglets with a weaning weight of about 8.0kg.

In summary the I-pig can be called only moderately fertile. Sub-optimal management conditions do not only prevent full realisation of its reproductive potential, but even lead to reproductive disorders such as anoestrus, failure to conceive oragalactia (lack of milk). Malnutrition seems to be one of the main reasons for reproductive disorders.

No data on daily weight gain are available for pure I-pigs because all of them were sold as piglets. Literature shows that daily gain "on farm" can be as high as 230g/ day for I-pha (6th to 7th month) and 166g/ day

for I-mo (7th month) and 305g/ day for I-pha "on station " (7th month) (KHANH & HIEN, 1963). LUAN & QUANG (1983) even found a daily gain of 550g / day for I-mo pigs. Feeding efficiency „on station“ is between 4.5 and 4.6kg feed/ kg weight gain (LANG & THAP, 1983).

In order to assess the economic performance of the participating households, the net profit per animal unit was calculated. The following four production forms were distinguished:

„Fattening“ → The participant possesses one I-sow (premature, no heat until now) and additionally a few fattening pigs.

„Boar keeping“ → The participant possesses one I-boar and additionally a few fattening pigs or one or two breeding sows (MC).

„Sow keeping“ → The participant possesses one I-sow and in addition one MC-sow. 2 of the 5 farmers with this production form had premature I-sows.

„Sow keeping + fattening“ → The participant possesses one I-sow (premature), one MC-sow and a few fattening pigs.

Table 4: Net profit and efficiency for the participants of the conservation programme (by production form), subsidies are not considered

	Net profit	Efficiency	n
Production form*	Mean ± SD	Mean ± SD	
Sow keeping (1000 VND)	1,778 ± 857	7.9 ± 7.1	5
Sow keeping + fattening (1000 VND)	1,571	7.1	1
Fattening (1000 VND)	699 ± 432	2.2 ± 0.9	5
Boar keeping (1000 VND)	680 ± 513	3.9 ± 2.2	2

*For definitions see text

Exchange rate: 14,000 VND = 1 USD

As can be seen in the table above, „boar keeping“ and „fattening“ return the smallest net profit and „sow keeping“ returns the highest NP. Sow keeping, combined with fattening, returns a medium NP. It must be born in mind that the majority of investigated farms had sows (I-sows) that were still premature and had no litters up to that moment. As soon as these sows become mature and give birth to their first litter, NP should increase.

The efficiency is relatively high on farms with sow keeping (7.9) or sow keeping combined with fattening (7.1) but is low on farms, which practice fattening (2.2) or boar keeping (3.9).

The data show that the participants of the I-pig-programme lie in a lower income range, when compared with other Kinh-farmers (for comparison see Table 21). Further the dislike of the farmers to keep I-boars can be explained by the low net profit and the low efficiency of boar keeping.

9.1.6 Appreciation of the conservation programme

9.1.6.1 Appreciation of the breed by the participating farmers

The I-pig is described as undemanding in regard to feeding (93.3 percent of the answers). It can be fed by grass and banana stem. Therefore feed-costs are low (21.4 percent). The I-pig is considered to be the pig breed that fits best the economic conditions of the participating farmers (46.7 percent). It is easy to keep (46.7 percent) and is considered to be disease resistant (86.7 percent). It is well adapted to dirty and wet conditions (26.7 percent) as well as to the climate (6.7 percent). The good meat quality is emphasized (20.0 percent). The most serious disadvantage is the slow growth of the breed (20.0 percent).

I-pigs are considered to be fertile (46.7 percent), to have good mothering abilities (60.0 percent) and a high milking performance (26.7 percent). Only few farmers were of opposite opinion.

9.1.6.2 Appreciation of the conservation programme by the participating farmers

86.0 percent of the interviewed farmers highly appreciate the conservation programme. One of the farmers had reservations regarding the programme because he would like to gain more money from it. One farmer did not give an opinion on the programme.

For almost two thirds of the interviewed farmers, the original motivation to participate in the conservation programme was that they valued the good characteristics of the breed, which they knew from own experience or from experience and reports of others. Further, the traditional meaning of the breed was a reason to participate. Nearly one third of the farmers considered the idea of the conservation programme to be convincing and meaningful. Only 10.0 percent of the interviewed farmers were primarily interested in economic aspects (for detailed information see table 25, appendix).

When asked about the most important aspect of the conservation programme at this very moment, nearly 70.0 percent of the interviewed farmers considered their economic benefit to be most important; and 54.0 percent found the subsidies from the conservation programme to be most valuable. Conservation of the breed followed on the third rank (46.2 percent). About one third of the farmers called the support by the manager to be most important. The good characteristics of the breed was on fifth rank (23.1 percent of farmers).

From the farmers' statements it follows that they actually achieve an improvement of their economic situation by participating in the programme. Therefore 56.0 percent of the interviewed persons wish the extension of the conservation programme onto other villages.

However, the majority of the farmers actually attributed the economic advantage to the subsidies of the NIAH, not to the keeping of the I-pig. Additionally, the income of the farmers really rose due to participation, but is still below the income of their neighbours, who keep other pig breeds than I-pig. The participants consider higher subsidies to be the solution of that problem (56.0 percent). Only few farmers would keep I-pigs without further subsidies. For the majority of the farmers a separation of conservation efforts and subsidies seems impossible. (However, the economic viability without subsidies should be the objective of the programme – for a further discussion of this statement see 9.1.8).

The strong emphasis of the economic aspects means a risk: I-pigs are the guarantor for payments of the NIAH. However, if the funds arrive delayed, the farmers can come into financial bottlenecks and may consider it to be more profitable to sell or maybe to eliminate the "useless eaters", like it occurred occasionally in the past. Therefore it would be favourable to uncouple the conservation programme from the payment of subsidies and to shape it economically viable, maybe in connection with the organization of a marketing programme (see 9.1.8).

Another idea for improvement, expressed by a few farmers, was to replace the managers' visits by shared trainings-courses to get contact to other participants. A lot of farmers understood the managers' visits as proof of distrust.

9.1.6.3 Assessment of the conservation programme by non-participating farmers - assessment of their interests to participate

One objective of this study was to answer the question whether the conservation programme can be extended to other local pig breeds. One crucial point for answering this question is the acceptance of the I-pig-programme by non-participating farmers. However, this was not so easy, because some farmers only knew "their own" breed. Others knew the I-pig from stories and reports of others but not from own experience. Therefore, they were afraid to pronounce their opinion. Only two farmers made statements. One of them praised the fertility and mothering abilities of the I-pig, the other farmer criticized its slow growth.

According to the statements of the managers and participating farmers, the interest of farmers in neighbouring villages to participate in the I-pig-programme is high. However, at the moment the low

budget limits the expansion of the programme. Additionally, at present the conservation programme is restricted to a few communes. If farmers from a larger area wanted to participate, boars would have to be kept in these communes, or an insemination service would have to be created.

The farmers without I-pig that were interviewed in Thanh Hoa were not interested in participation. Also, due to their safe economic position they did not correspond to the target group of the conservation programme.

9.1.7 Economic importance and efficiency of the I-pig-programme

When assessing the economic importance and efficiency of the programme, it must be taken into account that farmers' net profit is increased by the subsidies he receives. The possible dimension of this is demonstrated in following – hypothetical - example.

Farmers, who keep sows (production form sow keeping), earn income only from the sale of fattening pigs/ piglets. The average net profit amounts to 1,779,000VND/ AU (without subsidies). Assumed, the farmers have their I-sows serviced exclusively by I-boars, sell the complete female offspring to the manager, and fatten the complete male offspring, they could earn up to 1,181,000VND subsidies in one year. Their net profit would thus increase to 2,369,000VND per animal unit, i.e. 133.2 percent of the net profit without subsidies. An estimation of the impact of subsidies on farmers net profit is given in table 24 (appendix).

Table 5: Estimation of the annual income of a participant of the I-pig-programme, including income from pig production and subsidies

	Boar keeping	Sow-keeping
Net profit/ animal unit without subsidies (VND)	680,000	1,779,000
Annual subsidies (VND), all AU	1,440,000	1,181,000
Sum (Net profit + subsidies)/ AU (VND)	2,040,000	2,369,000
Increase of the NP/ AU by the subsidies (%)	152.9%	133.2%

Exchange rate: 14,000VND = 1USD

Thus the subsidy payments constitute a large proportion to the net profit per animal unit, and the financial situation of the farmers actually improves by the participation in the I-pig-programme.

On the other hand, the participants compare their own situation with the situation of other farmers in their village or in neighbouring villages, who keep other pig breeds than I-pig. These farmers gain for "sow keeping" an average net profit of 3,653,000VND/ AU (see table 21). The I-pig-farmers, with the same production form, gain only two thirds of that (2,369,000VND correspond to 64.9 percent of 3,653,000VND). The I-boar keepers stand even worse, as with 1,181,000VND correspond to 28,5 percent of 3,653,000VND).

One reason for the low net profit of the participants is the I-pig's low performance. However, in addition the management conditions that were observed for participants are of lower quality when compared to those found for non-participants. This is mainly due to the lower economic potential of the participants: They are able to invest only smaller amounts of money into pig production. Thus it can be assumed that the participants' pigs can not realize their performance potential in the same way as pigs of non-participants. After all, this results in a lower performance of I- and MC-pigs when managed by participants of the I-pig-programme.

In contrary to the lower net profit, keeping of I-pigs can be realised with higher efficiency when compared to keeping of MC-pigs. Main reasons are the lower variable costs for health care, service and purchase of breeding sows.

9.1.8 Final evaluation of the I-pig-programme

In-situ-conservation: In-situ-conservation of domestic animals means the conservation of living animals in their natural habitat and their utilization at the same time. In-situ-conservation should be more favour-

able when compared to ex-situ-conservation, due to the proceeds from utilization of the domestic animals (HENSON, 1992). The NIAH chose this conservation-method for financial criteria, criteria of practicability and criteria of reliability (THIEN, 1996).

However, the I-pig-programme is not economically independent. Due to this fact its continuation depends on the good will of the government and the annual subsidy-grants. With the varying subsidies also the acceptance by the farmers varies.

The advantage of in-situ-programmes is that they do not require any complex technical equipment. They are based on the farmers' indigenous knowledge on pig production (which, however, should be broadened, see below). The technical breakdowns do not jeopardise the population as such. The population can adapt to a changing environment and is accessible for research.

On the other hand, genetic drift, inbreeding, artificial selection and diseases seriously endanger a population as small as the population of the I-pig.

