

Karbi Anglong's pig sub-sector:
Current status, constraints and opportunities

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Foreword

The present study is one of a series of five reporting appraisals of the pig sub-sectors of selected districts in Assam State, Northeast (NE) India. This report covers the district of Karbi Anglong; the other districts were Dhemaji, Kamrup, Kokrajhar and Golaghat. A sixth report synthesizes the results of the district reports, draws conclusions and makes recommendations at the state level, and summarizes the district-level and site-specific conclusions and recommendations. Given that a common approach and the same methodology were used in each of the district appraisals and that the same authors wrote the reports, the series of reports have the same structure and some common text. While designed to be part of a series, each district report can be read in its own right.

Acknowledgements

The series of appraisal studies was jointly funded by the Assam Livestock and Poultry Corporation Limited (ALPCo) and the International Livestock Research Institute (ILRI). Nevertheless, the views expressed in this report are those of the individual scientists and do not necessarily reflect the views of ALPCo, ILRI or the other organizations associated with the study.

The study would not have been possible without the participation of many individuals and organizations. The oversight and review provided by three resource persons, Dr M. K. Tamuli of the Indian Council of Agricultural Research (ICAR)'s National Research Centre on Pig (NRCP), Dilip Sarma (Centre for Humanistic Development), Dr A. B. Sarkar, former Director of Research, Assam Agricultural University (AAU), were indispensable to the design of the study and to the interpretation of the results. The officers and staff of the Animal Husbandry and Veterinary Department (AHVD) were instrumental in completion of the field study; without them the study would not have been fruitful. We are also indebted to the many pig producers and their families, pig traders, pork retailers and input suppliers who shared their knowledge, experiences and insights with us and to the officials of AHVD and the District Rural Development Agency (DRDA) in Karbi Anglong district and in the sample villages for their guidance and for the benefit of their expertise and experiences. We also thank Jyoti Khatanair for research assistance. And finally, the series of studies would not have been possible without the advice, commitment and continual support of Moloy Bora (ALPCo) to whom we express our gratitude.

Executive summary

The present study is one of a series of five that appraises the pig sub-sectors of selected districts in Assam state, NE India. The five districts were chosen to reflect the variation observed in Assam for pig production and marketing. This report covers the district of Karbi Anglong; the other districts were Dhemaji, Golaghat, Kamrup and Kokrajhar. A sixth synthesis report brings together the results and conclusions of the district reports. The objectives of the appraisals were, first, to build a comprehensive understanding of the pig systems in Assam through a participatory process involving key stakeholders and second, to identify entry points for effective public- and private-sector interventions in the pig sub-sector in order to improve livelihoods and generate employment.

The appraisal studies applied two complementary methods: a review of secondary information from or relevant to Assam and the collection of primary data through semi-structured interviews. The interviews were carried out at district, village and household levels with consumers, market agents and producer households and district- and village-level key informants. Through consultations with key resource persons, district veterinary officials and some district-level market agents, three cluster areas per district were identified in each of which interviews were carried out in three households in each of two villages. Generally, one cluster was selected near the district headquarters/major town of the district and the other two some 30 to 70 km in different directions away from the district headquarters. The clusters were selected to include the principal areas of pig production and their expected variation for ethnic group, production system (including cropping) and market opportunities.

In Karbi Anglong district the three selected clusters were Manja, Silonijan and Howraghat. The clusters were visited during the third and fourth weeks of October 2006 to collect information from producer and consumer households, market agents, input suppliers and other key players and stakeholders in pig production and marketing. Drawing upon their experience and knowledge, the key resource persons guiding the study considered that the distinctive features of Karbi Anglong relative to the other surveyed districts were: topographically highland and recognized as a hill district; ethnic diversity including Karbi, Dimasa, Kuki, Manipur, Bodo, Shyam, Ahom, Rengma, Jayantia, Man Tai, Assamese-speaking general community and Nepali; second highest concentration of scheduled tribe (ST) population in Assam; poor access to

markets, farm inputs and veterinary services; and the *jhum* (shifting) system of cultivation.

Karbi Anglong, which was formed in 1976, is a rural district that lies in the centre of the state. In the 2001 census its population was 0.8 million (approximately 150,000 households), less than the current population of Guwahati, the state capital. About 90% of the district's population is rural. Karbi Anglong has six urban centres; Diphu, the district capital, has a population of about 50,000 while that of each of the other five centres is less than 15,000. The district is thinly populated with fewer than 80 people per square kilometre compared to the state average of 340. In the Assam Human Development Report, Karbi Anglong had the highest Human Poverty Index of all Assam's districts. The majority of Karbi Anglong's people are Hindus (over 80%) followed by Christians (15%). The ST community forms 56% of the district population, the second highest proportion in Assam. In the district, Karbi is the largest tribe followed by Bodo, Dimasa and Kuki.

Smallholder farm households form the large majority of the rural population. Forestry and non-agricultural enterprises serve as supplementary sources of income. Forest covers 30% of the district, while the total cropped area is less than 20%. Paddy is the main crop and *jhum* the main system of cultivation; other crops include maize, cotton, tapioca, ginger and turmeric. Relative to the plain districts, operational holdings in Karbi Anglong are larger. Only 30% of households have holdings of less than 1 ha; the state average is over 60%. Livestock (including poultry) are integral to household livelihoods. Pigs are traditional components of tribal households, serving as a source of income, a means of diversifying household risks and a means of fulfilling socio-religious functions. The 2003 livestock census reported 112,000 pigs in the district.

It was against this broad background that a detailed overview of Karbi Anglong's pig sub-sector was compiled through consultations along the market chain from consumers of pork to retailers, pig traders and pig producers, and with the organizations that serve them. Consistent with expectations, pig production was mainly a small-scale market-oriented enterprise of tribal communities. About 75% of rural tribal households reared pigs, mostly crossbreeds. Amongst the Karbi/Tiwa and Bodo/Rabha/Kachari ethnic groups the proportion was 95%. The majority of households did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. About 95% of households

tethered or penned their pigs and less than 1% allowed their pigs (generally the indigenous type) to scavenge. Nevertheless, traditional feeding practices prevail and these limit pig performance. Slaughter pigs were reported to reach 50 to 60 kg live weight at 10 months of age with the lower weights being more prevalent. A major contributing factor was poor diet quality (low protein) because feeds were mainly by-products of the rice crop – bran and *juguli* (the residue of country liquor) – along with *Colocasia/taro*. However, because these and other local feed resources were of low or no opportunity cost and the labour for caring for the pigs was provided mainly by the women of the producer households, pig production was an attractive, profitable business. What is more, even close to Diphu town there has been, as yet, little or no private-sector investment in more intensive systems of production.

This competitive small-scale sector in Karbi Anglong has been responding to a vibrant market for fresh pork; traders and retailers said that demand has increased considerably (by approximately 50%) over the last five years. They were also confident that sales of fresh pork would continue to grow as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there have been limited inflows of slaughter pigs from other districts of Assam and from other states (an estimated 10% of slaughter pigs are sourced from outside the district), it is clear that small-scale production must have expanded considerably during recent years to satisfy the increased demand for pork in Karbi Anglong. These changes have resulted not only in more pigs being produced from the estimated 66,000 small-scale units with benefits to the livelihoods of the tribal producer households, but there are also many more people earning their living from the marketing of pigs and pork and from the provision of services.

These market-driven changes meant that pig producers in Karbi Anglong were happy with the income they generated but, at the same time, they said that they were not very keen to further increase the sizes of their herds because of the lack of household feed resources and labour. Hence the conundrum; the market is continuing to demand more pork but the input constraints now faced by the majority of producers – the many thousands of resource-poor, tribal households – are limiting their capacity to respond. Pressure is also increasing on Karbi Anglong's existing stock of pigs due to the shortage of supply from Dimapur because of the increased cost of transport and some hidden expenses. To meet the shortfall, Karbi Anglong procures some slaughter pigs from the

nearby Nagaon and Golaghat districts; and an estimated 20% of all piglets marketed in the district are sourced from Golaghat, Nagaon, Lakhimpur and Dhemaji districts. Therefore, when interventions to support the production of piglets and slaughter pigs in Karbi Anglong are developed, they have to take into account the competition from these other sources of supply. It is also important to recognize that production systems vary by ethnic group. Consequently, it is probable that ethnic-specific interventions will be required that will result in local pig producers increasing production by intensifying their systems. The alternative is that the market for pork in Karbi Anglong district, and in Assam generally, will attract significant imports of slaughter pigs in the way that the state imports large quantities of chicken meat, eggs and fish.

Given this demand and supply scenario, what **specific recommendations** can be given to overcome the technical, institutional and policy constraints faced by the pig sub-sector in Karbi Anglong and thereby to exploit the opportunities for improving productivity and profitability, especially amongst the tribal communities?

Production constraints and opportunities

1. The lack of operating capital and limited credit facilities were major constraints to piggery development in Karbi Anglong. One result has been the prevalence of the *adhiary* (share-cropping) system. To address this constraint, one option is to make available more micro-credit through non-governmental organizations (NGOs). Capacity building of existing NGOs to play an intermediate role in money lending would be a first step. Since resource-poor rural farmers are risk-averse, group insurance schemes should also be made available with the credit.
2. Inadequate knowledge about feeding, health care and breeding management was given by producers as another major constraint to improving production. Current extension programs were said to be less effective and limited in their reach. Required are needs-based, client-oriented programs that use participatory methods to improve the capacity of pig producers to make more effective use of available feed resources, to maintain their pigs in good health and to breed productive crosses.
3. A technical production constraint repeatedly reported by producers was the inadequate supply of quality piglets, a result of the small proportion of producers in Karbi Anglong that kept breeding stock and the absence of systematic breeding programs. A re-assessment of current government breeding programs is required.

Innovative community-based systems need to be developed and private-sector investments encouraged to better meet the unsatisfied demand for improved breeding stock and quality weaners. It is recommended that key elements should be expanding the stock of the preferred Large Black breed and making available quality boars to all breeders in the villages for use in the prevailing fee-paying mating system. The possibility of introducing artificial insemination (AI) should be explored by research and development (R&D) agencies and a needs-based and effective training program should be designed for smallholder pig breeders on the care and management of breeding stock.

4. For extension programs designed to improve feeding practices for faster growth rates and better reproduction, a key opportunity results from the main feed sources – rice bran, *juguli* and *Colocasia* – being rich in energy but deficient in protein. This constraint can be offset by three complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forages including soybean; (ii) testing the profitability for pig producers and feed suppliers of a protein-rich feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units; and (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia/taro*, sweet potato and maize. Each of these interventions conforms to the principle of providing farmers with information and technological options that allow them to combine feeds optimally in relation to the cost of production (including family labour) and the contribution of each feed to meeting the nutrient requirements of their pigs for profitable performance.
5. The participatory approach to extension ensures that the interactive, iterative process of identifying constraints, evaluating options to resolve the constraints and assessing the benefits increases the capacity of the pig-producing households to improve their husbandry through continuous knowledge sharing within their communities and with their R&D partners. At the same time, the process will facilitate the strengthening of institutional linkages and effectiveness amongst the R&D organizations, including the agencies that give credit, the provision of which is likely to have a key role in supporting the adoption of technical innovations.
6. The same participatory process would also be applied to evaluate the impacts of pig diseases and their threats to the viability of small-scale herds, particularly in relation to designing effective prevention and control systems for swine fever. Current systems for vaccine delivery do not work and alternatives are required, through

community-based training, in the early clinical diagnosis of swine fever and the collective actions required to prevent the spread of infection. Community-based schemes would include veterinary assistants paid by the community to supply a variety of services and the training of local skilled persons to castrate and vaccinate pigs and to provide first aid treatment.