In spite of the disadvantages mentioned above, the aim to improve the economic situation of the pig farmers does in this case stipulate the method chosen, i.e. in-situ-conservation.

In addition, the NIAH has already started some ex-situ-measures (e.g. gene mapping) and has planned other measures (e.g. creation of semen depots). Especially the creation of semen depots can be considered to be very important. Until now, the spatial enlargement of the I-pig-programme was limited due to the small number of boars and due to the limited transportation facilities for breeding boars. The better availability of I-boar-semen would resolve this problem.

Nucleus foundation: To set up the nucleus of a conservation programme it is recommended to select animals from the entire distribution area of the breed with the entire spectrum of breed-typical characteristics, and with as little relationship as possible between the animals (HENSON, 1992). However, the founder population of the I-pig-programme was kept rather small (20 sows, 2 boars, effective population size = 7.3) in order to minimize costs. Moreover, it was assumed that a nucleus of 20 sows and 2 boars would be sufficient for conservation of the I-pig (TANG & CUONG, 1994). Since its foundation, the nucleus has been managed as a closed breeding group. Therefore the inbreeding level within the nucleus has increased heavily. It is therefore recommended that I-pigs from outside the nucleus be bought to increase the genetic variability.

Nucleus maintenance: The I-pig-programme was in as much successful as the effective population size increased since its foundation from 7.3 to 20.6.

No success so far could be achieved with respect to minimise inbreeding: The level of inbreeding was probably high at the beginning of the conservation programme (all animals originated from the same region), and it has since then increased. The number of boars is too small and the relationship among boars is too high. Therefore, it is considered necessary to purchase of I-pigs from outside the nucleus.

At the moment a division of the population in spatially separated breeding lines is not possible, because the number of pigs in the nucleus is too small. However, the boar population was divided up between Thanh Hoa and Hanoi (measures for maintenance of the nucleus after HENSON, 1992)

Duties of the coordinator: Higher management and planning belong to the responsibilities of the NIAH (duties after WEIGEND, 1999 and HENSON, 1992). However, its capacity of action is limited by financial and technical limitations.

The NIAH developed strategies for in-situ- and ex-situ-conservation. It conducted surveys of domestic animals populations (which are not completed until now) and administers the available data (which are not completely analysed or published so far).

Selection of breeding animals is based on conformation criteria because other evaluation criteria are missing so far. However, first of all the special characteristics of the I-pig should be investigated. Such investigations should precede further molecular-genetic investigations like gene mapping. A performance recording scheme for pigs "on farm" would also be necessary, in order to assess the importance of the breed.

A manager employed by NIAH organizes the programme at village-level. Until now, the care for farmers was carried out in personal "discussions" between manager and farmer. The majority of the farmers were very positive on this intensive care. Nevertheless, the programme should aim at holding training courses. Thus a common sense of responsibility for the I-pigs and a community feeling could develop. In addition the meeting of all participants could be the basis for common decisions like an integrated marketing programme. Until now the search for marketing facilities was only discussed by the managers, without participation of the farmers. Until now there are no practical efforts to build up marketing structures. Moreover, training courses permit the use of specific successful training methods.

Conservation and utilization: In-situ-conservation can only be economically viable when the conserved breed is utilized in the optimum way. This means that there sales prospects must exist and therefore marketing structures for the produced goods must be in place. Moreover, regarding the local breeds the product must obtain a price, which compensates the losses due to relatively lower animal performance. Regarding the farmers' participation it must be said that farmers are mostly economically motivated. They are interested in maximization of profit. In the long run, this requirement cannot be fulfilled by subsidies.

It is not worth keeping I-pigs when only productivity (number of born piglets p.a., fattening performance, fattening period, slaughtering weight etc.) is considered and no improved marketing facilities are available.

The utilization of so-called special traits as a basis for better marketing chances is desired but at present not existing: It is true that farmers praise the outstanding meat quality (smell, taste, cooking characteristics) of the I-pig. However, the consumers in the villages and smaller cities do not buy high-quality pork, but cheap fatty meat. There are no consumers for meat of special quality and thus a higher price. Marketing on the basis of excellent meat quality would become possible if consumers with higher purchasing power became "activated", i.e. the higher income market segment in the larger cities (provincial capitals, Hanoi, Haiphong, Saigon). However, the producers in Thanh Hoa have no access to this market segment until now.

Another point is the sale of breeding animals: Characteristics such as resistance, mothering ability, utilization of fibre-rich feedstuffs and frugality could be interesting characteristics for a sow-line. Whether the I-pig becomes sufficiently attractive and competitive as breeding material due to these traits is not known so far. It would be necessary to comparatively evaluate the different available pig genetic resources in the country (both local and improved breeds) under a variety of pig husbandry systems as found to be currently practised in order to assess whether the I pig could become sufficiently attractive and competitive.

Subsidies: Subsidies are meaningful in the case that economic pressures force stock-keepers to give up their breed or to slaughter pigs (BREM et al., 1984; HENSON, 1992).

The I-pig-farmers receive a mixture between „subsidy per head of animal“ (for sows/ boars) and „production-associated subsidy“ (subsidies for piglets, weaned piglets, depending on piglet losses and weaning weights, i.e. depending on the quality of management) (definitions after HENSON, 1992). Thus, good management pays back for participating farmers. Linking the subsidies even stronger to management quality would possibly not only increase the economic incentive of "active participation" in the programme, but would certainly also contribute to increase general pig management in the programmes target areas.

However, with view to long term economic sustainability it appears evident that the programme must strive for a shift from subsidised to market oriented production. The subsidies make the I-pig-programme dependent on political decisions of the government. However, at the moment I-pig-conservation is not possible without subsidies because the improvement of the economic situation due to the governmental subsidies is the main motivation for farmers to participate in the I-pig-programme. In addition, the state

should at least partly be responsible for the conservation of the country' s biodiversity. But with the change to market-orientated structure the subsidies could be reduced.

Sustainability: Sustainability means to handle natural (genetic) resources carefully in order to protect and keep them for generations to come. Sustainability criteria for community-based programmes were taken from literature, listed in the following table and compared with the situation in the I-pig-programme.

Table 6: Sustainability criteria of conservation measures with special consideration of the situation of resource-poor farmers, compared with the I-pig-programme

Criteria of sustainability	Criteria fulfilled?
Farmers are owner and exploiter of the breed	Yes
Appreciation and responsibility of the stock-owner for the breed	Yes
Utilization of existing resources by the farmers	Yes
Not capital-, but work-intensive	Yes
Easily understandable for farmers	Yes
Not in contradiction to the farmers' culture	Yes
Management can adapt well in risky situations	Yes
Stability of the leading institution	Yes
Support of the leading institution by government	Yes
Support of the leading institution by other partners (for instance NGO's)	Yes
Scientific investigations on the breed, their characteristics and needs	Qualified
Agreement, confidence of the farmers in the leading institution	Largely
Continuation of the project after support measures are finished	Uncertain
Lateral spread of the acquired technology	Uncertain
Programme is autonomous, manager represents participants	No
Participation of stock-owner in management decisions	No
Investigations of the interactions between programme and farmers	No
Economic viability	No
No economic risk for farmers	No*
Strengthening of the self-confidence of the farmers	No

Changed after MILNER- GULLAND & MACE, 1998; RIVERA & EDWARDS, 1998; BANG, 1999

*The income of the farmers is very low in spite of subsidies. The loss balance by NIAH has its problems. As the manager decides on the breeding management there is no reliability in planning.

Based on the above criteria , the I-pig-programme is only of limited sustainability. No economic viability is presently achieved and the programme depends on subsidies. Therefore lateral enlargement depends on the financial support from the government. Whether the programme is really beneficial for participating farmers has not been evaluated by NIAH so far.

Moreover, the programme is not autonomous as all decisions are taken by NIAH or by the 2 managers. Communication between leading institutions and managers on one side and farmers on the other side is insufficient. It appears that enlargement or development of marketing structures would work better if farmers were self-responsible.

9.2 Can the programme be enlarged onto other local breeds?

9.2.1 Which breeds would require conservation programmes, and why?

Different question must be answered before deciding whether a livestock breed actually requires and also deserves becoming the target of a conservation programme:

Conservation of biodiversity: The MC is considered to be insecure. The breeds Meo, Co, Lang Hong and I-pig are considered to be at the risk of extinction. With view to the general agreement that conservations efforts are per se worthwhile if a livestock breed is at risk of becoming extinct, this seems to be 'reasonable enough' for enlarging the programme onto these breeds.

However, due to financial and logistic reasons, not every breed can actually be conserved. Hence, the decision depends on further criteria, as e.g. whether the breed possesses "special characteristics" or is genetically 'more diverse' than other breeds. Such evaluations are missing so far for the investigated local pig breeds. However, hints can partly be drawn from animal descriptions and farmers' experiences, but special traits should be systematically studied in order to correctly assess the value of the local breeds and to make it clearer to administrative or governmental institutions.

Additional factors like cultural importance of a breed in its region of origin as well as attachment between stockkeeper and breed should also be considered.

Economic aspects: When compared with exotic breeds or crossbreeds encountered in North Vietnam, the performance of Meo, Co and I-pig (fattening performance, feed efficiency, litter size, litter frequency, piglet mortality) are much lower. Therefore, their owners realise only low net profits. Nevertheless, when compared to high-input farming systems, the smallholders can achieve a higher efficiency of production due to lower variable costs. However, the higher efficiency depends also much on the quality of management. Therefore, if managed properly, the local breeds can constitute an important production factor to their owners.

The economic value of special characteristics, like e.g. mothering ability or adaptation to climate, can only be estimated with the aid of correlated traits. This requires more extensive investigations, which would help to justify the necessity of conservation measures. In summary it can be said that the local breeds from the farmers view are worthwhile being protected.

From the consumers' standpoint, the protection of local breeds has at present no priority. On the market, the consumer does not receive any information on origin, quality or characteristics of the meat. Additionally, consumers presently do not buy meat of special quality, although the consumer potential most likely exists. Therefore, marketing strategies for special products can only develop if the marketing system changes and/or if new market segments can be opened up.

Stockholders view: The acceptance of the various local pig breeds strongly differs.

The acceptance of I-pigs is rather high, not only among participants of the conservation programme but also among outsiders. However, there are also critical voices. Several problems regarding the I-pig-programme showed that farmers cannot be forced to participate and protect I-pigs against their will. Mong Cai and Lang Hong are a highly accepted, which is an important prerequisite of conservation measures.

For the Meo pig, the situation is a bit ambivalent. More than one third of all interviewed farmers who keep Meo pigs would prefer a different pig breed if they could afford it. On the other hand, the majority of farmers are strongly attached to the Meo pigs. Probably it would be possible to find a sufficient number of farmers for voluntary participation in a conservation programme.

The case of Co pig seems to be negative. More than 70.0 percent of the farmers who keep Co pigs would prefer another pig breed if they could afford it. Under these circumstances it seems to be difficult to find volunteers for participation in a conservation programme.

The awareness among farmers that local breeds are endangered is low. The owners of Meo and I-pigs are more aware of the situation than owners of other breeds. . The case of the I-pig-owners shows, that the farmers recognize the endangering of their breeds after discussions on the topic. This consciousness could thus be raised also in other farmers.

In summary, Meo pigs seem to be worthwhile being protected more than other local breeds: It is well accepted. Keeping Meo seems to return a high income, high net profit and seems to be relatively efficient. Thus the economic incentives to keep Meo are high. The breed is popular among farmers due to special characteristics. It may be possible to organize a marketing programme based on the high lean meat content and other quality traits of the Meo pork.

The MC is not under the risk of extinction but only insecure (but of course the development of the population must be observed). The LH is a very interesting and valuable breed. However, in case of LH the work of the “manager“ seems to be very efficient for breed protection. The Co pig is very unpopular, and the population shows a high level of inbreeding, two facts that are not a good basis for conservation measures.

9.2.2 Practical recommendations for further conservation efforts in various geographic regions of North Vietnam

From the discussion on the I-pig-programme (9.1.8) and the statements on the needs of different local breeds to be conserved (9.2.1), a set of recommendations for conservation strategies is derived. It will be described on the basis of a fictitious example „Model for conservation of the Meo-pig in Son La“.

Building up the nucleus: Because this is a model for a Meo-conservation-programme most of the participants will probably be Thai (integration of H'mong -farmers would be difficult due to different factors, first of all the management system, which is based on scavenging pigs).

The founder population should be as large as possible, at least 25 boars and 50 sows (HENSON, 1992) and contain Meo-pigs from the whole territory of the breed (or a territory as large as possible). Thus the risk to include related animals would decrease.

For selection of the founder generation a catalogue of selection criteria would be necessary that would be based on body conformation traits. Farmers whose pigs fit the standard can be considered for participation. The ancestry of the animals should be recorded as exactly as possible to exclude related animals from the programme or to take the relationships between animals in the breeding scheme into account.

The programme should aim at resource-poor farmers (similar to the I-pig-programme). With farmers who agreed to participate a contract will be made for documentation of rights and obligations.

Maintenance of the nucleus: The management of the I-pig-programme (purchase of pure piglets for a price higher than market price, handing over to new participants free of charge) seems to be economically not viable, and is responsible for the high costs of the I-pig-programme. An alternative could be the following procedure:

The herd is managed as open nucleus. Genetic exchange is possible: Pigs of the nucleus are sold to non-participants and pigs from outside the nucleus are bought and become new nucleus members. This kind of exchange could be carried out via a livestock auction or a pig market. The presentation of high-quality breeding animals on livestock auctions combined with qualified information has shown to be a good incentive for breeding animal purchase (MILL et al., 1997). Additionally the price level on auctions is higher, which would be an advantage for the sellers. The auction should be open to farmers from outside the programme. It should be born in mind that farmers who have to buy animals instead of getting them free of charge appreciate them higher.

In case that the exchange of breeding animals does not work sufficiently, the level of relationship between animals must be considered in the conservation programme , therefore a herdbook would be necessary.

The number of boars is another important parameter and a minimum number should be maintained. The selected boars should have a minimum size and age (male piglets reach sexual maturity with 9 month, THUY, 1999). Set up of a boar transportation service or an insemination service should be considered in order to facilitate the genetic exchange between pig sub-populations in different villages. However, there is no insemination service for the I-pig until now. Therefore it will take a lot of time to establish the necessary structures for an insemination service for the Meo.

Tasks of the coordinators: Similar to the I-pig-programme, NIAH should be the leading/ advisory institution in a new programme. The NIAH possesses the required personal, financial and technical equipment and is accepted by local institutions and by farmers. Because NIAH has been coordinating all conservation efforts for Vietnamese livestock species since the 1980ies it has a lot of experiences in this field.

There are several ways to improve the management of the conservation measures. One way is that NIAH employs a manager (similar to the I-pig-programme). A second way is to encourage self-administration of the programme by the participants under leadership of NIAH.

As can be seen in case of the I-pig-programme, communication between farmers and managers does not work without problems. When the programme area becomes larger, the problems regarding logistics, transportation and financing would further increase. However, the spatial enlargement of the programme and the allocation of the population on a larger area (for safety, in case of epidemics) are desirable. It does not make sense to employ a greater number of managers because that possibly would cause conflicts between managers and would further increase the costs (similar to the I-pig-programme). Therefore the self-administration by farmers appears to be the best and most sustainable solution.

Extension and training could be done by private extensionists or by lecturers of the university based on contracts. However, regarding costs, acceptance and sustainability, it would be better if this were done by farmers. The participants should select a representative who would receive the necessary training regarding pig production and conservation.

The manager should organise exchange of breeding material, livestock auctions, insemination service and boar transportation. Additionally, he should campaign for setting up a marketing system. He should organise training courses for all farmers at regular intervals, say, four times a year. Moreover, regular data collection should be carried out. Important data are the animals' performance regarding reproduction and production as well as data regarding health care and management. Participants in the programme should be involved in data collection.

Conservation and use: The interviews have shown that very important evaluation criteria for pig production are the economic benefit and security, and the extension service. The pig production of the Thai people in Son La not only returns a high net profit but is also very efficient. High profit and high efficiency can be incentives for participation in a new conservation programme.

Extension service should be provided for all participants free of charge or for a small fee via trainings courses. Another step to reach economic security could be achieved through the implementation of a marketing system.

To improve the sale of Meo-pork the consumer should be provided with qualified information. As meat in the market is neither marked nor identifiable, it is the task of the retailer to give information. Another factor is organisation of marketing (Meo-pork only at certain days, on certain places, on markets where "richer" people buy food, contracts with certain restaurants).

As better situated consumers concentrate in bigger cities, the normal transportation system (motorcycle) is not sufficient. It would be necessary to buy 1 or 2 cars for transportation. Since a stable cooling chain is very important (especially in the Vietnamese climate) transportation of living pigs should be preferred instead of meat-transport.

It must be carefully reflected whether payment of subsidies to new participants is necessary:

Subsidies are important, when economic factors force stockowners to give up the respective breed or to slaughter single animals (BREM et al., 1984; HENSON, 1992). Subsidies balance financial losses associated with keeping a breed with low performance that farmers would not keep otherwise. However, that is not true for the Thai-people in Son La: When compared with the I-pig, the Meo pig is better accepted and farmers keep it voluntarily. Therefore it would be better to pay subsidies only to boar-keepers (because it is not common to keep adult breeding boars but to use male piglets for service). Subsidies for the boar should balance the loss due to keeping a boar instead of a sow that would return a higher profit. However, with view to economic viability of such programmes, ways should be sought to avoid subsidies altogether. Thai farmers do not normally pay for a boar serving their breeding sows. In case a low or moderate service fee would be introduced, e.g. around 10,000VND per service, subsidies could probably be avoided. At three servings per week, the boar keeper would earn 120,000VND per months, which is the same as is paid as subsidy in the I-pig programme.

In addition, the selection of exotic boars for crossbreeding is very important. Especially Cornwall-crossbreeds show a high performance, good adaptation and are highly accepted. An idea would be for the programme to buy Cornwall-boars and offer their service to participants of the programme (subsidised price) and non-participants (full price). Unfortunately this contradicts the Vietnamese strategy not to import Cornwall boars due to their higher fat percentage in the carcass.

Extension: The low performance of local breeds is not only due to genotype but also due to environment and management. Therefore extension regarding the following topics should be executed: feeding, hygiene, breeding, and efficiency calculation. Increasing animals' performance and resulting increasing profit would be important incentives for participating farmers.

A list of topics to be included in extension services when targeting resource poor farmers is given in table 6.

Table 7: Extension topics for application in a conservation programme

Topics of extension	Focal points
Feeding	Feedstuffs and their components, preparing feed, feed hygiene, economy of feeding, connection between feeding and diseases, connection between feeding and fertility
Hygiene	Recognition of disease symptoms, qualified use of medicine, necessity of vaccinations and worming, management measures for epidemic prevention, service hygiene, connection between person movement and spread of diseases, quarantine
Housing and management	Importance of hygiene in the stable, spatial separation of chickens and pigs, piglet keeping, disadvantage of modern concrete sties compared to traditional wooden sties, disadvantages of the floor design in traditional Thai sties
Breeding	Inbreeding, decreasing weaning age, castration
Economy	Minimization of costs (example feed costs), meaning of "efficiency"

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12 Appendix

12.1 Outline of the conditions of pig production with local pig breeds on smallholder farms in North Vietnam

12.1.1 Socio-economic situation

The visited families had an average total size of 6.0 family members including 2.4 members capable of working (that means, the farm-owner and his wife) and 2.9 children. In most of the households there lived also the parents of the farm-owners (see table 10, appendix).

The Kinh-farms in the lowlands of the Red River Delta (Ha Tay, Bac Giang, Thanh Hoa) are specialized in paddy cultivation. The areas for cash crops, garden and ponds are small. The farms do not possess any forest areas. The possibilities to produce feed are marginal. The participants in the I-pig-programme belong to this production type.

The Thai- and H'mong-farms in the mountainous areas (Son La, Nghe An) cultivate quite large fields, and plant production is diverse. The farmers cultivate little paddy and mainly upland rice, cassava, maize, peanut and other cash crops. Almost every household has its own forest areas (separated in areas for protection and areas for use). Utilised areas return wood, food for humans and feedstuffs for animals. Live-stock feeding is based on farm-grown feed, namely household- and cooking wastes, maize, cassava and green forage from the forest. This favours the keeping of local breeds, which are well adapted to a fibre-rich and energy-poor diet (see table 11, appendix).

The household income comes from the sale of cash crops and of domestic animals and their products. Nearly all of the investigated farms have chickens. Ducks are not as common as chicken. Poultry is an important cash source, but is also necessary for own consumption of the family. Goats were found only in one of the investigated households. Cattle and buffalo keeping are quite common in households of the mountainous areas (Thai, H'mong in Son La, Thai in Nghe An). They are mainly used as draft animals due to the fact that the level of mechanization is lower in the remote highland regions compared to the lowlands. In addition, the large forest areas of the highland households are used as herbage. Buffalo or cattle can be an important source of income (see table 12, table 13, appendix).