Marketing and consumption issues

1. Whereas households faced constraints to pig production, the market for their pigs (output market) generally worked efficiently with attractive prices for producers and reasonable margins for market agents. But rent-seeking (“hidden expenses”, i.e. bribes) by police added to marketing costs during the transport of piglets, slaughter pigs and pork, increasing the price of meat to consumers and reducing profits for producers. It is recommended that there should be an awareness program to overcome this problem which would involve all participants in the market chain: producers, traders, police and other officials.
2. In need of improvement was the food safety of pork. With pork consumption rising and the number of market participants between producer and consumer increasing, the risks to public health from unhygienic practices are growing. Currently, even in Diphu, there is no routine pre- or post-mortem inspection of slaughter pigs because of inadequate coordination among the AHVD, town committee and police administration, inadequate manpower and physical resources and the absence of physical infrastructure (like buildings, water and electricity) to slaughter pigs and sell pork.
3. These deficiencies in public health measures should be addressed through a risk assessment along the production-to-consumption value chain to systematically analyze the practices of pig producers, pork wholesalers and retailers. The evaluation should assess the requirements for improved infrastructure and inspection (manpower and physical resources) and for training in meat hygiene and food safety based upon consumers’ needs, perceptions and willingness to pay.
4. One specific aspect of public health is measly pork (infestation of pork by the zoonotic tapeworm *Taenia solium*), the signs of which were well-known to consumers, pork retailers and pig traders such that traditional knowledge and food cooking practices reduce adverse impacts on human health and on the consumption of pork. Nevertheless, it and other zoonotic diseases of pigs should feature prominently in the proposed training in meat hygiene and food safety. The

training should be given to all participants along the value-chain: pig producers and traders, pork retailers and veterinary and public health inspectors. One option for the training-of-trainers is the courses given by the Manila-based Animal Products Development Centre of the Bureau of Animal Industry, the Philippines. See http://www.aphca.org/reference/apdc_ph/apdc_index.html for details.

5. Notable results from the key informant interviews and field surveys were that there was no price differential between lean and fat pork and that pork from indigenous pigs was more expensive than that from crossbred pigs, especially in some rural areas, reflecting consumer preferences based on taste. In order to inform private investment and government planning, there is the need to better define and quantify consumer perceptions of pork quality, including aspects of taste, appearance and composition. It is recommended to carry out such a study, the results of which will have implications for market opportunities, and for the type of pigs to be kept, how they should be managed and how their meat should be presented to consumers.

Policy and institutional constraints and opportunities

1. As was discussed in relation to production, principal amongst the constraints faced by current and potential pig producers was the ineffectiveness of the publicly-funded production and veterinary extension services, despite the integral contribution of market-oriented pig production to the livelihoods of tens of thousands of resource-poor rural households in Karbi Anglong. Furthermore, the increasing demand for pork represents a major opportunity to improve livelihood security and increase incomes, particularly amongst marginalized groups including unemployed youth.
2. What is lacking to exploit these opportunities is effective extension support driven by a policy that recognizes that improvements in productivity and profitability of current producers will come from incremental production changes developed by innovative, community-based programs that use participatory methods implemented by staff oriented towards the needs of their clients. The approach requires a mind-set change by government officials, the increased role of NGOs and building upon local social infrastructure, e.g. successful self-help groups (SHGs).
3. To achieve this, two complementary institutional mechanisms are recommended: (i) a program of capacity building in participatory methods and (ii) the establishment

of a planning and coordination group as a platform to catalyze the process of mind-set change and to prepare a policy on pig sub-sector development.

4. To be effective, the planning and coordination group will have to overcome the current inadequate coordination among the varied R&D stakeholders like the College of Veterinary Science (CVSc), Indian Council of Agricultural Research-North Eastern Hill Region (ICAR-NEH), NRCP, AHVD, DRDA, ALPCo, commercial banks and insurance companies. This issue can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.
5. It is noted that options for the capacity building in participatory methods are the courses on “Participatory action research for rural development” and “Participatory innovation development: a training of facilitators” given by the Regional Centre for Asia of the International Institute of Rural Reconstruction (IIRR) in the Philippines. See <http://www.iirr.org> for more details.
6. It is further recommended that integral to the strategy and its implementation through participatory approaches should be the provision of financial resources to ensure the exposure of the research community to field problems and to support the extensive participatory field testing of promising research findings, particularly those with potential to improve feeding practices.
7. As well as these production-level interventions, and as was outlined in the “Marketing and consumption issues” section above, public health issues related to current slaughter and meat-handling practices merit attention. The awareness and training programs that have been recommended to improve value-chain and institutional capacity for hygienic pork marketing have to be designed to take into account the limits to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices.

By better understanding the current constraints to and opportunities for the productivity and profitability of Karbi Anglong’s pig production, pig and pork marketing and the consumption of pork, it has been possible to identify some specific actions to improve the pig sub-sector’s contribution to livelihoods in the district, particularly with expected benefits to marginalized groups. A major challenge facing the state and district government departments is to ensure that policies and publicly-funded programs are even-handed in support for small-scale production with its important social equity contribution and its counterpart, the expected emergence of larger-scale, more

intensive production units responding to the continuing increasing demand for pork. Monitoring and evaluating these changes in the structure of piggery in Karbi Anglong will be an important responsibility for the proposed planning and coordination group.

1. Introduction

1.1. Background to the study

Identifying development opportunities for the NE region of India and particularly for its tribal and other marginalized communities, is a priority for India's central and NE state governments (Planning Commission, 2006). The NE is characterized by a high proportion of tribal people for whom pig keeping is integral to their way of life; over a quarter of all India's pigs are in the NE. The increasing demand for animal-source foods in the NE and in India generally, matched with the current low productivity of the NE pig population, suggests that well-targeted interventions to improve pig production could deliver significant livelihood benefits for tribal and other marginalized groups in the region.

ILRI carries out pig systems R&D to alleviate poverty and improve rural livelihoods in Southeast Asia. After consultation with and at the request of its national partners in NE India, ILRI committed to work with its partners to appraise the pig sub-sector (pig production and marketing) beginning in Assam, the NE state with the largest human population and biggest pig herd.

Discussions about the appraisal design focused on how to support the Government of Assam in its efforts to develop an effective program for the pro-poor development of pig production and marketing. The aim was to improve livelihoods especially amongst the tribal communities in the state. Central to the process was the need to build a shared understanding amongst key public- and private-sector stakeholders about current pig production and marketing systems, their constraints and the opportunities for improvement. ALPCo agreed to co-sponsor the implementation of the appraisal.

1.2. Objectives

From the discussions it was agreed that the objectives of the appraisal were twofold:

1. Build a comprehensive understanding of the pig systems in Assam through a participatory process involving key stakeholders, and from that information,

2. Identify entry points for effective public and private sector interventions for developing the pig sub-sector within a pro-poor market-oriented strategy to improve livelihoods and to generate employment.

1.3. Approach and methods

The approach taken to develop the appraisal work program was to consult with key stakeholders drawn primarily from the public sector but also involving the private sector. The consultations included a stakeholder meeting co-hosted by ALPCo in Guwahati in September 2006, which was followed by detailed discussions with key resource persons including specialists in pig systems R&D and rapid appraisal methodologies, and market agents and pig producers.

It was agreed that two complementary methods would be applied to implement the appraisal: a comprehensive review of secondary information and the collection of primary data through semi-structured interviews at district, village and household levels. The interviews drew on check-lists prepared for consumers, market agents and producer households and for district- and village-level key informants (see Appendix 1 for the list of key informants).

In summary, the interviews (field surveys) gathered information on:

- the populations and income groups practising pig production and marketing;
- the relative importance of piggery in livelihood strategies;
- production practices (feeds, breeds, disease control and reproduction);
- pig productivity and profitability;
- marketing chains and the actors involved;
- consumer demand and preferences;
- support services (particularly genetics/reproduction);
- an approximate timeline of changes (i.e. the dynamics of the systems) and
- interviewees' perspectives on constraints and opportunities, i.e. the scope for improving the productivity and profitability of pig systems.

To ensure that the results of the field surveys reflected the variation observed in Assam for pig production and marketing, five contrasting yet complementary districts were selected: Dhemaji, Kamrup, Karbi Anglong, Kokrajhar and Golaghat. Each district was

selected based on the diversity in respect of ethnic groups, geographical location, agro-climatic zone, production system, pig population and market opportunities. Relevant secondary information and knowledge of the key resource persons about the major supply- and demand-side factors influencing the variability of pig systems in the state was the guiding force in the process of selection.

The resource persons considered that the distinctive features of Karbi Anglong, the district for which results are given in this report, were:

- Topographically highland, recognized as a hill district
- Ethnic diversity including Karbi, Dimasa, Kuki, Manipur, Bodo, Shyam, Ahom, Rengma, Jayantia, Man Tai, Assamese-speaking general community and Nepali
- Second-highest concentration of ST population in Assam
- Poor access to markets, farm inputs and veterinary services
- Existence of *jhooming* system of cultivation (shifting cultivation)

Three cluster areas were identified within each sample district – Karbi Anglong in this case –in consultation with the key resource persons and a district veterinary official. The three selected areas in Karbi Anglong were Manja, Silonijan and Howraghat (Figure 1) in Diphu and Bokajan sub-divisions where the semi-structured interviews were carried out at village and household levels. Because of socio-political disturbances in the area, Hamren sub-division was excluded from the field survey. In each cluster, the interviews were carried out in two villages and in three households in each village. In all the surveyed districts, a common process was adopted to select the clusters. One cluster was selected near to district headquarters/major town of the district (within 5 to 10 km) and the other two clusters were selected in two different directions 30 to 70 km away from the district headquarters. Efforts were also made to accommodate the areas thought to have most potential for increasing pig production and having different ethnic groups, production systems and market opportunities. Likewise, within each cluster two villages were identified (Table 1) from a list of about 10 villages after detailed discussion with the veterinary assistant surgeon (VAS) and staff of concerned local veterinary dispensaries about the demographic and livelihood pattern, role of agriculture and livestock in farming system, concentration of pig population, variation in ethnic groups and proximity to the market. The clusters and villages were visited during the third and fourth weeks of October 2006 to collect primary information from producer and consumer households, market agents, input

suppliers and other key players and stakeholders in pig production and marketing. These, therefore, included district officials working on pig systems. The local daily and weekly markets which were visited are listed in Table 1.

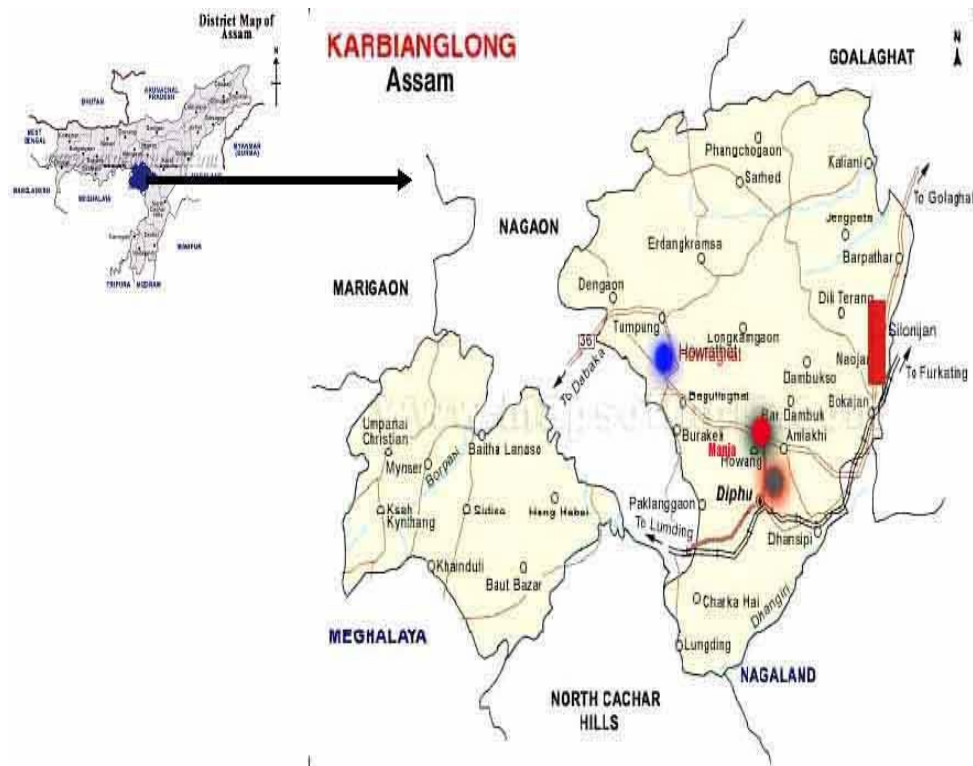


Figure 1: Map of Karbi Anglong district showing the pig clusters.