The majority of investigated households possess 1 to 2 sows and sale the offspring (for time of sale see below). Sometimes the farmers buy additionally a few fattening pigs or keep fattening pigs instead of sows. In summary, the form of husbandry can be characterized as smallholder husbandry.

The participants of the I-pig-programme also belong to this production form. However, data show that they keep about one animal unit more compared to non-participating farmers. Maybe they try to compensate the smaller income due to low performance of the I-pig by additional use of more breeding sows or fattening pigs.

Only a small number of Kinh-households in favoured areas near bigger cities (Ha Tay, Son La, one farm in Thanh Hoa) is able to intensify production and to keep a higher number of fattening pigs (see table 14, appendix).

For Kinh farmers pigs are mainly a source of income. Thai and H'mong farmers need pigs not only for sale but also slaughter them at certain occasions (New Year, wedding, building a new house). However, all households buy pork and fat for daily consumption in the market (with exception of the H'mong).

Only a few families in mountainous regions (Thai, H'mong) have the chance to get off-farm income. This is only possible near or in cities with improved infrastructure (schools, companies, shops, transportation, market, etc.).

The investigated Kinh-farms in Ha Tay and Son La have better opportunities to get additional income. Many farmers get voluminous credits, which are mainly invested into livestock production (most important is purchase of feed, followed by purchase of animals and building material for sties). Only a few

farmers said that they didn't need any credit. On the other hand, not every family is able to get a credit. Some of them are not considered to be credit-worthy, other families are afraid that they cannot pay back the money. Thai- and H'mong -families take credits, similar to Kinh-families. However the average credit sum is smaller. It's the same with the participants in the I-pig-programme (see table 15, appendix).

12.1.2 Introduction of the investigated pig breeds

The following Vietnamese local pig breeds were investigated: I-pig, Meo, Co-pig, Mong Cai and Lang Hong. For none of these breeds the exact population size is known. However, based on the definitions of FAO, Meo, Co and Lang Hong are considered to be „under the risk of extinction“ (THIEN, 1996; THUY, 2000, pers. communication). The Mong Cai-population is considered to be insecure (THIEN, 1996).

The following breed descriptions are based on own investigations and are complemented by quotations from literature.

I-pig: The I-pig is a very small pig with potbelly and hollow back. The shoulder height of adult female animals was $48.2 \pm 1.3\text{cm}$ ($n = 5$, own results). The colour of the skin and the sparse hair is black. After KHANH & HIEN (1963) there exist two sub-species characterized by a different outer appearance:

The I-mo or pure I-pig is the smaller sub-species with short legs and short trunk. Typical characteristics are the big head with short snout that is bent upward. The face is extremely wrinkled so that the eyes seem to be closed. The ears are small and stand upright. Most of the animals have 10 teats.

The I-pha originated from crossing of various (unknown) local breeds with I-mo. Meanwhile the I-pha is considered to be a breed on its own. The I-pha is bigger than the I-mo, with longer legs and a longer trunk. The potbelly is not as pronounced as in case of I-mo. The snout is longer and tapering. The face is only slightly wrinkled. The ears are bigger and stand horizontal. The number of teats lies between 10 and 12 (KHANG & HIEN; 1963).

The I-pig is characterized by the following traits (after TANG & CUONG, 1994; THUY, 1999f, statements of visited farmers):

Reproduction: Early maturity (puberty at 3 or 4 month of age), high reproductive performance (!), good mother abilities, longevity

Adaptation: Adaptation to hot and wet climate and tolerance of dirty and wet housing conditions, disease resistance (is considered to be resistant against FMD), resistance against parasites, adaptation to a fibre-rich diet

Special traits: Even-tempered, excellent meat quality (smell, taste, no disorders like PSE)

Disadvantages: Slow growth, early obesity, and external appearance (often called „ugly“)

The asked farmers praised the I-pig's longevity, a daptation and special traits. The growth capacity was critically judged.

Meo and Co-pig: Both breeds originated from the Central Highlands of Vietnam (THUY, 1999d and 1999e). The Co-pig can still be found in the Central Highlands were it is mainly kept by Thai farmers. The Meo can also be found in the Central Highlands. However, it has spread from here to the Northern mountainous regions, where it is the breed of Thai and H'mong. Both breeds resemble the wild pig type. They have neither a potbelly nor a hollow back. The snout is long and tapering, the ears stand upright. The skin is black and densely hairy.

The majority of Co-pigs has uneven white marks on head or legs. Animals are small; the average shoulder height of adult female animals was $44.1 \pm 6.2\text{cm}$ ($n = 8$). Co-pigs have 10 teats (HOT; 1982). The degeneration due to inbreeding is high (THUY, 2000, personal communication).

Regarding Meo the farmers describe 3 local varieties that differ in size, appearance of white marks (snout, tip of the tail, legs), reproductive performance and growth capacity. The pigs measured for this study belong to one of the smaller sub-species (shoulders height $48.7 \pm 3.7\text{cm}$, $n = 6$). Meo are well known for their adaptation ability and disease resistance. Meo as well as I and Co are adapted to a fibre-rich diet.

The meat quality is considered to be excellent, the lean meat percentage seems to be high up to 50 or 60 percent (ANH & DUNG; 1994).

Lang Hong and Mong Cai: Both breeds originated in North-East-Vietnam (THUY, 1999b and 1999c). The Mong Cai was for a long time the dominating pig breed in North Vietnam. Government supported its spread and utilization. At the moment a lot of MC-sows can still be found. They are used to produce crossbred piglets. However, the „Lean-meat-programme“ of the state means a potential risk for the breed's survival.

The Lang Hong was never as widely spread as the Mong Cai. However, in some regions the Lang Hong has strongly mixed with Mong Cai (THUY, 2000, pers. communication).

Both breeds have a potbelly and a hollow back and get obese very early in live. Head, back, and ham have a black colour while neck, belly, and legs are white. The Lang Hong is a little bit smaller compared to the MC: The shoulders height of MC-sows in Ha Tay was measured to be 60.3 ± 3.7 cm (n = 11), the average shoulders height of MC-sows in Thanh Hoa was 55.7 ± 4.4 cm (n = 10). The average height for female Lang Hongs was 55.6 ± 1.7 cm (n = 5). The LH has a shorter trunk; potbelly and hollow back are less marked than in case of the MC. The snout is shorter; ears are smaller and stand upright. On the forehead there is a white triangular mark. Sows of both breeds develop so-called duck-feet when they get older. That means that all four toes touch the earth. MC have 12 to 14 teats while LH have 12 teats.

LH and MC are considered to be very fertile (MC: 1.5 to 2 litters/ year, 10 to 14 piglets/ litter; LH: 1.7 to 1.8 litters/ year, 9 to 13 piglets/ litter). They reach sexual maturity early (LH: 4 to 5 month; MC: 3 month). Both breeds show good mothering abilities (THUY; 1999b and 1999c).

12.1.3 Recording of production technique and economic parameters

12.1.3.1 Feeding

Pig feeding in smallholder households is based on household wastes and green vegetable. Feedstuffs with high energy content are rice bran (mainly lowlands) and maize/ cassava (mainly highlands).

Almost all Kinh-households buy vegetable and maize or cassava for feeding, because the cultivation system that is specialized in paddy cannot return these products. The participants of the I-pig-programme are also forced to buy additional feed every day. Only a minority of the Kinh-farmers utilizes protein-rich feed like soybean or fish. The Kinh in Son La and Thanh Hoa (and the Thai in Son La) are an exception inasmuch as they use more protein-rich feedstuffs. The reason could be the more intensive extension service in those regions (extension projects or extension as part of the conservation programme). 53.0 percent to 78.0 percent of the investigated Kinh-farms use concentrate. However, the occasional purchase of concentrate seems to be a minor financial burden for the household compared to the daily purchase of staple feed. Thai and H'mong buy only seldom staple feed or concentrate. Protein-supplements are almost never used (Exception: Thai in Son La, see above).

In the bigger farms of this study (> 5 AU) feeding is based on vegetable and cassava/ maize/ rice bran with little amounts of concentrate or protein-rich feed, too. Only the biggest farm visited (83 animal units, Ha Tay) uses exclusively rice bran and concentrate, however, no fish or soybeans.

Feeding management depending on age or performance is a widely used method among Kinh farmers (min. 54.0 percent to max 100.0 percent depending on the region). On the contrary, only very few of the Thai (5.9 percent to 37.5 percent) seem to practice this method. A reason could be that Thai and H'mong farmers do not spatially separate pigs of different age.

Seasonal shortage of feed or price increase of feed occur in the investigated households mainly in times, when stocks of the previous harvest are used up, shortly before the next harvest.

Kinh-farms that buy pig-feed mainly in the market spend more money on the same amount of feed in times of shortage. Due to their smaller financial resources Thai and H'mong cannot afford to buy feed, or they are not willing to spend any money on pig-feed. On the other hand they can avoid feed shortage by

collecting feed in the forest. However, the Kinh in Son La, who also possess forest areas, rarely use this strategy.

Feeding based on green forage covers only subsistence level of the pigs (for example banana-stem 0.39MJ ME/ kg DM); fattening is not possible. A few farmers use cassava instead of forest vegetable and plants. Cassava is available throughout the year, but when fed in fresh form its energy content is very low, too (4.78MJ ME/ kg DM, FÖRSTER, 1998, pers. communication).

If feeding is based on farm-grown feed, shortage periods can be overcome by storage of harvest surplus. In some regions (Nghe An) this method is either unknown or the production level is too low to allow storage.

12.1.3.2 Breeding management

The breeding management varies due to production form of the different ethnic groups.

The Meo pigs of the H'mong are mostly scavengers. Therefore scavenging sows are mated randomly by scavenging boars or, sometimes, by wild boars. Selection of breeding animals is nearly impossible. Probably it would be difficult to integrate scavenging pigs in a conservation programme.

The Thai farmers keep their Meo in fenced paddocks under or in sties on stilts besides the residential building. In some households pigs are kept in stables only in the vegetation period. Scavenging sows or sows in paddocks can be serviced by scavenging boars. However, most of the farmers borrow a boar from their neighbour free of charge. In addition, it is quite common among Thai farmers (44.4 percent of the Thai in Son La, 52.9 percent of the Thai in Nghe An) to let the whole litter or the best male piglet uncastrated in the pen together with the mother, until the mother is serviced by one of the male piglets. Due to this praxis the level of inbreeding is quite high. That can clearly be seen in case of the Co-pigs of Nghe An and is less obvious in case of the Meo (Son La). However, the farmers in Son La told that the average height of Meo pig has decreased in the last years due to inbreeding. The majority of farmers didn't accept that inbreeding could be a problem.

The Thai farmers seem to have a really closed relationship to their pig breed. They observe the animals very precisely and know a lot of selection criteria for breeding animals (criteria of feed consumption, size, health, beauty, condition, body conformation regarding trunk, back, pelvis, snout, skin colour, number of teats, udder conformation).

Farrowing interval is very high due to the use of the male offspring for service (sexual maturity of male piglets at 4 or 5 month, THUY, 1999d) and due to high weaning age (≥ 2 month).

The breeding management of the Kinh is mainly based on artificial insemination of Mong-Cai-sows with semen of exotic boars. The insemination costs amount to ca. 15,000VND. The staffs of the breeding centre normally select the breeding boar. Only very few farmers use the female offspring for replacement of their own sows. The relationship between farmers and animals seems to be less closed compared to the Thai farmers' appreciation of the Meo pig. Farmers describe pigs not very clear and know only a small number of selection criteria (strength, beauty, health, feed consumption, and body conformation of trunk, snout, legs or udder and number of teats). The weaning age is as high as in the Thai production system (2 month).

As far as known, Lang Hong pigs are bred only pure. They play a special role; therefore they are regarded in another section (see below).

12.1.3.3 Reproductive performance of sows

In Asia- one of the centres of pig domestication- pig production and pig breeding were very early intensified. Today there are improved, high-yielding breeds that resulted from a long breeding period, and native breeds with low performance (LEGEL, 1993). The Vietnamese breeds Lang Hong, Mong Cai and I can be characterized as improved breeds whereas Meo and Co rather belong to the group of native breeds.

In this investigation MC and LH showed the best performances with a litter size of 12.4 - 12.6 piglets, a productive life of 7.2 to 8.0 years, the highest farrowing frequency (1.5 - 1.7 litters/ year) and the highest weaning weight (9.5 - 10.2kg). The highest lifetime performance was estimated for Lang Hong with 1,637kg weaned piglets.

The I-pig reaches in spite of small litters (7.6 piglets), high piglet mortality (27.5 percent) and low weaning weights (5.3kg) due to a high farrowing frequency (1.4 litters/ year) and an extremely long productive life (10.0 years) a lifetime performance of up to 416kg weaned piglets. The Meo shows after the Co-pig the lowest lifetime performance with 93kg weaned piglets due to a farrowing frequency of one litter per year with 5.4 piglets and a productive life of only 4.3 years (see table 17, appendix). One reason for the short productive life of Co and Meo is the management form of the Thai- and H'mong-farmers, who do not differentiate between breeding pigs and fattening pigs, see below.

The pig performances that are shown above seem to be quite low compared with performances recorded by other authors: However, most of these studies were carried out "on station", where better feeding and management were available. The difference between performance recorded "on station" and recorded "on farm" is particularly high in case of I, Meo and Co. The feeding of these breeds is mainly based on green forage and only small amounts of high-energy feed so that their "on farm"-performance is quite low. Due to the feeding management that is not standardized the performances of the different local breeds cannot be directly compared.

Different factors influence the reproductive performance of the sows.

In the case of I, Meo and Co the piglet mortality is rather high because piglets normally run free and so they are exposed to many dangers. The floor made of bamboo grids that can be seen in most of the Thai sties could also cause accidents. On the other hand, Meo and Co piglets seldom starve to death due to a lack of milk, because the small litters do not need so much milk. However, in case of I-pig starving occurs more frequent. Sometimes piglets die immediately after birth. In most cases the cause remains unknown. Lack of energy and protein, spoiled feed and infections seem to be main causes of reproductive disorders, shortage of milk or high piglet mortality.

In case of LH and MC the biggest problem is the discrepancy between litter size and milk production. Therefore almost all farmers sell some piglets of each litter immediately after birth (or give them away as presents) and keep only 10 to 12 piglets. Although shortage of feed occurs less frequent in case of LH and MC (when compared to Meo, Co or I) its consequences are more serious due to the bigger litters. Other reproductive disorders (failure to get pregnant, abortion) play a less important role and infections seem also to be less frequent. Piglet losses due to crushing by the sow or accidents are quite seldom; may be due to the concrete floors in the Kinh sties that seem to be safer than the grid-floors in Thai sties.

Regarding reproductive disorder the crossbreds between exotic and local pig breeds lie on a medium level. That means their fertility is not as bad as in case of Meo or Co but not as good as in case of LH or MC. However, the keeping conditions of exotics and their crossbreds are better than that of local breeds.

12.1.3.4 Fattening performance

As an indicator of fattening performance the average daily gain was calculated. As parameters for the calculation age and weight of pigs at sale were used. However, due to different management and feeding the respective breeds cannot be directly compared.

In addition, due to method of data collection the results for gain per day of life and per day of fattening period cannot be separated.

In case of LH the average daily gain could only be estimated for piglets. There are no data for fattening pigs. Scientific articles on fattening performance of LH could not be found.

The results of this investigation show that MC-crossbreds have the best fattening performance with a daily gain of 370.3g/ day. Other authors recorded for DE-MC-crossbreds on station an average daily gain of up to 783.0g/ day (LUAN & QUANG, 1983).

The average performance of pure Meo in this investigation was a daily gain of 185.6g/ day, the daily gain of Co was measured to be 91.3g/ day. The fattening performance of Co- and Meo-crossbreds is by far

higher than that of the respective pure genotypes (Cornwall x Meo: 272.0g/ day; Mong Cai x Co: 164.3g/ day; see table 19, appendix).

For I-pig data of average daily gain are also missing. However, Vietnamese scientists carried out different investigations. They showed that I-pig is comparable to Meo or has a slightly higher fattening performance (KHANH & HIEN, 1963; LUAN & QUANG, 1983; see 9.1.5.2).

12.1.3.5 Marketing of local pigs

The majority of the interviewed Kinh-farmers consider breeding and fattening as different production forms. Fattening pigs are used for fattening only, and breeding pigs are used for breeding until litter size decreases due to the reached age. Production is market-orientated; and pigs are not considered to be savings for shortage periods (only 18 percent of the Kinh-farms). In 90.0 percent of the investigated farms the time of sale depends on age or weight of the pigs (see table 20, appendix). Only a few farmers consider also feed- and meat prices when they fix the time of selling. Slaughtering for household consumption is not common (only about 10.0 percent of the Kinh-farms).

The pig production of Thai and H'mong is less market-focused. Breeding and fattening are not separated so that breeding animals are sold in time of financial shortages. Normally, the farmers sell pigs at a certain age or weight (45.5 percent of the Thai-farmers in Son La). Additionally, pigs are sold in times of financial shortages (54.5 percent of the Thai farmers in Son La). A few farmers wait until they find a buyer. Feed shortage can also force the farmers to sell their pigs.

In addition to selling most of the Thai- and H'mong-families slaughter one or more pigs for festive occasions. With it they lay in a fat stock for the next 12 months. For the daily meat consumption the family normally buys meat on the market. The H'mong are an exception because they do not buy meat but shoot game.

It is common to sell fattening pigs to a dealer and to sell piglets to farmers of the neighbourhood. Only in two villages near Hanoi farmers reported on a dealer specialized in marketing (purchase and sale) of piglets for breeding (Provinces Bac Giang, Ha Tay).

Prices vary in different regions. Piglets' prices lie between 7900VND/ kg (0.56USD; male Lang Hong, Bac Giang) and 13,900VND/ kg (0.99USD; Co pig, Nghe An). If piglets are used only for breeding than female piglets are more expensive than male piglets. However, this is not very common. 'Dual purpose piglets' (breeding and/ or fattening) obtain the same price for male and female animals.

The price for fattening pigs varies between 8500VND/ kg (0.61USD; Lang Hong, Bac Giang) and 10,500VND (0.75USD; Son La). Pigs are sold alive. The payment is not graded after fat or lean meat percentage of the carcass' parts. However, prices depend on the breed. 'White', lean pigs obtain a price that is 1000VND/ kg higher than the price for 'black', fat pigs (4/ 2000, Son La). Lean meat is on the market twice as expensive as fatty meat (lean meat about 28,000VND/kg = 2USD; fatty meat 13,000VND/ kg).

12.1.3.6 Economic assessment of pig production

The majority of the smallholder farms are mainly market orientated. In order to compare the economic success of pig production of the investigated farms, the net profit per animal unit (NP/ AU) and the efficiency were calculated for all households (for description of the method see section 9.1.5, for results see table 21, appendix).

In general, sow-keeping farms get the highest net profit per animal unit. There were only two exceptions to this result, namely Thai farmers in Nghe An and Kinh farmers in Bac Giang. Keeping sows in combination with pig fattening returns a medium NP/ AU, fattening only returns the lowest NP/ AU. However, the data for pig fattening are not very dependable due to the small number of observations. Therefore the results shown below refer only to sow keeping-farms.

The efficiency of fattening is lower than the efficiency of sow keeping (exception: H'mong -farmers in Son La).

The Kinh possess a high-yielding breed, the MC. Production based on MC-genotype returns a high NP/ AU (3,688,000VND). However, due to high feed-costs and more expensive animals the pig production is not so efficient (5.7).

Due to outsize feed-costs and low gain for sale of piglets the Lang Hong-owner operate only at loss (-788,000VND). The efficiency is minimal (0.7).

The participants of the I-pig-programme get a smaller NP/ AU (1,779,000VND) compared to MC-owner (3,688,000VND, see above). This is due to the low performances of the I-pig. However, the efficiency of pig-production with I-pig is reasonable (7.9), due to low costs for feeding, animals, vaccination and so on. The Thai in Son La reach a very high NP/ AU (mean = 4,115,000VND/ AU, however with high variability of the single farms) and the highest efficiency (34.3) for sow keeping, due to reasonable fattening performance of the Meo and minimal input.

Co-Pig-owner (Thai) and H'mong achieve only a small NP/ AU (291,000VND; 424,000VND) due to low animal performances. Especially the Thai (Nghe An) are dissatisfied with their pig breed but cannot afford to buy animals of improved genotype or the feed that is required for "better" pigs. However, Thai and H'mong operate with reasonable efficiency because variable costs are low (19.7; 3.6): They utilize farm-grown feed, use sows' offspring for remount, spend only a little money on health care and have no expenses for service of the sows) (see table 22, appendix).

12.1.3.7 Health status and health care management

Many scientists as well as interviewed farmers praise the disease resistance of local breeds. However, that is a general assessment that should be investigated more accurately.