Drawing upon this field data and the secondary information gathered during the literature review and through visits to the major R&D organizations, this report provides a description of the pig systems in Karbi Anglong district and a preliminary analysis of the constraints to, and opportunities for, increasing their contribution to improving livelihoods and generating employment.

Table 1: Areas and markets surveyed in Karbi Anglong

Clusters	Villages	Daily markets	Weekly markets
Manja	Manja Kuki Basti		Manja
	Disagadeva	Diphu	
Silonijan	Dihingia		Silonijan
	Purana Silonijan		
Howraghat	Baligaon	Howraghat	
	Jal juri		

1.4. Expected outputs

Based upon the discussions and plans for the appraisal prior to its implementation, the expected outputs were:

- A better understanding of current pig production and marketing systems in Karbi Anglong and the constraints to and opportunities for improving systems productivity and profitability, especially amongst the tribal communities.
- Specific recommendations to overcome technical, institutional and policy constraints and to exploit the opportunities for improving productivity and profitability.
- A sound basis for the development of a new program or project by AHVD and ALPCo for interventions in support of improved livelihoods through pig production and marketing.
- A basis for others to develop needs-based projects and/or commercial ventures.

These outputs are derived in the context of Karbi Anglong's current economy and resources (section 2), its pig marketing (section 3) and production (section 4) systems and the related policy and institutional issues (section 5). Finally, section 6 presents the report's conclusions and recommendations.

For the Assam state-level results, conclusions and recommendations, the reader is referred to the synthesis report, which draws on this Karbi Anglong report and the equivalent reports for Kamrup, Dhemaji, Kokrajhar and Golaghat districts (Deka *et al.*, 2007).

2. Historical and demographic overview

2.1. *Karbi Anglong and its people*

In 1951, a new district – United Mikir and North Cachar Hills – came into being, covering the hilly areas of the state of Assam. Before that year, the area formed part of Nagaon, Sivsagar, United Khasi and Jaintia Hills and Cachar districts. Historically, this area was classified as backward tract and partially excluded area by the Government of India². After independence in 1947, the Constitution of India maintained the area's special status by constituting the Karbi Anglong Autonomous Council in 1952 with its headquarters at Diphu. Thus, the constitution provided reasonable autonomy to the district council and vested it with legislative, executive, judicial and financial powers and functions. In 1970 the district was split into Mikir Hills and North Cachar (NC) Hills districts. Mikir Hills district was renamed Karbi Anglong in 1976 (the term "Mikir Hills" is nowadays considered derogatory). The district is situated in the central part of Assam between 25°33' N to 26°35' N latitude and 92°10' to 93°50' E longitude (Figure 1).

At the decadal population census of 2001, Karbi Anglong's population was 0.803 million, less than the total population of Guwahati, the state capital. About 90% of the population lives in rural areas. There are six urban centres: Diphu, Dokmoka, Howraghat, Bokajan, Hamren and Donkamokam (Figure 1). Urbanization is slow; Diphu's population is about 50,000 while that of each of the other urban centres is less than 15,000. The district is thinly populated with a density of 78 people per square kilometre in contrast to the state average of 340. Table 2 presents descriptive statistics of the district's social structure and infrastructure, and some indicators of its development relative to other districts in Assam.

² Evaluation study on the pattern of flow and utilization of funds by Karbi Anglong autonomous council of Assam, NIRD (2003)

³ Statistical handbook, Assam, 2005, Directorate of Economics and Statistics, Government of Assam

Table 2: Some key statistics of Karbi Anglong district

	Karbi Anglong	Assam
No. of villages	2931	26,312
No. of towns	6	125
Total households	144,334	4,914,823
Population density (per sq. km)	78	340
Sex ratio (female per 1000 males)	926	935
Decadal population growth (from 1991-2001 in %)	22.7	18.9
Literacy rate (%)	57.7	63.3
Road length per '00' sq. km of geog. area	40.3	47.8
Percentage of village electrified	40	77
Population per hospital/dispensary/PHC	16,266	30,359
Heads of cattle per veterinary hospital/dispensary/ mobile dispensary	9439	17,614
Per capita Gross District Domestic Product at current price (2000-01), Rs	9638	11,937
Human Development Indicator ⁴ (state)	0.494 (Rank 4 among all districts of Assam)	0.407
Income Index	0.491 (Rank 4)	0.286
Education Index	0.535 (Rank 19)	0.595
Health Index	0.457 (Rank 6)	0.343
Human Poverty Index	35.52 (Highest in the state)	23.24

In respect of religion groupings, the majority of Karbi Anglong's people are Hindus (82%) followed by Christian (15%) and others (Muslim, Jain, Buddhist, etc). After NC Hills district, Karbi Anglong has the second highest concentration of Christians amongst the districts of Assam. The ST community comprises 56% of the district population in contrast to the state average of 12%. It is the second highest tribal-dominated district in the state after NC Hills. Karbi Anglong is home to many tribes including Karbi, Dimasa,

⁴ Assam human development report (2003)

Bodo, Mann Tai, Kuki, Rengma, Jayantia, Hmar and Adivasi. There are also people from Nepali, Bihari, Bengalee and Assamese-speaking general community. Karbi is the largest tribe followed by Bodo, Dimasa and Kuki. Karbi and Dimasa people reside predominantly in the Jirikinding and Omrangshu areas, while the Karbi and Bodo people mostly reside in the Dokmoka and Parakhowa areas. The Kuki people are reported to be concentrated in Singshan hills and Manja. There are also areas where Karbi people reside together with Nepali, Bihari and Assamese-speaking general community. These areas include Bokolia, Bokajan, Silonijan and Kahara. Kheroni area is inhabited mainly by Bihari people. In all the urban centres there is a mixture of the different communities.

The district forms part of the Hill Zone and is characterized by undulating topography. It has three geographical tracts: plains, hills with gentle slopes and hills with stiff slopes. About 85% of the district is covered by hills⁵. The highest peak, Sighasan, stands at about 1360 metres. Kapili and Dhansiri along with their tributaries form the main river system in the district.

The district is the largest in Assam covering some 10,000⁶ square km, about 13% of the state area. About 30% of the district's area is forest covering with dense tropical forest on the hills and flat plains (Table 3). Total cropped area is about 18%, of which 68% is net area sown and 32% is sown more than once. The rest is barren and uncultivable.

The district's climate is sub-tropical with semi-dry summers and cold winters. Average humidity is about 75% and temperature ranges from 8°C in winter to 36°C in summer. Between December 2003 and November 2004, the average monthly rainfall in the district was 92 mm, with the highest rainfall recorded in July (256 mm) and lowest in February (9 mm). Due to differences in topography, climate varies within the district.

In respect of road, power and communication, the district is relatively poorer than the majority of other districts in the state. The Assam Human Development Report (2003) shows Karbi Anglong having the highest Human Poverty Index (proportion of human poverty) in Assam (Table 2).

⁵ Evaluation study on the pattern of flow and utilization of funds by Karbi Anglong Autonomous Council of Assam, NIRD (2003)

⁶ Handbook of Agricultural Statistics, 2005-06, Directorate of Agriculture, Government of Assam

Table 3: Land use ('000 hectares) in Assam state and in the five surveyed districts

District	Total area	Total cropped area*	Net sown area	Fallow	Forest and misc. trees	Others
Karbi Anglong	1033	181	123	**	314	596
(%)			12		30	58
Dhemaji	324	108	55	214	82	165
(%)			17	7	25	51
Golaghat	354	156	116	7	166	66
(%)			33	2	47	18
Kamrup	446	247	175	6	142	123
(%)			39	1	32	28
Kokrajhar	313	145	87	2	168	56
(%)			28	1	54	17
Assam	7850	4087	273	176	2166	277
(%)			34	2	28	36

* Total cropped area comprises net sown area and area sown more than once out of net sown area, so total cropped area is not calculated under the total area

** Separate classification of areas for hill districts is not available; all are included under barren and uncultivable land.

Source: Handbook of Agricultural Statistics, 2005-06, Directorate of Agriculture

2.2. Rural economy and the role of pigs

The rural economy in Karbi Anglong can be termed as agro-based with paddy as the main crop. Cereals, pulses, oilseeds, fibre crops and vegetables are also grown. In hilly areas, people follow the *jhum* system of cultivation while in the plains, sedentary or wet cultivation is widely practised. Using traditional tools and techniques, *jhum* is practised on 20 to 30% of hills. The major crops under *jhum* cultivation include maize, cotton, tapioca, ginger and turmeric. *Jhum* predominates in some areas of Hamren sub-division, while wet cultivation predominates in the plain valleys of Howraghat, Samalangso, Bokajan and Lumbajan where paddy, wheat, oil seeds, sugarcane, fruits and vegetables are the main crops. Relative to the plain districts, the operational holdings of farming families are larger in Karbi Anglong (Table 4). Only 30% of farm

families have marginal holdings (less than 1 ha in size) compared to the state average of 62%.

Table 4: Numbers ('000) and percentages of farm families by size of land holdings in Assam state and in the five districts surveyed for the pig sub-sector appraisal

District	Marginal	Small	Large	Total
Karbi Anglong	16.0	20.8	16.4	53.2
(%)	30	39	31	
Dhemaji	45.4	16.9	14.2	76.5
(%)	59	22	19	
Golaghat	82.6	28.6	24.7	135.9
(%)	61	21	18	
Kamrup	140.0	46.1	42.2	228.3
(%)	61	20	19	
Kokrajhar	59.5	19.7	14.6	93.8
(%)	63	21	16	
Assam	1669.3	561.0	452.7	2683.0
(%)	62	21	17	

Source: Handbook of Agricultural Statistics, 2005-06, Directorate of Agriculture

Paddy cultivation occupies approximately 70% of the total cropped area. There are three types of paddy: *sali* (winter rice), *ahu* (autumn rice) and *boro* (summer rice). *Sali* is the major type (90%) followed by *ahu* (8%) and *boro* (2%). Of the total net cropped area, about 47% is sown more than once; this is slightly lower than the state average of 50%. The rest of the land lies barren for the most part of the year. The low cropping intensity can be partly attributed to negligible use of irrigation (less than 1% of the total cropped area is irrigated). Even though 65% of land under paddy is sown with high-yielding variety seed, this does not stimulate productivity to a large extent partly because of negligible use of fertilizer. The district has one of the lowest rates of fertilizer use in Assam state, after NC Hills and Dhemaji districts. Karbi Anglong's paddy yield of 1533kg/ha is slightly lower than the state average.

Apart from paddy, other significant crops are maize and sugarcane. Karbi Anglong is the highest maize-producing district in the state, producing about 60% of Assam's total maize production (13,851 tonnes in 2004-05). According to manufacturers of feed mills, the quality of maize grown in Karbi Anglong is superior to that grown in many

other places in the country. Sugarcane cultivation is another important farming activity in the district, which produces about 20% of all sugarcane grown in the state. Wheat, lentil, black gram, mustard, sweet potato and tapioca are some other crops cultivated in the district. Amongst the fruits and vegetables, bananas, papaya, oranges, pineapples, cabbages, potatoes and tomatoes are usually grown in the backyards of most households. These homestead crops and vegetables not only meet household consumption needs but also generate cash.

Crop agriculture and livestock and poultry rearing are integral to the livelihoods of these farm families. Although livestock rearing is observed throughout the district irrespective of geographical or ethnic variation, fish farming is mostly restricted to Howraghat area (Figure 1). While farmers from the general community commonly rear cattle, goats and poultry, the tribal communities prefer to rear pigs and poultry. Except for a small number of crossbred dairies (managed by Nepalis in Bokajan, Silonijan, Kahara and Manja area) and poultry farms (especially in Bokajan area), the majority of the livestock (including pigs) and poultry are indigenous breeds or their crosses managed using traditional practices. Common property resources (CPR) like hillsides, forestland, roadsides, playgrounds, school fields and riverbanks are the major sources of livestock feed and fodder.

In common with the other livestock species, piggery serves as a way of bringing additional income to rural families (principally the tribal communities) and, like poultry- and goat-keeping, it requires only a low level of investment. Nevertheless, there are many instances, where tribal people in the district consider pig rearing as a primary source of livelihood. Pig feed comes mainly from the by-products of paddy and of other crops and from CPR. Pigs, therefore, serve to convert existing resources into high-value animal-source food for sale. Unlike in Kamrup district, integration of piggery with fishery was not generally observed in Karbi Anglong. Fish farming is reported to be more popular amongst the Dimasa and Bodo community than other communities. As with other livestock, keeping pigs helps rural and urban households to diversify their risks and improve livelihood security. Pig keeping also serves as a source of cash in times of need, e.g. to repair houses, take land on lease, pay school fees or meet day-to-day household expenses. Apart from pig rearing, a few people also sell slaughter pigs, pork and piglets to earn their livelihoods. These functions of income generation and diversifying risk are also relevant to significant numbers of urban households who, in

Karbi Anglong as in Dhemaji and Kamrup districts, keep little over a quarter of the district's pigs (Table 5).

Table 5: Numbers ('000) and percentages of pigs in rural areas in Assam state and in the five surveyed districts

Project districts	Rural	Urban	Total	% rural
Karbi Anglong	79	33	112	70
Dhemaji	86	28	114	75
Golaghat	95	-	95	100
Kamrup	71	23	93	75
Kokrajhar	99	3	102	97
Assam	1365	178	1543	86

Source: 17th livestock census (2003)

In addition to the farming households, some rural dwellers work full- or part-time as farm labourers. In Karbi Anglong, about 30% of the district population (as per 2001 census) is involved in agriculture⁷ with about 24% working as cultivators and the rest as agricultural labourers. Apart from agricultural labourers, a section of people are engaged in wage labour, carpentry, transport, mechanics and petty trading (sale of firewood, beetle nuts, rice, country liquor, vegetables and fruits in small temporary retail shops). In the study area, the female labour participation rate in activities like vegetable selling was found to be higher. Although the district falls under major tea-growing areas of the state, in 2003 there were only eight tea gardens covering an area of 1900 ha. Karbi Anglong is one of the least industrially developed districts in the state and unlike Kamrup district, the rate of employment in the manufacturing and service sectors is low (11%). Amongst non-farm activities in rural areas, weaving and handicraft (especially bamboo handicraft) are notable. About 6% of Karbi Anglong's population engages in weaving; for most it is a part-time occupation. Only about 10% of rural households are involved in sericulture.

In the absence of significant manufacturing units and services, the primary sector contributes 48% of the total Gross District Domestic Product⁸; the remainder is from the secondary (14%) and tertiary (37%) sectors (2000-01 at current price). The contribution

⁷ Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Government of Assam

⁸ Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Government of Assam

of the primary sector in Karbi Anglong is much higher than in Kamrup district and above the state average of 42%.

In summary, Karbi Anglong's rural economy is agro-based. It seems that for the 56% of the population that is tribal, piggery is an integral part of household livelihood strategies. From the secondary information, it was not clear what the importance of piggery was relative to the other non-crop components of tribal household livelihoods (e.g. weaving), or whether the importance of piggery for tribals was increasing or declining. Equally, it was not apparent whether there was any tendency or trend for other communities to engage in piggery as an enterprise for improving their livelihoods.

2.3. The pig sub-sector and its contribution to livelihoods: hypotheses

Prior to the field surveys carried out to assess the current status of piggery in the sample districts, hypotheses were formulated about its role in the economy of Assam. Some hypotheses address the contribution of piggery to the livelihoods of the state's marginalized people, principally the tribal communities. Others consider factors that may change the structure of the pig sub-sector. These hypotheses included:

1. In Karbi Anglong, piggery is invariably a small-scale backyard enterprise practised by tribal communities and Other Backward Classes (OBC) that include Ahom and Chutiya.
2. Pig production by tribals serves several livelihood objectives that include generating income, accumulating capital and providing a low-cost source of meat.
3. While it is recognized that the contribution of piggery to the livelihood of a household may be small, it is likely to be critical to the well-being of the women of the household.
4. Current systems of pig production depend on family labour (particularly women) and on other local inputs, particularly feed, that are of no or low cost relative the value of the pig being reared.
5. Traditional management practices continue to dominate production systems with the exception that indigenous pigs have largely been replaced by crossbreeds.
6. Despite the pig enterprise being market-oriented, the scale of production is invariably small and the level of purchased inputs is low such that its contribution to the livelihood of a household is not large.

7. Currently local feed resources define the scale of production of backyard enterprises. Therefore, improved feed resources and feeding practices will be the key interventions to increase the productivity and profitability of small-scale backyard piggery.
8. The market for the slaughter pigs produced in Assam is invariably within the state and generally within the district of production, i.e. the local market is the primary consumer of production.
9. In Assam, consumption of pork has traditionally been associated with tribal communities but with changing food habits, consumption of pork among non-tribal people has increased.
10. If the demand for pork increases, it is expected that production will shift from small-scale rural backyard enterprises to large-scale peri-urban units using purchased inputs (particularly feed), i.e. traditional rural production will not compete with intensive peri-urban production.
11. The market for pork will increasingly differentiate between meat from indigenous breeds and their high-grade crosses reared traditionally and meat from exotic crossbreeds reared more intensively.
12. Public interventions related to better access to technical knowledge will be required to support improvements in the productivity and profitability of small-scale backyard piggery.

3. Marketing of pigs and consumption of pork

As elsewhere in the NE, pork consumption and pig production in Assam is strongly associated with tribal (ST) communities (Table 6). Tribals have a high per capita consumption of pork whereas consumption is very low in the predominant general community. Reflecting the low proportion of ST people in Assam relative to the neighbouring states of Meghalaya and Nagaland, the average per capita consumption of pork is lower in both rural and urban Assam than in the other two states (Table 6). Likewise, National Sample Survey Organization (NSSO) statistics show that in Assam rural and urban populations spend only 9% and 1%, respectively, of their total meat expenditure on pork while in Nagaland both rural and urban households spend over 30% of their total meat expenditure on pork.

Table 6: Per capita consumption of pork (kg/annum) in urban and rural areas and for rural social groups in three NE states

State	Urban	Rural	ST*	SC*	OBC*	Others
Assam	0.09	0.61	2.26	0.44	0.49	0.21
Meghalaya	3.26	2.04	2.14	0.00	2.26	0.15
Nagaland	9.54	7.18	7.45	1.61	4.14	1.80

* ST: Scheduled Tribe group; SC: Scheduled Caste group; OBC: Other Backward Classes

Source: NSSO (2003)

The NSSO data also illustrate the wide variation in pork consumption amongst the surveyed districts (Table 7) with Dhemaji district, which has a high proportion of tribal people living outside the district capital, having the highest level of pork consumption. Kokrajhar also has many tribal (over 30%) and non-tribal people who consume pork so, at least for Kokrajhar, the NSSO statistics given in Table 7 may not reflect field reality. On the other hand, the higher level of pork consumption in Karbi Anglong relative to Kamrup is consistent with the district's higher ST population. It was against this background that the field surveys examined the current marketing of pigs and consumption of pork.

Table 7: Per capita consumption of pork (kg/annum) in urban and rural areas in selected districts of Assam

District	Rural	Urban
Kokrajhar	0.00	0.02
Dhemaji	2.57	0.51
Golaghat	0.09	0.00
Karbi Anglong	1.06	0.04
Kamrup	0.51	1.13

(Source: NSSO, 2003)

3.1. Projections of demand and supply of pork

Information from secondary sources and particularly from the field surveys showed that relative to its current pork consumption, the district's production is slightly deficient (less than 10%) in respect of slaughter pigs. Although, the majority of ST households in Karbi Anglong rear pigs, the domestic supply of slaughter pigs is not adequate to satisfy demand because pork is eaten by almost all the communities in the district.

Traders in Diphu market reported that the deficit in slaughter pigs was partly met by procuring pigs from Dimapur, which were in fact pigs imported from Uttar Pradesh (UP), Bihar and Haryana. Of late such imports have been irregular because of high transport costs which include "hidden" expenses (bribes to police). Pork retailers, especially in Diphu town, face a shortage of slaughter pigs. This forces them to procure pigs from nearby Nagaon and Golaghat districts and from far-away places in the district like Howraghat, Rajapathar, Bokolia and Dockmoka which increases their costs of operation. Further, some pork retailers in Diphu town mentioned that slaughter pigs were not available every day, forcing them to close their businesses. In the surveyed areas of Silonijan and Howraghat, pork traders procure the number of pigs they require from adjoining areas.

In Diphu market, retailers felt that pork consumption in the district had doubled over the last five years, while pork consumption in Howraghat, Silonijan and Manja markets during the same period increased by about 50%. While the quantity of marketed pork had increased significantly, this was not reflected in the sales of individual pork retailers because their numbers had increased markedly. It was reported that five years back in Diphu town there were about 10 pork retailers while in October 2006 there

were 25. Likewise, in Silonijan and Howraghat market, there were more pork retailers. Some of the new entrants did not run the business individually but in groups of three or four working on a rotational basis⁹. It was reported that, unlike in Guwahati, there was no wholesaler to supply pork to the retailers in Diphu town. However, there were some businessmen/contractors who engaged some pork retailers to procure pigs and sell pork in the market, but who did not personally get involved in the business.

Based on the information gathered from the surveyed markets and from the key informants for the markets in other areas of Karbi Anglong, it is estimated that the total quantity of pork traded in Karbi Anglong district was about 7900 kg per day. The quantity of pork sold at the different daily and weekly markets in the district is presented in Table 8.

Based on the current availability of pork in the daily and weekly markets and an estimated human population in 2006 of 0.89 million, the per capita consumption in Karbi Anglong district is estimated at 3.22 kg per annum. On the other hand, AHVD statistics for 2005-06 report that the total annual production of pork in the district is about 816,200 kg. This gives a per capita consumption of about 0.91 kg per annum, which is lower than the estimate of 1.07 kg derived from the NSSO round of 1999-2000 and much lower than the estimate from our study. A major contributing factor to the difference is that the AHVD report assumes an average yield of pork per pig of 19 kg, whereas the information gathered from the various markets in this study gave the average yield as 40 kg per pig. Nevertheless, per capita consumption of pork in Karbi Anglong is much higher than in Kamrup district, irrespective of the source of estimation. The higher proportion of ST people (over 55% of the total) and their preference for pork over other types of meat result in a high per capita consumption.

⁹ In a pork market, if there are three stalls and six pork-selling parties, then parties will decide among themselves to run the business by a single party every other day instead of regularly. Thus, each party will get a chance to run the business for three or four days a week.

Table 8: Quantity of pork sold through markets in Karbi Anglong district, October 2006

Markets surveyed	Daily markets (kg)	Weekly markets (kg)	Weekly total (kg)
Diphu	1000		7000
Howraghat	250		1750
Manja	100	300	1000
Silonijan	250	200	1950
Another 10 daily markets like Silonijan	2500		17,500
Another 20 daily markets like Manja	2000		14,000
Another 10 weekly markets like Manja		3000	3000
20% of total pork of the above markets is sold by occasional pork retailers	1300		9200
Total			55,400

Source: Market agents

There was consistent information from pork retailers and pig traders that the majority of households within non-tribal communities were now consuming pork regularly and that the proportion of consumers was increasing yearly. In the estimate calculation given above, we have assumed that 50% of non-tribals are pork consumers on the basis that in Karbi Anglong there are non-ST communities like the Ahom and Chutiya who are traditional pork consumers. Furthermore, the predominance of tribals in the district resulted in pork being more accessible and popular amongst the general community than Kamrup. The district's low proportion of Muslims (2%) may be another contributing factor to the high proportion of people who eat pork.

Therefore, it is estimated that the total requirement of pork by 2010 will be 3.4 million kg, an increase of about 18% in four years, and the per capita consumption about 3.58 kg. This estimated increase in demand for pork is based on these projections and estimates:

- i. the projected number of ST households in 2010 of 93,970 and a current consumption of 0.75 kg/household thrice a month;

- ii. an estimated 50% of the non-tribal communities currently consume 0.5 kg pork twice a month;
- iii. about 60% of the general community will begin to consume pork by 2010; and
- iv. the level and frequency of pork consumption amongst the existing consumers will increase by 10% between 2006 and 2010 (based on the increased trend of consumption as reported by market agents).