In fact losses among adult pigs occur seldom; only sometimes pigs are lost due to epidemics (leptospirosis, salmonellosis, pasteurellosis or other). On the contrary, piglet mortality is extremely high, caused by accidents and diseases. First of all diarrhoea is quite common.

Only a small number of farmers do not care for sick animals. Most of the farmers call the veterinary service or buy medicine on their own. Medicine is everywhere available without restrictions. Unfortunately not all farmers possess sufficient knowledge on the use of medicine. First of all antibiotics for humans are often used to cure domestic animals. Added to this, dosage is not observed. The poorest households often cannot afford to buy medicine to cure their animals. However, there are no alternatives inasmuch as only a very small number of farmers seem to know any kind of traditional medicine.

The farmers' awareness of animal health is not too strong. In the course of this investigation a few sick pigs were seen. However, when the respective stockowners' attention was drawn to the sick animals most of them reacted uncomprehending.

Vaccinations are meanwhile offered in almost every village, but not in every case with the necessary regularity. This is especially true for the H'mong -villages, which are difficult to reach for the veterinary service. Additionally, a lot of H'mong -farmers refuse the vaccination of their domestic animals (as do some Kinh- and Thai-farmers, too). They say that vaccinations are „not necessary“; „too expensive“; „an needless expense“ or even „harmful “.

The results do not permit to assess whether local breeds are more resistant to diseases than exotic breeds. Mortality, especially piglet mortality, diseases and reproductive disorders are strongly promoted by the practiced management and feeding. Hints to a special disease resistance could be drawn from the statements of those farmers, who already have experiences with exotic breeds. Another hint are the own investigations: For instance, mange seems to be quite common among exotic breeds but was never seen among local breeds in the course of this investigation.

12.1.3.8 Appreciation of the investigated pig breeds by the stockowners

The acceptance of the local breeds by their owners is listed in the following table.

Table 8: Attitude of the farmers towards their respective pig breed (% of positive answers)

Stockowner	Thai	Thai, H'mong	Kinh	Kinh	Kinh
Pig breed	Co	Meo	I	MC	LH
Do you like the pig breed you keep?					
I like 'my' pig breed	23.5	63.0	86.7	86.7	100.0
I do not like 'my' pig breed	5.9	7.4	0.0	0.0	0.0
I would prefer to keep another pig breed if I had enough money	70.6	29.6	13.3	13.3	0.0
Could you imagine that your pig breed would disappear one day?					
Yes	11.8	31.5	33.3	0.0	0.0
No	88.2	57.7	58.1	74.1	100.0
I do not care about that point	0.0	3.2	8.3	23.9	0.0

In addition to these more general questions farmers were asked about the special advantages and disadvantages of their respective pig breeds. The figures in brackets give the proportion of farmers (percent), who said yes to the respective question. The figures for the acceptance of the I-pig can be found in section 9.1.6.1.

Co-pig (answers of 17 Thai-farmers; Nghe An): Co-pigs are easy to keep (70.6 percent) and extremely undemanding in regard to feeding (76.5 percent). Therefore they cause only small feed-costs (23.5 percent). They do not need protein-supplements or concentrate (5.9 percent).

Co fit best the economic situation of the Thai farmers in Nghe An (11.8 percent). Additionally, it is tradition to keep Co pig in that region (11.8 percent).

Co-pigs are disease resistant (41.2 percent), strong (5.9 percent) and well adapted to climate (5.9 percent). Disadvantages of the breed are the slow growth (29.4 percent) and a lack of resistance (5.9 percent).

Meo (answers of 27 Thai-farmers, Son La) and „black F1“ (4 Thai -farmers): Similar to the Co (see above) Meo are undemanding in regard to feeding (60.3 percent) and easy to keep (48.1 percent). They need only little feed (40.7 percent) and cause only low feed-costs (11.1 percent). Meo fit best the economic situation of the Thai in Son La (25.9 percent). Meo-piglets are cheap in the market. Moreover, they can easier be sold compared to "white" piglets, because farmers in that area prefer Meo and their cross-breeds. In the visited region there exists a long tradition to keep Meo (29.6 percent).

The statements on growth capacity are conflicting (positive: 18.5 percent; negative: 18.5 percent). The meat quality is considered to be excellent (25.9 percent). Meo are disease resistant (25.9 percent) and well adapted to climate (44.4 percent).

The visited Thai seem to have a very closed relationship to their Meo-pigs. That follows from the Thais' description of Meo: Meo are said to be „beautiful“ due to various characteristics of their body conformation (small body size, prick-ears) and because of the black colour. Meo-pigs are "like good friends" or "like children".

The „black F1“ (Cornwall x Meo, Cornwall x MC) were described as positively as Meo. They need only little feed (25.0 percent) and are undemanding in regard to feeding (25.0 percent). "Black F1" growth faster (50.0 percent) and are more fertile (25.0 percent) compared to Meo. However, they are as disease resistant as Meo (50.0 percent) and show a good meat quality (25.0 percent).

Mong Cai (answers of 27 Kinh-farmers in Thanh Hoa, Ha Tay, Son La): The following answers were obtained from MC-owners, who do not take part in the I-pig-programme.

MC are easy to keep (70.4 percent) and undemanding in regard to feeding (yes: 77.8 percent; 1 negative answer). Therefore the feed-costs are low (yes: 11.1 percent, 1 negative answer). MC fit best the economic conditions of the Kinh farmers (yes: 11.1 percent, 1 negative answer).

Except one negative answer many farmers praised the high fertility of the sows (41.0 percent), the good mothering abilities (37.0 percent), the high milk yield (18.5 percent) and the big litter size (14.8 percent).

The statements regarding growth were contradictory (growth is sufficient: 2 answers, not sufficient: 1 answer). The disease resistance seems to be reasonable (positive: 14.8 percent; negative: 7.4 percent).

Lang Hong (answers of 9 Kinh-farmers, Bac Giang): The Lang Hong-pig is undemanding in regard to feeding (100.0 percent) and easy to keep (100.0 percent). Further, it is a fertile breed with big litter size (22.2 percent) and good mothering ability (11.1 percent). The LH is considered to be disease resistant (22.2 percent).

The LH fits best the economic situation of its owners (yes: 55.6 percent; 1 negative answer). This statement is amazing when the negative net profit and the low efficiency of the Lang Hong-owners' pig production are born in mind (for the further discussion of the special case of Lang Hong see 12.1.3.9).

“White F1“ (answers of 28 farmers; Kinh and Thai; Son La, Ha Tay, Thanh Hoa):

The attitude towards exotic pigs and “white F1“ varies due to the economic situation of the respective stockowner. The farmers in Nghe An are dissatisfied with their Co-pigs. However, most of them have no own experience in keeping pigs of improved genotype. The farmers praise the “white F1“ due to their strength and resistance (26.7 percent) and due to their high growth capacity (66.7 percent). The farmers expect a higher profit from the crossbreds compared to local breeds (20.0 percent). However, the keeping of crossbreds is considered to be very expensive (53.3 percent). Therefore farmers still keep the native pig breed of that region.

The statements of the MC- and Meo-owner are more negative. Many of those farmers already made experiences with “white pigs“. “White pigs“ are difficult to manage (10.7 percent), demanding in regard to feed (25.0 percent) and cause high feed-costs (39.3 percent). The disease resistance was assessed to be very low (14.3 percent); the same was true for fertility (10.7 percent), poor mother abilities (21.4 percent) and low milk yield (14.3 percent). On the other hand growth (14.3 percent) and frugality (10.7 percent) were assessed positively by other farmers. The acceptance of “white pigs“ by input-intensive farmers (Ha Tay, Thanh Hoa) or by input-extensive farmers without own experience (Thai in Nghe An) is higher than the acceptance by input-extensive farmers who already made some experience (Son La).

Exotic pigs (8 Kinh-farmers; Ha Tay, Thanh Hoa): Pure exotic pigs are assessed negatively. They are difficult to keep (37.5 percent), extremely demanding in regard to feeding (37.5 percent) and cause very high feed-costs (75.0 percent). Exotic pigs are susceptible to diseases (25.0 percent) and have no mothering abilities (25.0 percent). However, they grow faster than locals (25.0 percent). Two farmers said that exotic pigs fit best their economic situation, another farmer didn't agree with this.

12.1.3.9 The special case: Lang Hong

The Lang Hong-population has decreased very rapidly up to now. The remaining population is restricted to a small number of villages in the province Bac Giang. Only one of these villages was visited.

In this village a single manager organizes the keeping of Lang Hong. This manager is in the same person extensionist, dealer for feedstuff and dealer for pigs. All Lang Hong-owners belong (whether they know or not) to one great system: Farmers produce purebred piglets. Feed for piglets is only bought from the dealer, who is also the only person to provide extension service. All weaned piglets are sold to this dealer (except some female piglets that will be used for remount). Due to the integration in this „system“ the farmers enjoy some kind of “safety“. They do not interact directly with the market but with the manager as a connecting link who is able to alleviate the changes and risks of the market.

On the other hand that dealers pays the lowest price for piglets ever seen during this study. The farmers do not get any profit. Instead of this they loose money due to high costs (daily feed purchase, use of concentrate) and small proceeds (low prices, only sale of piglets). Efficiency is below 1.0. Amazingly the farmers do not complain. On the contrary, the breed was praised regarding their productive and economic traits. It could be that economic safety and alleviation of market forces are the most important criteria of pig production for the farmers.