Assuming a carcass yield of 40 kg per pig, meeting this increased demand for pork in 2010 will require 85,000 slaughter pigs; this is 20% more than the estimated pig production for that year (70,000 slaughter pigs). This means that in 2010, an extra 38 slaughter pigs or 1500 kg pork will be required per day up from the current level.

The latest livestock census (2003) of Karbi Anglong district reported that the pig population was 0.12 million which was a little lower than that reported in the previous (1997) census. This represents a decline of about 0.8% per annum between 1997 and 2003. However, from our study and based on the reported average herd size (two pigs per household) and proportion of pig-rearing households (75% of tribal households) in the district, the pig population in 2006 can be estimated at 0.126 million. This represents an increase of 1.2%.

The percentage of pig-rearing households in ST communities in Karbi Anglong is relatively lower than in Kamrup district because some non-traditional pig-rearing ST communities like Dimasa and Shyam started to rear pigs only recently. Considering the growth pattern, the pig population in 2006 and 2010 can be estimated at 0.132 million and 0.14 million, respectively. Our field reports suggest that the pig population has been growing, mainly because of the increasing numbers of pig-rearing households in ST and non-ST communities. Some SHGs have also started to rear pigs. Key veterinary informants support this view. Government statistics show a pig:person ratio in the district of about 13:100. In comparison to the state average of 5:100, this indicates that Karbi Anglong has a much higher concentration of pigs than other districts.

Despite these trends and statistics, the current deficit of slaughter pigs is about 8% and is expected to increase to 15% by 2010. This suggests a gap between the projected demand and the supply from local production of about 11,000 additional slaughter pigs. If Karbi Anglong is to meet this deficit, at least 5000 additional families or

individuals will need to rear pigs (at current herd sizes), or tribal families will have to increase their scale of production and/or productivity. If the response in local production is good, there is also the opportunity to sell pigs to the neighbouring state, Nagaland. Finally, it is important to note that markets in Karbi Anglong required fresh pork and there was no demand for processed or frozen pork.

3.2. *Current supply chain of pigs and pig meat*

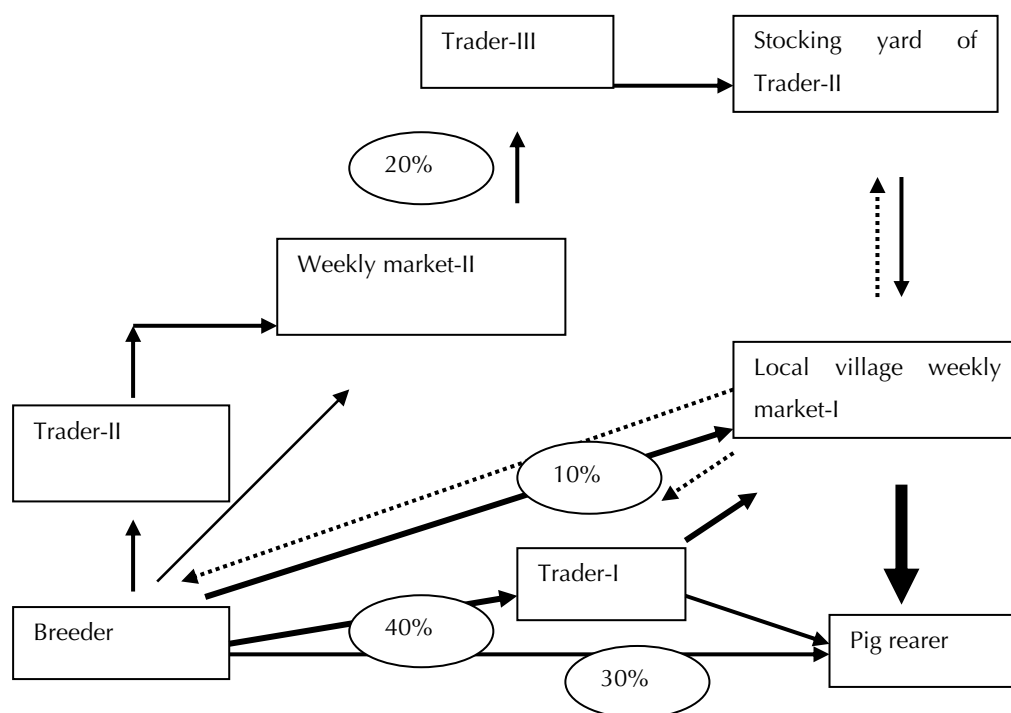
3.2.1. Output market (piglets, slaughter pigs and pork)

The output market of the pig sub-sector in Karbi Anglong district has three principal products: weaner piglets, slaughter pigs and fresh pork. Weaner piglets are the first product in the production supply chain. Piglets are produced in pig units that keep breeding sows. In Karbi Anglong the large majority of these units are small-scale backyard enterprises, some of which rear piglets to slaughter weight. Piglets that are sold may be marketed in one of several ways (Figure 2), the simplest of which is direct sale of the piglets by breeders to pig rearers. For piglets of known quality from reputed breeding units¹⁰ these transactions are generally within a village or with a nearby village. Compared to Kamrup district (where 10% of piglets were sold in this way), this route is more common in Karbi Anglong where 30% of piglets are sold directly to rearers. This is because of the scarcity of piglets in villages, the relative lack of weekly markets and the long distance from villages to the markets. Pig breeders in Howraghat area reported that because of the scarcity of piglets, pig rearers will pay the breeders an advance deposit of about Rs. 200 to 500 even before piglets are born in order to acquire a piglet.

While 30% of marketed piglets move directly from breeder to rearer, another 50%, especially those relatively inferior in terms of growth and/or breed characteristics, are sold to both men and women traders (Traders-I) who visit villages looking for piglets to procure (Figure 2). Generally the traders pay Rs. 50 to 100 less per piglet than the prices prevailing in the breeder-to-rearer market. The purchased piglets are transported by bicycle or public bus to the traders' homes. There they are kept in a stocking yard until the following weekly market where they are offered for sale to pig producers (especially women) who go to the market to buy pigs. The traders also try to sell piglets

¹⁰ Breeding units include small-scale breeding units with one or two sows (with or without a boar) and small commercial stall-fed units. Government pig breeding farms also supply piglets to pig rearers.

directly to farmers in the villages. On many occasions, breeders also visit the markets to sell their own piglets (10% of piglets sold). About 40% of all piglets sold are sold directly by breeders; this is double the proportion of direct sales of piglets in Kamrup district. This may be partly explained by the relative lack of weekly markets, the distance from the market and the poor road network. The remaining 20% of piglets are sold by traders (Traders-II and III) (Figure 2).



Trader-I: Procure piglets from local breeders to sell in local village weekly markets

Trader-II: Traders of other districts who procure piglets from breeders to sell in weekly markets of respective district.

Traders-III: Traders either from Karbi Anglong or other districts who procure piglets from other districts and sell it in Karbi Anglong.

Market-I: Weekly market of Karbi Anglong district

Market-II: Weekly markets of other districts

Figure 2: Supply chain for piglet marketing

Piglet traders (Traders-III) from Manja, Dengaon and Dokomoka weekly markets reported that they visit the Bihara weekly market of Golaghat district as a group to buy 10 to 20 piglets from local traders (Traders-II) at Rs. 350 to 650 per piglet. They then transport the piglets collectively by public bus or auto van to their homes for sale in the local weekly markets. Costs vary from Rs. 10 to 30 per piglet, depending on the mode of transport and the distance. The traders keep the procured piglets in their stocking yard (rearing costs are about Rs. 2 to 3 per piglet per day) and visit nearby weekly

markets to sell them. The sale price of piglets varies from Rs. 400 to 1000 depending on breed, age and weight. In each weekly market, sellers paid Rs. 10 to 30 per piglet as a market cess to the market committee or lessee.

Another group of about 10 traders from Sarupathar area of Golaghat district were interviewed in the Manja weekly market. They procure piglets either directly from farmers or from traders in the weekly market (i.e. Sarupathar, Merapani, Borpathar and Ratanpur), stock them in their homes and transport them to Manja and Uriamghat weekly markets for sale. This group of traders sells 50 to 60 piglets every market day. The market agents reported that some piglets are also brought for sale by another group of traders from Dimapur (Nagaland). These piglets are in fact from Dhemaji and Lakhimpur districts. In Howraghat area, it was reported that some traders procure piglets directly from the same districts and using the same route. Based on the information given by the market agents, the estimates of the numbers of piglets traded in various weekly markets are presented in Table 9. While the quantity of pork sold through the markets had grown considerably, it appeared that the number of piglets sold had not increased over the years, suggesting that increased numbers being produced by the breeding units were retained for rearing in the villages.

Table 9: Estimated numbers of piglets traded in various weekly markets of Karbi Anglong, October 2006

Weekly markets	Estimated no. of piglets traded
Manja (Friday)	60
Langhin (Sunday)	50
Dengaon (Tuesday)	60
Baligaon (Saturday and Tuesday)	50
Parakhowa (Saturday)	30
Balipathar	200
Uriamghat	50
Total	500

Source: Market agents

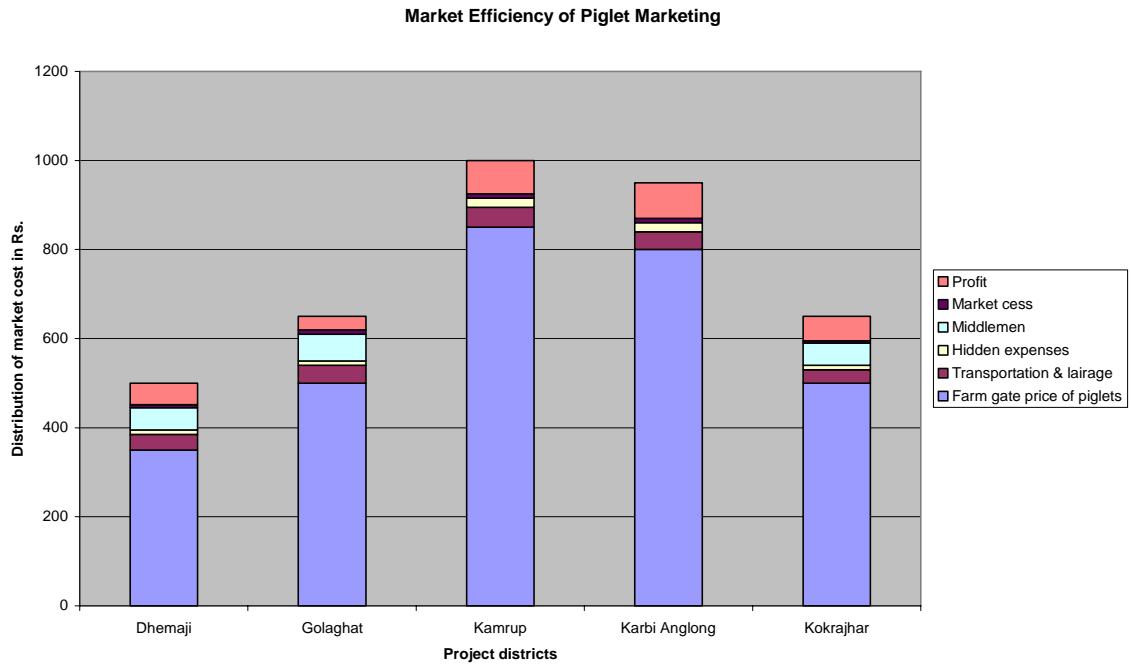


Figure 3: Marketing costs for piglets in Karbi Anglong and the other four surveyed districts.