12.2 Appendix of tables

Table 9: Outline of the villages visited during the field trips, their allocation to administrative units and the duration of the respective stay

Province	District	Commune	Village	Duration of the stay
Son La	Mai Son	Hat Lot town	Bac Quang	1. Stay: 4. 3. - 11. 3. 2000
		Hat Lot	Na Bo, Na Huong	
		Ta Hoc	Pa Hoc, Ban Hoc	2. Stay: 23. 4. - 29. 4. 2000
		Na Ot	Na Ot	
	Muong La	Muong Chum	Ban Pat	
	Son La	Chieng Co	Ban Hun, Ban Muong, Ot Noi	
Chieng An		Co		
Ha Tay	Hoai Duc	Kat Que	Dong	20. 3. -22. 3. 2000
Bac Giang	Viet Vien	Tang Tian	Phuc Long	23. 3. -24. 3. 2000
Thanh Hoa	Hoang Hoa	Hoang Ngoc	Hoang Ngoc 6	27. 3. -5. 4. 2000
		Hoang Dat	Ha Vu, Van Ning	
		Hoang Trinh	Thanh Nga	
		Hoang Quang	Nguyet Vien, Vinh Quang, Vinh Tri	
	Quang Xuong	Quang hung	Thon 4	
Nghe An	Con Cuong	Chau Khe	Ban Bung	12. 4. - 16. 4. 2000
		Ban Pat	Khe Thoi	

Table 10: Family size and composition regarding age on the investigated farms (Mean \pm SD)

Province	Ethnic group	Number of farms (n)	Total family members	Adult family members	Children
Son La	Kinh	15	4.7 \pm 0.7	2.2 \pm 0.6	2.3 \pm 0.7
	Thai	22	7.0 \pm 2.2	3.0 \pm 1.9	3.4 \pm 2.1
	H'mong	3	4.7 \pm 0.6	2.0 \pm 0.0	2.3 \pm 1.2
Ha Tay	Kinh	14	6.6 \pm 2.7	2.6 \pm 1.6	3.3 \pm 1.1
Bac Giang	Kinh	9	5.1 \pm 1.1	2.1 \pm 0.3	2.7 \pm 0.7
Thanh Hoa	Kinh ⁽¹⁾	15	5.5 \pm 1.6	2.5 \pm 1.1	2.4 \pm 1.3
	Kinh ⁽²⁾	6	5.5 \pm 0.8	2.0 \pm 0.0	2.8 \pm 1.0
Nghe An	Thai	17	6.7 \pm 2.1	2.2 \pm 0.6	3.4 \pm 1.7
Mean \pm SD		102	6.0 \pm 2.0	2.4 \pm 1.2	2.9 \pm 1.5

(1 Participants in the I-pig-programme

(2 Non-participants

Table 11: Plant cultivation on the farms visited (m² per household, mean, SD)

Province	SL			HT	BG	TH	NA
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number of farms (n)	15	22	3	14	9	21	17
Crops							
Paddy	340	1917	0	804	2300	1911	1724
SD	547	3437	-	420	872	1183	1770
Upland rice	0	3595	15000	0	0	0	*
SD	-	5332	5000	-	-	-	-
Cash crops	-	-	-	129	128	405	-
SD	-	-	-	154	176	387	-
Maize	10,627	5710	7300	-	-	-	1250
SD	11,262	5586	4619	-	-	-	1510
Cassava	267	2828	2500	-	-	-	3088
SD	594	3852	2291	-	-	-	2706
Fruits	786	2467	0	-	-	-	588
SD	2424	4625	-	-	-	-	2425
Peanut	0	0	0	-	-	-	2050
SD	-	-	-	-	-	-	2034
Home garden	1700	1120	0	99	-	192	406
SD	3156	2547	-	215	-	346	411
Pond	10	355	0	6	43	82	76
SD	39	659	-	16	98	201	244
Forest	667	14,023	0	0	0	0	40,590
SD	2582	14,043	-	-	-	-	33,300
Total	15,483	32,255	24,830	1038	2471	2519	48,565
SD	14,913	13,488	9385	446	895	1314	35,946

* Existing, but no exact data available

Abbr. of the province names: Son La SL, Ha Tay HT; Bac Giang BG, Thanh Hoa TH, Nghe An NA

Table 12: Domestic animals population on the investigated farms: Proportion of farms that keep the respective species (percent), for pigs differentiated after production form, under specification of preferred pig breeds

Province	Son La			Ha Tay	Bac Giang	Thanh Hoa	Nghe An
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number of farms (n)	15	22	3	14	9	21	17
Animal species							
Buffalo	13.3	63.6	0.0	0.0	0.0	9.5	64.7
Cattle	26.7	40.9	33.3	21.4	0.0	19.0	76.5
Goat	0.0	9.1	0.0	0.0	0.0	0.0	0.0
Chicken	86.7	100.0	100.0	92.9	88.9	95.2	94.1
Duck	6.7	68.2	0.0	7.0	22.2	42.9	11.8
Pig- production form							
Sow	86.7	81.8	100.0	78.6	100.0	95.2	88.2
Boar	13.3	9.1	0.0	0.0	11.1	9.5	0.0
Fattening	53.3	86.4	33.3	57.1	11.1	57.1	58.8
Piglets	46.7	45.5	66.6	71.4	88.9	42.9	17.6
Pig breed	MC	Meo	Meo	MC	LH	I/MC	Co

Table 13: Domestic animals population on the investigated farms: Average number of animals on farms that keep the respective species, for the pig differentiated after production form (mean \pm SD)

Province	Son La			Ha Tay	Bac Giang	Thanh Hoa	Nghe An
Ethnic	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number farms (n)	15	22	3	14	9	21	17
Domestic animals species							
Buffalo	1.0 \pm 0.0	1.9 \pm 0.7	-	-	-	1.0 \pm 0.0	1.9 \pm 0.8
Cattle	1.0 \pm 0.0	3.2 \pm 1.4	2.0 \pm 0.0	1.7 \pm 0.6	-	1.3 \pm 0.5	2.5 \pm 1.6
Goat	-	18.0 \pm 0.0	-	-	-	-	-
Chicken	42.6 \pm 21.9	29.5 \pm 26.7	13.7 \pm 14.8	35.2 \pm 65.9	16.9 \pm 10.1	46.5 \pm 58.6	29.3 \pm 21.2
Duck	12.0 \pm 0.0	11.7 \pm 10.0	-	4.0 \pm 0.0	100.0 \pm 0.0	43.1 \pm 92.1	5.0 \pm 2.8
Production form							
Sow	1.5 \pm 1.0	1.3 \pm 0.6	1.7 \pm 0.6	1.4 \pm 0.5	1.1 \pm 0.3	1.6 \pm 0.7	1.3 \pm 0.5
Boar	1.0 \pm 0.0	1.0 \pm 0.0	-	-	3.0 \pm 0.0	0.1 \pm 0.3	-
Fattening	3.3 \pm 2.5	3.2 \pm 2.0	1.0 \pm 0.0	44.5 \pm 84.0	2.0 \pm 0.0	2.5 \pm 3.7	3.4 \pm 1.6
Piglets	14.0 \pm 7.6	7.4 \pm 3.5	7.5 \pm 6.4	14.3 \pm 5.6	15.0 \pm 9.3	4.9 \pm 8.7	6.0 \pm 1.7

Table 14: Farms classified according to size (percent) and number of animal units (mean \pm SD)

Province	SL			HT	BG	TH	NA
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number of farms	15	22	3	14	9	20	17
Size of farm < 5 AU (%)	76.7	100.0	100.0	71.4	100.0	95.0	100.0
Number of AU	1.6 \pm 0.9	1.5 \pm 0.8	1.5 \pm 0.5	1.5 \pm 0.5	1.4 \pm 1.0	2.2 \pm 0.8*	1.3 \pm 0.5
Size of farm > 5 AU (%)	13.3	-	-	28.6	-	5	-
Number of AU	14.1 \pm .6	-	-	44.1 \pm 9.9	-	6.0 \pm 0	-

* Mean for participants in the I-pig-programme: 2.7 \pm 1.2; mean for famers without I-pig: 1.8 \pm 1.0

Abbr. of provincenames: Son La SL, Ha Tay HT, Bac Giang BG, Thanh Hoa TH, Nghe An NA

Table 15: Percentage proportion of farms with additional off-farm income or raised loan, as well as the average income and average loan in Mio VND, mean \pm SD

Province	Son La			Ha Tay	Bac Giang	Thanh Hoa	Nghe An
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number of farms (n)	15	22	3	14	9	21	17
Farms w. off-farm income (%)	80	13.6	0	57.1	77.8	76.2	11.7
Ø Off-farm income (Mio. VND)	13.0 \pm 9.2	9.7 \pm 7.2	-	8.0 \pm 8.7	4.2 \pm 1.4	8.2 \pm 6.9	4.6 \pm 5.4
Farms with loan (%)	57.1	57.1	33.3	30	11.1	52.4	41.2
Ø Loan sum (Mio. VND)	18.1 \pm 18.5	3.8 \pm 3.5	2.0 \pm 0	10.8 \pm 16.4	1.0 \pm 0	2.6 \pm 1.9	2.0 \pm 0.8

All data for 1999

Thanh Hoa: Income for participants in the I-pig-programme: 8.2 \pm 8.1; non-participants: 6.1 \pm 2.8 Mio VND

Exchange rate: 14,000VND = 1USD

Table 16: Feeding management on the investigated farms (percent of interviewed farmers)

Province	SL			HT	BG	TH	NA
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Thai
Number of farms	15	22	3	14	9	21	17
Feeding management							
Buying additional feed	86.7	13.6	0	100.0	100.0	90.5	5.9
Buying add. feed (except concentrate or protein)	80.0	13.6	0	100.0	100.0	85.7	5.9
Feeding of concentrate	53.3	9.1	0	71.4	77.7	66.7	0
Feeding of protein supplements	60.0	18.2	0	0	0	23.8	5.9
Feeding depending on age or performance	100.0	37.5	0	53.8	77.8	85.7	5.9
Seasonal shortage of feed-stuffs	6.1	22.7	0	14.3	100.0	61.9	82.4

Participants in the conservation programme: Buying additional feed 92.3 percent; Buying feed (without conc. or prot.) 86.7 percent; feeding concentrate 60.0 percent; feeding add. protein 26.7 percent; feeding depending on age or performance 80.0 percent; seasonal feed shortage 66.7 percent

Abbr. of province names: Son La SL, Ha Tay HT, Bac Giang BG, Thanh Hoa TH, Nghe An NA

Table 17: Results of the questioning regarding reproductive performances of sows (mean \pm SD).