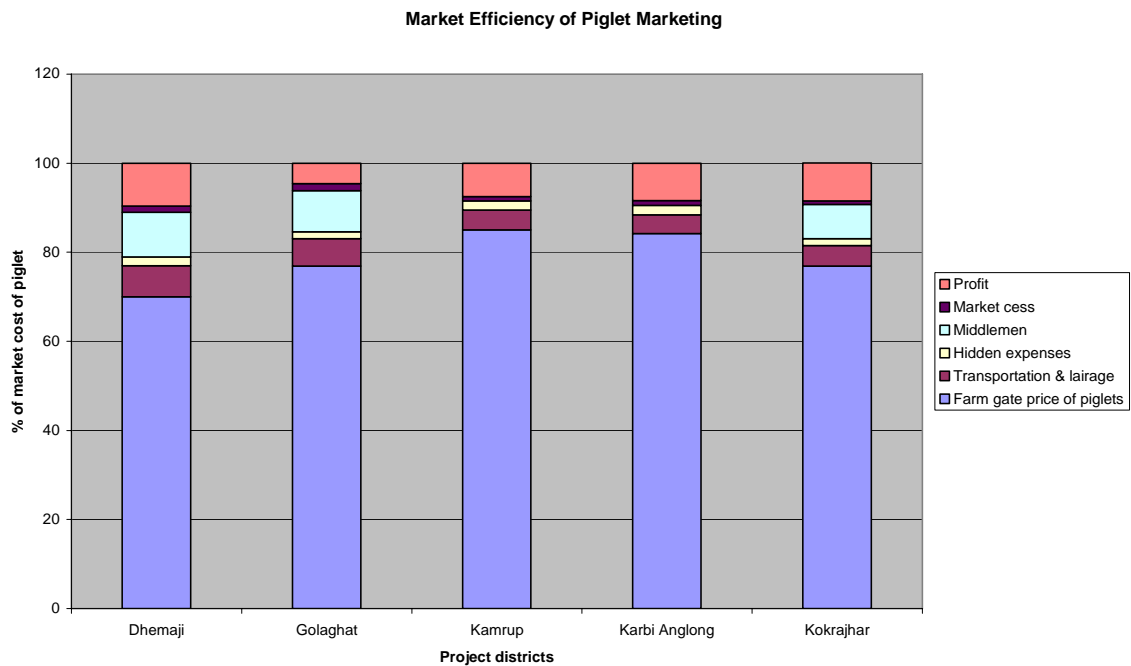


Figure 4: Relative marketing costs for piglets in Karbi Anglong and the other four surveyed districts.

Figure 3 presents a summary of the costs that were reported in Karbi Anglong for the supply chain for piglets. The results from the other four surveyed districts are included for comparison. Although middlemen were not part of the supply chain in Karbi

Anglong and Kamrup districts, transport costs were significantly higher than the combined costs of market cess and “hidden” expenses. It was estimated that there were 180 piglet traders serving Karbi Anglong and that the net daily profit per individual trader was approximately Rs. 170. Given that in Karbi Anglong, on average about 84% of the retail value of piglets is paid to the producer (Figure 4), it appears that the market chain for piglets efficiently serves pig breeders, traders and pig fatteners in the district.

Supply chain for slaughter pig and pork marketing

The supply chain for slaughter pigs in Karbi Anglong district is presented in Figure 5. As would be expected, some producers slaughter their own pigs and sell the pork in their villages or by the roadside. This route is more active in Karbi Anglong than in Kamrup; about 20% of pigs are slaughtered and sold this way. Field reports indicate that poor density of daily or weekly markets, poor road connectivity and the inconvenience and cost of transport contribute to the higher percentage of pigs slaughtered and sold by rearers. Another contributing factor is that the producer may need immediate cash and the price paid by traders may not be satisfactory. Slaughter for local sale is also carried out during festivals when there is good demand for pork in the village. It was reportedly more remunerative for producers to sell pork locally than to sell pigs to traders though the process is laborious and requires one or two skilled workers to slaughter the pigs.

By contrast, about 70% of all slaughter pigs are sold by producers to pork retailers (Figure 5). Local retailers visit the villages to buy fatteners (slaughter pigs). They sometimes use local informants who are paid Rs. 50 to 100 per pig for their services. Alternatively, producers go to the market to inform the pork retailers about the availability of a slaughter pig. Procured pigs are transported by bus, auto van or pulling cart to the retailer’s stocking yard (generally near a market) where they receive feed and water which costs about Rs. 20 to 50 per pig depending on the number of days they are kept in the stocking yard. Generally, one to three days elapse between procurement of stock and sale. Pigs are generally slaughtered near the market place and the offal is usually cleaned in a nearby stream, pond or well. Pork retailers work in groups of three to five. One or two retailers roam around the villages looking for pigs to buy while the rest slaughter the pigs and sell the pork. During the process of slaughtering, the hair is burnt from the skin with a blow torch or paddy straw. One liquid petroleum gas cylinder is enough to burn off the hair of seven to eight pig carcasses at a cost of about Rs. 50 per pig). However, in Diphu market, pork retailers reported that good quality

the offal), Rs. 20 for four tins of water, Rs. 15 for 1.5 kg of newspaper for packing and Rs. 10 for two cartons placed over the wooden platform. In total, the pork retailers spend about Rs. 100 per slaughter pig each day.

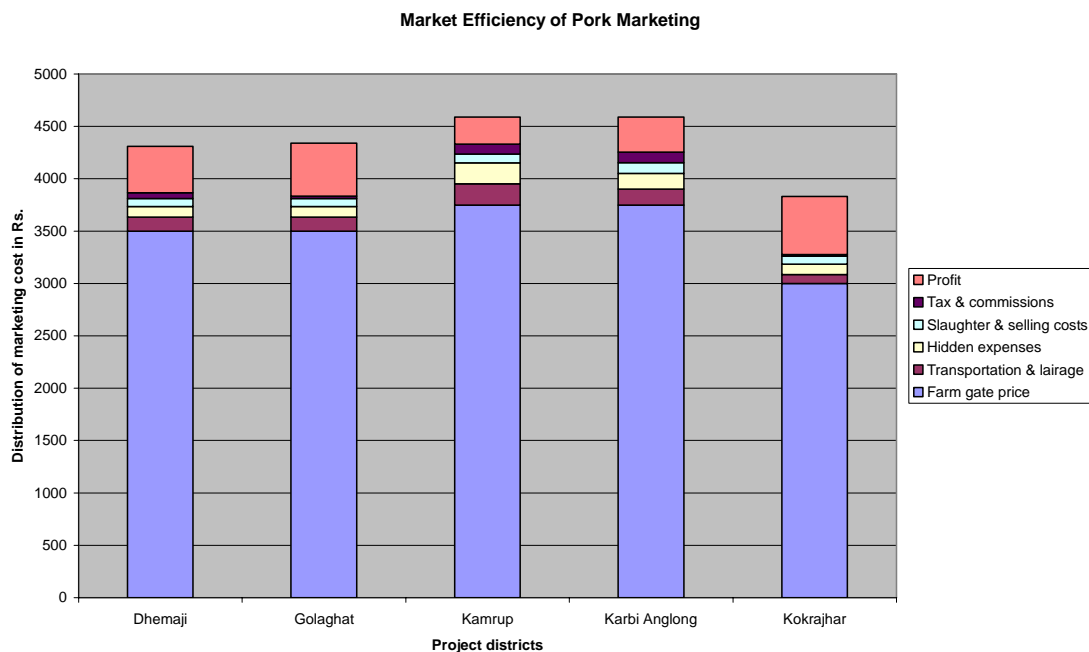


Figure 6: Marketing costs for pork in Karbi Anglong and the other four surveyed districts.

Figure 6 presents a summary of the costs that were reported in Karbi Anglong for the supply chain of pork, i.e. the purchase of a pig, its slaughter and its sale as pork. The results for the other four surveyed districts are presented for comparison. The costs related to taxes, commissions and “hidden” expenses were similar to those incurred for transport and slaughter. It was estimated that the net daily profit per trader was Rs. 95 and that there were approximately 295 pork traders in Karbi Anglong. That estimate, together with the 82% of pork retail value that is paid to pig producers (Figure 7), suggests that the market chain efficiently serves the producers, traders and consumers in the district.

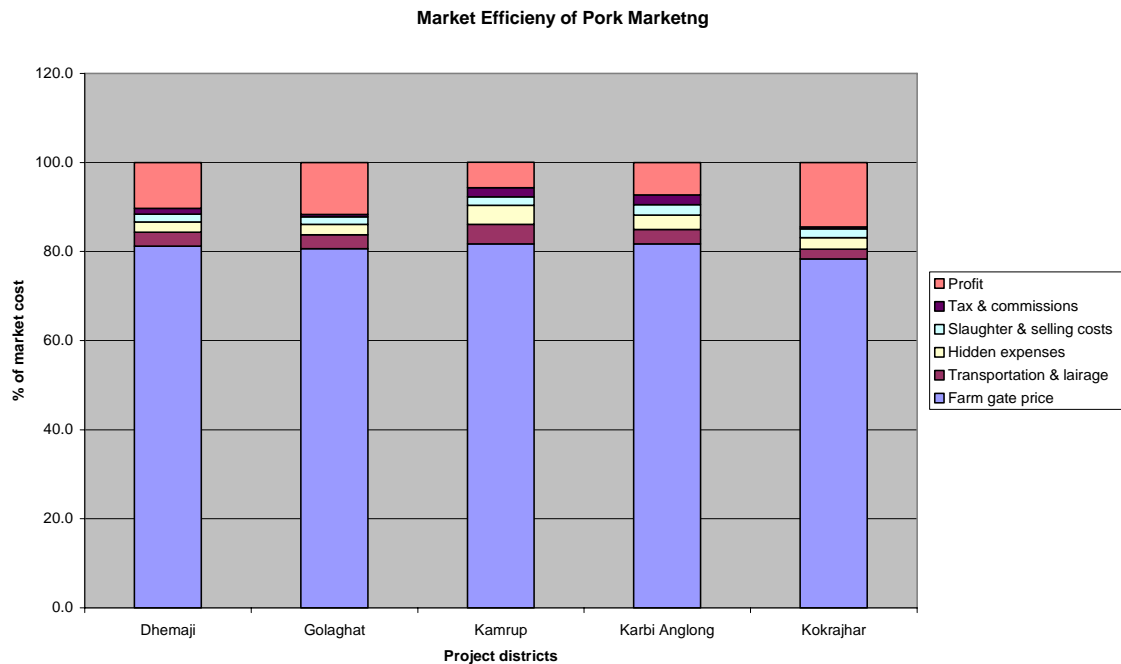


Figure 7: Relative marketing costs for pork in Karbi Anglong and the other four surveyed districts.

3.2.2. Input market (piglets, feed and veterinary inputs)

The major inputs for pig production are piglets, labour, feed and veterinary supplies. In Karbi Anglong, about 40% of piglets are procured directly from breeders (unlike the 20% in Kamrup) and the remainder are bought through the weekly village markets (section 3.2.1). Compared to these large numbers of piglets, the supply from public-sector sources (government breeding farms at Diphu and Donkomoka) is low: only 350 piglets per year. Prices of piglets vary depending on breed, age, sex, growth performance and source. Body size corresponding to age has a strong bearing on the price of piglets. Male piglets are preferred to females for fattening. Karbi Anglong pig keepers mostly prefer black-coloured piglets with drooping ears and an elongated body; these are, in fact, crosses between Large Black and indigenous pigs (locally known as “Australian”). Pig rearers reported that this type of pig grows fast and has a good litter size. The black colour is also important especially for those who rear pigs for religious purposes (e.g. the *Swarag Puja* religious festival of the Karbi community). Pigs that are black with a white belt on the chest (typical of the Hampshire and Saddleback breeds) are preferred by a few farmers. However, white pigs (Large White Yorkshire) are not liked. These preferences were shared by all sections of producers in all surveyed markets.

Piglets sold by stall-feeding units (including government farms) fetch a higher price (Rs. 1000 to 1300 for a two-month old piglet) than backyard units, probably because of the better quality of piglets and their higher cost of production. Season greatly influences the price and availability of piglets; these are higher during the winter months of November to March. Producers usually start rearing piglets during the winter so that the fatteners are ready for slaughter the following winter when prices are higher.

In Karbi Anglong, as elsewhere in Assam, pig production is mainly based on family labour and feeds gathered or produced by the household. Apart from some crop and milling by-products, purchases of feeds are not frequent and except for a few small-scale commercial units and government pig farms, the use of commercial concentrate feed is negligible (less than 1% of total feed). Major feed sources used by pig producers are rice polish and *juguli*, the residue of rice-based country liquor. Both these feeds are generally available to the majority of families. Those who do not have a sufficient quantity of rice polish to feed year-round procure it from nearby milling units or local feed suppliers. There are two qualities of rice polish: no. I and no. II. No. I rice polish is obtained from sheller mills and no. II from huller mills. Due to the different types of mills, no. I rice polish is reportedly smoother in texture and more palatable than no. II. Producers are of the view that pigs can grow faster when fed on no. I rice polish. This is reflected in their prices: Rs. 15 to 18 per 5 kg tin of no. I rice polish and Rs. 10 to 14 per tin of no. II rice polish. The price of rice polish also varies depending on seasonal scarcity. The price is higher between August and November when rice polish is scarce. The price of rice polish was lower in Karbi Anglong than in Kamrup district, and was even lower in Silonijan (Rs. 1.50 per kg). This may have influenced herd sizes in Silonijan where up to seven pigs were reared under the backyard management system, a higher number than in the other two surveyed areas. Apart from rice polish, the other major feed ingredient is *juguli*. Tribal households with surplus *juguli*, sell it to nearby villagers at Rs. 5 to 6 per 5 kg tin of rice, although some households do not buy but “borrow” from neighbours. Pigs are also fed on broken rice that costs Rs. 11 to 12 per kg. The women in farming families that keep pigs play an active role in procuring piglets and feed.

In respect of veterinary supplies, there were no private veterinary clinics in the surveyed areas except in Diphu town. In Manja, Silonijan and Howraghat areas,

veterinary medicines were sold in human pharmacies. Pig keepers travelled long distances to buy medicine from these private veterinary clinics and human pharmacies. The private veterinary clinician in Diphu town said that though he had sufficient stocks of veterinary medicines, he did not have the swine fever vaccine due to a shortage of supply. Unreliable electricity supply is another problem, making it difficult to maintain the cold chain required for the vaccine. Of the available medicines, sales of deworming drugs were the highest followed by mineral and vitamin mixture and antibiotics. It was reported that the majority of farmers came to the clinic without a prescription.

3.3. Pork consumption and preferences

Marketed non-vegetarian food in Karbi Anglong mainly comprises pork, chicken, chevon, fish and eggs. Since about 56% of people living in Karbi Anglong are from the ST community, who traditionally prefer pork, the demand for pork is presumed to be higher than for chicken, chevon, fish and eggs. Secondary sources of information and our field surveys showed that irrespective of age, sex or education level, almost all tribal people in rural and urban areas consumed pork (except a small fraction of the Karbi community, the Lakhania). Pork consumption was also reported amongst about 50% of households in non-tribal communities. Of the other non-vegetarian foods, dry fish was more preferred than fresh fish, and chicken was seldom purchased from the market because it was generally available at home.

Consumers preferred fresh pork. Preference for fat or lean meat varied depending on individual choice, mostly guided by taste and the consumer's age and health status, but overall, both fat and lean meat was equally sold and there was no price difference. In rural markets, tribal people mostly preferred lean meat (consistent with reports in Kamrup district). Therefore, the demand for and price of pork from indigenous pigs (which have less fat) was relatively higher (Rs. 90 to 100 per kg) than that from crossbred pigs (Rs. 80 to 90 per kg). Pork from imported white pigs was less preferred, perhaps because of its higher fat content or because pork was traditionally produced by black (indigenous) pigs. Apart from fat and lean meat, the feet, head and offal of pigs were also reported to be eaten by poorer sections of the community; these pig products were sold at Rs. 40 to 60 per kg.

As far as seasonality is concerned, pork retailers reported that the demand for pork was higher during winter (especially December to February) possibly because of the cooler climate and the festivals during that period. Demand was lower in summer, especially in July and August. Pork retailers reported that demand also varied within a month. Demand for pork increases during the first week of the month when employees receive their salaries; this was observed in Diphu market and other urban centres like Howraghat. Therefore, where salaried persons form a substantial portion of the market, pork retailers slaughtered more or larger pigs during that week. Demand for pork was also higher on Sundays than on weekdays, resulting in more demand for slaughter pigs on Fridays and Saturdays, including in rural areas. Demand was also reported to be much higher during festivals like New Year's Day, *Magh Bihu* (the agriculture-based festival of the Assamese community) and Christmas. In the Howraghat area (as in the Boko area of Kamrup district), pork played an important role in the *xauri*¹¹ system during ploughing, transplanting and harvesting of paddy. In this system, the household offers a feast (locally called *Nara Chinga*) of pork and country liquor on the first and last day of transplanting and the last harvest day to all the community workers contributing their labour. A feast is also offered on the first day of taking new paddy (locally called *Na khowa*) grown in their paddy fields. Since the majority of farming households in Howraghat follow the same system, feasts occur quite often in each village resulting in high demand for pork.

The price of pork usually does not vary by season because the market committee (town committee in Diphu) controls it. However, once the price increases, often during the festival season, it generally remains unchanged for at least another year.

Key informants in the district veterinary department reported that the frequency and quantity of pork consumption in urban areas had increased significantly over the last few years and at a faster pace than in rural areas, especially after ethnic violence in areas like Manja. Domestic consumers and pork retailers estimated that household pork consumption varied between 250 gm to 2 kg per week depending on the economic status of the households or area. For example, the quantity of pork consumed was higher in Howraghat area and lower in Manja area, while the frequency of

¹¹ *Xauri* is a traditional system of community participation in agricultural work in which members of each farm family spare one day to work in each household in turns.

consumption was lower among non-tribal consumers (twice a month) than tribal consumers (about thrice a month).

Amongst the different types of pork, preference mainly was for fresh, warm and newly slaughtered pork but some smoked pork was also eaten. No other processed pork products or frozen pork were reported in the surveyed areas of the district.

Responses during the household interviews indicated that 70% of the total consumption expenditure was spent on food. Out of the expenditure on food, 30% was spent on non-vegetarian food, out of which 80% was spent on pork. This confirms the important role that pork plays in the diets of meat-consuming households.

From the interviews with the wide range of informants, it was concluded that in addition to the tribal communities who are traditional consumers of pork, about half of non-tribal people in the district now eat pork. It was also concluded that the trend of increasing pork consumption is expected to continue as a result of economic growth, increased purchasing power and an increasing consumer preference for pork. Current trends suggest that both the quantity and frequency of pork consumption will increase among current consumers within their households, in the few urban areas in Karbi Anglong and in fast-food restaurants and hotels. It is likely that religious taboos associated with pork consumption will become less important and that the younger generation of the general community and increased income among the tribal community will be the driving forces behind the growing demand for pork.

3.4. Food safety and human nutrition issues

One potential food safety risk associated with pork and pig production is the infestation of pigs by worms, particularly the zoonotic tapeworm *Taenia solium* which can be transmitted among humans and between humans and pigs causing neurocysticercosis. Humans can acquire taeniosis (tapeworm infection) through eating pork. Consumers who were interviewed said that in order to reduce the risk of tapeworm infection, they always cooked pork by boiling it for a long time. Customers ascertain the quality of pig meat by visual inspection and previous experiences. Moreover, when buying pork, experienced consumers always looked for the presence of cottonseed-like follicles in the meat (measly pork) and if these was present they did not buy the pork. Likewise,

pork retailers also reported taking utmost care when procuring slaughter pigs from producers. They look for cottonseed-like follicles in the eyelids and tongue of the pigs, an indication of infestation with worms, and thus avoid buying infected pigs. Therefore, it appears that in Karbi Anglong district, traditional cooking practices and local knowledge of the disease and its manifestation greatly reduce the risks to human health from cysticercosis.

In Karbi Anglong, as elsewhere in Assam and throughout the NE, there is little or no formal infrastructure for slaughtering of pigs or for the display of pork, especially in rural markets. Generally, pork is sold at the roadside displayed on a gunny bag or polythene sheet without any hygienic measures for slaughtering the pigs. However, in the last few years retailers in some urban centres like Diphu have begun displaying pork on a platform instead of a gunny bag. Another unhygienic practice that poses a health risk to consumers is cleaning offal with water from ponds, tanks or rivers. However, the pouring of water on chevon by butchers to increase its weight was not done to pork as this would give it a pale colour and off flavours within one or two hours. Other risks to human health can arise from the practice of slaughtering diseased pigs and selling the meat to consumers. In Diphu market, retailers sold leftover pork the following day because most of them did not have access to refrigeration to store the meat overnight.

There is no specific regulation for registration and inspection of pork outlets under the Diphu Town Committee. Pork retailers do not respect the veterinary officers when they inspect the pork market because the retailers know that the officers cannot take any legal action against them. There is also inadequate coordination among the town committee, AHVD and police administration and this is the main reason for the lack of effective inspection of pork markets. Furthermore, the pork retailers pay daily bribes of Rs. 100 to 200 per pig to the police so they are reluctant to prosecute lawbreakers.

Consumer awareness was low on the nutritive value of different types of meat, apart from knowing that pork has relatively higher fat content. With the upward trend of meat consumption by urban and rural populations, it was noted that the expressed preference for pork was guided by taste rather than nutritive value.

3.5. Main issues in consumption and marketing

From the information gathered from the secondary sources and the field surveys, we can draw various conclusions and highlight some issues related to the consumption of pork and the marketing of pigs in Karbi Anglong district.

1. Pork is the preferred choice of meat amongst the majority of meat-eating consumers in Karbi Anglong. Unlike in Kamrup district, about half of the non-tribal communities consume pork resulting in an estimated per capita consumption of pork of 3.22 kg/annum, about three times higher than that of Kamrup (0.92 kg/annum).
2. Consumption was primarily of fresh pork, the demand for which was growing quickly in traditional and non-traditional pork-consuming households in both urban and rural areas. Likewise, the number of pork retailers has increased over the years in both urban and rural areas.
3. Quality of pork was reported as the major attribute for selection of source of purchase, followed by accessibility and price.
4. Detailed consumption studies are required to validate the preliminary projections of the increased demand for pork (presented in section 3.1) and to identify and quantify possible trends.
5. Currently, retail sales of pork in urban and rural areas are mainly through unhygienic informal markets which have inadequate infrastructure and are served by under-resourced institutions that cannot ensure consistent hygiene and food safety standards.
6. Even in Diphu (the district capital), there is no routine inspection of slaughtering, pork retail outlets or market facilities by the veterinary officer nor is there any awareness of town committee regulations for the registration and inspection of pork outlets. Inadequate coordination amongst the AHVD, town committee and police administration exacerbates this lack of supervision of the slaughter of pigs and the sale of pork.
7. In the light of the increasing demand for pork, these deficiencies in public health measures should be addressed through risk analysis along the production-to-consumption value chain. Required is a structured evaluation of the practices of pig producers, traders and pork retailers and the requirements for improved infrastructure and for training in meat hygiene and food safety based upon consumers' needs, perceptions and willingness to pay. It will be important to

include local slaughter practices in the evaluation because a high proportion of pigs in Karbi Anglong are slaughtered and the pork is sold directly to consumers by producers.

8. Although there is concern amongst consumers and pork retailers about the zoonotic tape worm *Taenia solium* infestation in pig (measly pork), traditional knowledge and food cooking practices reduce its adverse impacts on human health and on the consumption of pork.
9. Unlike the increase in the marketing of pork, the numbers of piglets being marketed do not seem to have increased probably because breeders are retaining more piglets for fattening.
10. Direct selling of pork or piglets to consumers or rearers was more prevalent in Karbi Anglong than in Kamrup district possibly because of fewer weekly markets, poor road connectivity and the distance of producers from markets.
11. Demand for pork and for piglets was higher during winter and lower during summer. Producers, therefore, synchronized their production cycle to match the market demand. In urban areas, demand for pork was also higher during the early part of the month because of the purchases by salaried households. Within a week, demand was relatively higher on Sundays. Festivals also stimulated demand.
12. Cheaper rice polish (reflecting its availability) may influence the number of pigs a household keeps. Herd sizes were higher (two to seven pigs) in Silonijan area where the price of rice polish was relatively low (Rs. 1.50 to 2 per kg).
13. The district has a shortfall in the supply of piglets which is currently met by procuring piglets from the neighbouring districts of Golaghat and Nagaon, and places like Lakhimpur and Dhemaji district via Dimapur, Nagaland situated about 350 to 400 km away. Because of this, piglets suffer from transport stress, disease or injury and margins for traders and pig rearers are reduced.
14. Marketing systems for piglets and slaughter pigs appeared to be efficient with attractive prices for producers and reasonable margins for market agents. However, rent-seeking ("hidden expenses", i.e. bribes to police) added to marketing costs during the transport of piglets, slaughter pigs and pork, the stocking of slaughter pigs (especially in Panbari area of Diphu town) and the sale of pork. This increased the cost of meat to producers and reduced the profits for producers. An awareness program is required for pig/piglet/pork traders and police officials about the legal aspects of transporting and selling of pig products.