Pig breed	I	Meo	Co	Lang Hong	Mong Cai
Ethnic group	Kinh	Thai, H'mong	Thai	Kinh	Kinh
Province	Thanh Hoa	Son La	Nghe An	Bac Giang	SL, HT, TH
Trait					
Number of sows	n= 5	n= 24	n= 11	n= 8	n= 36
Litters/ year	1.4 \pm 1.0	1.0 \pm 0.4	0.9 \pm 0.3	1.7 \pm 0.3	1.5 \pm 0.4
Piglets/ litter born	7.6 \pm 2.1	5.4 \pm 1.8	8.0 \pm 2.6	12.6 \pm 1.8	12.4 \pm 3.7
Piglets/ litter weaned	5.6 \pm 2.7	4.3 \pm 2.4	6.3 \pm 2.2	11.8 \pm 2.5	11.5 \pm 4.0
Mortality (%)	27.5 \pm 23.0	20.6 \pm 32.4	19.1 \pm 19.8	9.3 \pm 9.5	6.6 \pm 13.3
Number of piglets	n= 2	Quotation	Quotation	n= 8	n= 17
Weaning weight (kg)*	5.3 \pm 0.4	5	5	10.2 \pm 1.5	8.8 \pm 2.8
Number of sows	n= 6	n= 12	n= 8	n= 7	n= 11
Productive life (years)	10.0 \pm 4.4	4.3 \pm 1.7	6.2 \pm 3.3	8.0 \pm 3.8	7.2 \pm 3.2
Life performance (n of piglets. weaned)**	78.4	18.7	35.2	160.5	124.2
Life performance (kg of piglets. weaned)**	415.5	93.4	175.8	1636.9	1093.0

*Weaning weights for I and Mong Cai refer to crossbred piglets. The interviews produced no data for weaning weights for Co and Meo. Therefore weaning weights were estimated (Co) or taken from literature (Meo; ANH & DUNG, 1994)

**Total life performance: estimated on the basis of the data

Abbr. of province names: Thanh Hoa TH, Ha Tay HT, Son La SL

Table 18: Reasons for the occurrence of reproductive disorders (percent of sows)

Breed	Exotic x local breed	I	Meo	Co	LH	MC
Ethnic group	Kinh	Kinh	Thai, H'mong	Thai	Kinh	Kinh
Province	TH, HT, SL	TH	SL	NA	BG	SL, HT, TH
Number of sows (n)	14	8	14	9	8	
Reasons for reproductive disorders						
Did not get pregnant	14.3	50.0	21.4	0	0	11.1 (n= 18)
Had abortions	21.4	0	0	0	25	12.0 (n= 25)
Crushed piglets	28.6	37.5	35.7	50.0	0	34.6 (n= 26)
Did not have enough milk	50.0	25.0	7.1	11.1	37.5	76.0 (n= 25)

Multiple answers were possible

Abbr. of province names: Thanh Hoa TH, Son La SL, Nghe An AN, Bac Giang BG, Ha Tay HT

Table 19: Results of questioning regarding slaughter weight and slaughter age of pigs of different genotype. (Average daily gain in g/day; mean \pm SD)

Genotype	Average daily gain in g/day			
	Piglet		Fattening pig	
	Mean \pm SD	n	Mean \pm SD	n
Co-pig, pure (NA)	-	-	91.3 \pm 51.4	12
Co-pig x Mong Cai (NA)	-	-	164.3 \pm 140.4	6
Meo, pure (SL)	-	-	185.6 \pm 105.8	18
Meo x Cornwall (SL)	-	-	272.0 \pm 42.4	2
I-Pig, pure (TH)	166.7	1	-	-
I-Pig x Exot (TH)	110.6 \pm 0.8	2	-	-
Mong Cai x Exot (TH, HT, SL)	170.4 \pm 54.4	17	370.3 \pm 149.6	51
Lang Hong, pure (BG)	165.1 \pm 29.0	8	-	-

Data are not differentiated after daily gain for fattening period/ daily gain for whole life

Abbr. of province names: Nghe An NA, Son La SL, Thanh Hoa TH, Ha Tay HT, Bac Giang BG

Table 20: Utilization and marketing of pigs (percent of farms)

Pig breed	Meo	Meo	Co	LH	MC
Ethnic group	Thai	H'mong	Thai	Kinh	Kinh
Province	SL	SL	NA	BG	SL, HT, TH
Number of farms (n)	22	3	17	9	50
Time of sale depends on...					
Age/ weight of pigs	45.5	33.3	52.9	100.0	90.0
Financial requirements of the household	54.5	66.6	41.2	0.0	18.0
Market prices for pork/ feed-stuffs	4.5	0.0	0.0	0.0	8.0
Additional slaughtering takes place ...					
When demand for meat	18.2	0.0	0.0	0.0	0.0
At certain occasions	81.8	66.6	68.8	11.1	10.0

Abbr. of province names: Thanh Hoa TH, Son La SL, Nghe An AN, Bac Giang BG, Ha Tay HT

Table 21: Net profit/ animal unit (NP/ AU) and efficiency (proceeds/ variable costs) of pig production for the investigated farms (mean \pm SD)

Pig breed	MC	Meo	Meo	LH	I	Co
Ethnic group	Kinh	Thai	H'mong	Kinh	Kinh	Thai
Province	SL, TH, HT	SL	SL	BG	TH	NA
N of farms with piglet- production	24	6	2	8	5	11
NP/ AU	3688 \pm 2653	4115 \pm 4029	424 \pm 619	-788 \pm 647	1779 \pm 857	291 \pm 255
Efficiency	5.7 \pm 5.3	34.3 \pm 23.6	3.6 \pm 5.1	0.7 \pm 0.2	7.9 \pm 7.1	19.7 \pm 14.4
N of farms with piglet- production + fattening	7	1	1	-	1	2
NP/ AU	1986 \pm 2452	320	405	-	1571	243 \pm 524
Efficiency	2.7 \pm 2.0	21.1	21.3	-	7.1	1.8 \pm 2.6
N of farms with fattening	4	2	-	-	5	2
NP/ AU	1154 \pm 1382	-78 \pm 109	-	-	698 \pm 432	505 \pm 215
Efficiency	1.9 \pm 1.1	0.5 \pm 0.7	-	-	2.2 \pm 0.9	7.2 \pm 1.2

All data for 1999, in 1000 VND

Abbr.: Son La SL, Thanh Hoa TH, Ha Tay HT, Bac Giang BG, Nghe An NA N Number

Exchange rate: 14,000VND = 1USD

Table 22: Variable costs and proceeds for farms of different size and production form (In 1000 VND per AU; mean \pm SD)

Size of the farm	> 5 AU	< 5 AU	< 5 AU	< 5 AU
Production form	Fattening	Piglet-prod.	Piglet-prod.	Piglet-prod.
Pig breed	MC	MC	Meo	Co
Ethnic group	Kinh	Kinh	Thai	Thai
Province	Ha Tay	Ha Tay	Son La	Nghe An
Number of farms	3	8	6	11
Ø Animal units	49 \pm 35	1.4 \pm 0.5	1.0 \pm 0	1.3 \pm 0.5
Pig sale/ AU (1000 VND)	2715 \pm 1622	7079 \pm 4817	4386 \pm 4072	339 \pm 243
Feed purchase/ AU (1000 VND)	460 \pm 279	3150 \pm 2413	125 \pm 306	6 \pm 21
Pig purchase/ AU (1000 VND)	688 \pm 335	217 \pm 611	0	5 \pm 18
Sow raising/ AU (1000 VND)	0	122 \pm 0	5 \pm 7	11 \pm 7
Health care/ AU (1000 VND)	165 \pm 275	86 \pm 105	73 \pm 61	4 \pm 6
Service fee/ AU (1000 VND)	0	30 \pm 11	68 \pm 59	0
Labour/ AU (1000 VND)	58 \pm 100	0	0	0
Total input/ AU (1000 VND)	1370 \pm 498	3605 \pm 2770	271 \pm 327	26 \pm 28
NP/ AU (1000 VND)	1370 \pm 1498	3474 \pm 2934	4115 \pm 4029	313 \pm 255
Efficiency	2.1 \pm 1.3	2.1 \pm 1.4	34.3 \pm 26.6	19.7 \pm 14.4

All data for 1999

Abbr.: NP net profit, AU animal unit

Exchange rate: 14,000VND = 1USD

Table 23: Diseases and applied health-care measures on the farms visited (percent of farmers)

Province	Son La			Ha Tay	Bac Giang	Thanh Hoa	Thanh Hoa	Nghe An
	MC	Meo	Meo	MC	LH	MC	I	Co
Pig breed	Kinh	Thai	H'mong	Kinh	Kinh	Kinh	Kinh	Thai
Use of medicine	66.7	54.5	66.7	93.0	33.3	100.0	66.7	11.8
Vaccination	46.1	77.3	0.0	57.1	100.0	83.3	93.3*	41.1
Diarrhoea of piglets	40.0	22.7	33.3	93.0	44.4	100.0	66.7	29.5

Data for 1999

*20 percent of the participants let only I-pigs vaccinate, not the other pigs.

Table 24: Estimation of the annual subsidies in the I-pig-programme

Production form	Boar keeping	Sow-keeping
Type of subsidy		
Subsidies for a boar	120,000VND/ month	-
Subsidies for a sow	-	600,000VND/ year
Subsidies for a male piglet	-	50,000VND/ piglet → 266,000VND *
Subsidies for a female piglet at weaning age	-	14,600VND/ kg piglet → 314,776VND **
Sum of subsidies	1,440,000VND/ year	
Additional income	-	Fattening of male pure piglets → 942,388VND ***
Loss of income due to utilization of the sow for pure breeding	-	Estimated from own data → 547,400VND
Loss of income due to utilization of the boar for pure breeding	-	-
Absolute change of the net profit	+ 1,440,000VND/ year (102.9USD)	+ 1,575,764VND/ year (112.6USD)

Performance of the I-sow: 1.4 litters/ year; 7.6 piglets born; 5.6 piglets weaned

* Subsidies for male piglets → 50,000VND x 3.8 piglets x 1.4 litters = 266,000VND

** Sale of female piglets → 14,600VND x 5.5kg weaning weight x 2.8 piglets x 1.4 litters = 314,776VND (weaning weight after DOANH, 1985; TANG & CUONG, 1994)

*** Sale of male piglets after 6-month-fattening period with an average weight of 48.3kg (LUAN & QUANG, 1983) → 1.4 litters x 2.8 pigs x 48.3kg x 8742VND = 942,388VND

As mentioned above, subsidies are smaller for those farmers, who are cared for by the Womens' Union (instead of 600,000VND per sow and year only 250,000VND per purebred litter). Thus, for those farmers the net profit increases by only 1,225,776VND (87.6USD).

Table 25: Opinions of participants regarding the I-pig-programme

Why did you agree to take part in the conservation programme initially?

Because of the good characteristics of the I-pig	60.0%
Because of the good experiences that I/ my parents made with this breed	30.0%
Because I'm convinced that conservation of this breed makes sense	30.0%
Because the keeping of I-pigs has a long tradition in this area	20.0%
Because I expected to get an economic benefit from participation	10.0%

What is for you the most important aspect of the conservation programme at the moment?

The economic benefit from keeping I-pigs	69.2%
The subsidies I receive from the programme	54.0%
The conservation of the breed	46.2%
Transfer of knowledge and support I get from the manager	30.8%
The good characteristics of the I-pig	23.1%

What are your wishes for improvement of the I-pig-programme?

Higher subsidies	56.0%
Increase the number of I-pigs, spreading of the breed	56.0%
I want to learn more about pig production	11.1%

Number of interviewed farmers n= 15; multiple answers were possible

12.3 Appendix of pictures

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