15. Despite these issues, it was clear that the market/supply chain was significant and a growing source of income and employment for a section of tribal people. The majority of piglet traders and pork retailers considered the trade as a primary source of their livelihoods.

4. Pig production systems

4.1. Ethnic and geographic distribution

Pig production is widely distributed in Karbi Anglong because of the presence of pig-rearing ST communities throughout the district. In our study, three areas were surveyed based on their ethnic and geographic diversity and accessibility: Manja (north of Diphu town), Howraghat (western plain valleys adjacent to Nagaon district) and Silonijan (east of Karbi Anglong and adjacent to Golaghat) (Figure 1 and Table 10).

Pig production in the Manja area is practised by the Karbi, Dimasa, Kuki and Bodo communities, while in Howraghat area it is a popular activity amongst the Bodo, Karbi, Dimasa and Adibasi communities. Karbi, Ahom, Chutiya, ex-tea labourers and Nepalis (especially Limbo, Rai, Thapa sub-tribes) are the main communities that keep pigs in the Silonijan area. A few households of the Shyam community rear pigs in the Manja and Silonijan areas. Pig rearing amongst the Dimasa and Chutiya communities is less frequent than in other communities. As mentioned in section 3.5, apart from the ST community, the OBC Ahom and Chutiya communities also traditionally rear pigs. Our surveys found that in the Manja and Silonijan areas, a few general community households have started keeping pigs, but these are less than 1% of all households.

4.2. Classification of production systems

Table 10 shows the characteristics of the pig production systems in the three clusters surveyed in Karbi Anglong by ethnic group. Small-scale, market-oriented enterprises dominated the systems and rearing of pigs was an important source of supplementary income. Apart from income generation, pigs also play a significant role in various socio-religious festivals, especially amongst the Karbi and Kuki communities. Pigs serve for paying fines (under customary law) and as gifts, dowry and credit by the Kuki community. The majority of the Kuki community rear breeding and fattening pigs in a *chung* (bamboo or timber platform). About 95% households of the three major communities of Karbi Anglong (Karbi, Bodo and Kuki) rear pigs, compared to less than 20% of households of other communities like the Shyam, Nepali and Dimasa. Fattening was more commonly practised by the Bodo, Ahom, Chutiya and ex-tea labourers than breeding alone or breeding and fattening (Table 10). Women were mainly responsible

for the care and management of the pigs. Rearing of pigs exclusively for household consumption was not reported, except by some Karbi families who reared pigs for the *Swaraj Puja* religious festival which requires two to four own-reared pigs.

Table 10: Socio-economic and production characteristics of pig systems in Karbi Anglong

Ethnic groups and their areas	% pig-keeping households	Pig pop. (%)	Livelihood importance	Herd type	Surplus + or deficit -
Karbi: Manja, Silonijan, Bokajan, Diphu, Dokomoa, Jirikinding, Omrangshu	95	60	Important	Breeding: 30% Fattening: 70%	Fattener + Piglet +
Bodo: Howraghat, Dokmoka Parakhowa	95	20	Important	Breeding: 15% Fattening: 85%	Fattener + Piglet -
Kuki: Manja; Singhasan Hills	95	10	Important	Breeding: 80% Fattening: 20%	Fattener + Piglet ++
Dimasa, Shyam and other tribes: Jirikinding; Manja Silonijan; Omrangshu	20	5	Important	Breeding: 15% Fattening: 85%	Fattener + Piglet -
Ahom, Chutiya and Gen. comm. Silonijan; Bokajan; Bokolia; Kahara	70	3	Important	Breeding: 15% Fattening: 85%	Fattener + Piglet -
Nepali: Silonijan; Manja Bokolia, Kahara	20	1	Important	Breeding: 40% Fattening: 60%	Fattener + Piglet +
Tea labourers: Silonijan; Bokajan; Bokolia, Kahara	80	1	Important	Breeding: 5% Fattening: 95%	Fattener + Piglet --

Source: Interviews with traders at weekly markets

All ethnic groups in all areas considered rearing a few pigs to be an important supplementary source of livelihood. On the other hand, only a few households with so-called stall-feeding units considered pig rearing as a primary source of livelihood. In these units, men played key roles in decision-making while in smallholder units it was the women. The interviewed families were happy with the current demand for and price of pigs. In view of the growing income opportunity in the pig sub-sector, a section of poor farmers even reared pig under a type of share-cropping system locally called *adhiary*¹². About 50% of the interviewed farmers reported lack of finance as the major problem limiting pig rearing. As a result, the *adhiary* system was practised more in Karbi Anglong than in Kamrup. It was reported that micro-credit systems were weak and that insurance companies were not keen to insure smallholder piggery units in the district. Veterinary staff said that insurance companies were only interested in insuring piggery units that were started with bank loans.

Table 11: Pig management systems in Karbi Anglong district

System of management	Units (%)	Breed type	Housing	Main manager	Manure use
Scavenging	< 1	Indigenous/ crossbreed	Nil	Female	Not used
Tethered/ penned	95	Crossbreed	Tethering 50% Penned 50%	Mostly female	Generally not used
Stall-fed	5	Exotic/ crossbreed	Permanent shed	Mostly male	Not used/ as manure

Source: key informants during field survey

As elsewhere in Assam and the NE, the pig management systems in Karbi Anglong district can be classified broadly into three groups: tethered/penned, scavenging and stall-fed (Table 11). The herding system of pig management, which was earlier practised in some parts of Assam and still persists in some parts of South and Southeast Asia, is not present in Karbi Anglong. The systems of pig management in Karbi Anglong are discussed below.

¹² *Adhiary* means half. Under the system, financially-sound persons procure piglets and give them to poor farmers to feed and manage. When the pig is sold, the profit is equally divided. If the pig dies in the course of rearing, the loss is shared.

Tethered/penned: About 95% of households in the survey clusters managed between one and seven pigs in this system. Most of these households kept fattening pigs (Table 10) while about 25% of households kept pigs for breeding (production of weaners). Both tethering and penning (50:50) were observed in each of the surveyed areas irrespective of ethnic group or geographical location. This management system involves tethering the pigs in the backyard to a betel nut tree or a bamboo post or penning them within a bamboo/timber enclosure. In the Silonijan and Howraghat areas, households kept pigs in a stall during the night and tethered them during the day. Housing pigs in a formal roofed shed was not observed in the surveyed areas but some households constructed a temporary roof over the pig enclosure, especially during the rainy season. Tethered pigs are shifted every two to three days from one place to another within the backyard to keep the area clean and dry. One plastic tether costs Rs. 10 to Rs. 15 and lasts for only about a week, thus replacing the tether is a recurring expense during the year. When pigs are penned, the pen is usually kept in the same place throughout the year without cleaning; this practice results in an unusually dirty habitat. Some research carried out in India suggests that pigs reared on mud floors achieve higher weight gains than those reared on concrete floors (Jain *et al.*, 2000). In our study, the comparative performance under backyard conditions was not assessed.

Consistent with the report by Bora (1984), pigs in the tethered/penned systems were provided the required feed and water within the enclosure two to three times a day. The pigs were mostly crossbreeds and herd sizes usually did not exceed seven for fattening units or four for breeding units. The herd size is limited by scarcity of feed and family labour. Labour was not hired to manage pigs in this system. The feed and labour constraints meant that households were not keen to expand their existing units; only those households that had one or two piglets were likely to introduce one or two more for fattening. Households instead preferred to achieve higher growth rates (higher throughput in a fixed time) and avoid pig mortalities.

Stall-fed: About 5% of households in the surveyed areas managed their pigs in a semi-permanent pigsty. Majority of these pig farmers belongs to the Kuki community who keep their pigs under a *chung* (3-ft timber platform) day and night. Kuki pig producers reported lower incidence of diseases and easier maintenance of cleanliness and hygiene with the *chung* system. Some individual farmers, SHGs (mainly promoted by

Jirsong Asong) and a few English medium schools also rear stall-fed pigs for breeding or for fattening or both. The production objective is purely commercial. Except for a few SHG members in Silonijan and Manja, none of the interviewed farmers had been trained in pig management. The size of the stall-feeding units varied from 5 to 15 pigs. Male counterparts of the farming families play key roles in managing the units while in the SHGs, the president and secretary are mainly responsible for management of the unit. The type of pigsty construction may affect pig performance. Research in India showed that intensively fed pigs on a concrete floor with an asbestos roof performed better than those on an earthen floor with a tile roof (Kumar *et al.*, 2004). This result contradicts the findings of Jain *et al.* (2000) mentioned under the previous section on “tethered/penned”. Unlike in Kamrup district, none of the stall-fed units in the surveyed areas of Karbi Anglong were integrated with fishery.

Scavenging: *Jirsong Asong*, an NGO in Manja area, reported that less than 1% of tribal households, especially in the Singhasan Hills dominated by the Kuki community, allowed pigs to scavenge freely for food throughout the day. Indigenous pigs or crossbreeds with poor genetic potential are mostly reared under this system. This system of pig management is practised by poor families who cannot feed pigs with their household feed resources or households that have sufficient land in the homestead, especially in hilly areas like Singhasan Hills. In years past, this was the traditional management system prevalent among tribal households, irrespective of ethnic or geographical location. Over recent years, however, the number of households that scavenging pigs has declined significantly because of increased incidents of straying pigs causing crop damage and the resulting dissatisfaction of villagers. Amongst the Kuki community, the level of dissatisfaction is relatively lower because of their socio-religious beliefs and customs.

Box 1: Bom Bahadur Thapa, a progressive pig producer in Silonijan

Mr Bom Bahadur Thapa, a Nepali pig producer from Purani Silonijan village, reared Large Black, Hampshire and Large White Yorkshire pigs under the tethered/stall-fed system as his primary source of livelihood. He had 11 parent stock and 21 piglets.

Despite keeping the three breeds, he preferred Large Black pigs to Hampshire and Large White Yorkshire. According to him, the Large Black has larger litters and grows faster: 9 to 10 piglets per litter and 70 to 80 kg body weight at 10 months of age. In comparison, Hampshire pigs produce six to eight piglets per litter and weigh only 40 kg at 10 months. While Large White Yorkshire has a similar litter size to Large Black, its growth rate is slower, attaining 60 to 70 kg at 10 months.

Mr Thapa said that his fellow farmers shared his preferences, which were reflected in the demand and price of piglets: Large Black and Large White Yorkshire piglets cost at Rs. 800 to 1200 while Hampshire piglets cost Rs. 600 to 700.

The performance of pigs in the three management types is shown in Table 12. In the study areas, farrowing intervals for stall-fed and tethered/penned sows were reported as six to eight months; the interval of 6.5 months recorded on the CVSc farm under the All India Coordinated Research Project on Pig (AICRPP) falls within this range. In the same project, 50:50 Hampshire:indigenous crossbreeds attained about 90 kg in 10 months. This was higher than the field performance reported in the current study (60 to 80 kg), possibly reflecting the more intensive feeding and other management practices in the AICRPP. The project also reported average litter sizes at birth and weaning of 6.91 and 5.91, respectively. These were lower than those reported by our study informants (7 to 12 and 6 to 10, respectively). Breed differences may explain some of the variations.

Table 12: Pig performance in the three management types, Karbi Anglong district

Production traits	Stall-fed	Tethered/ penned	Scavenging
Farrowing interval (months)	6-8	6-8	8-9
No. of litters in lifetime	4-5	4-5	4-6
Litter size at birth	7-12	6-12	3-8
Litter size at weaning	6-10	5-10	3-6
Age at weaning, days	30-60	30-90	60-120
Weight of fatteners at 10 months (kg)	60-80	50-60	30-40

Source: key informants during field survey

In respect of age at weaning, AICRPP staff weaned piglets at 56 days of age while the field practice varied from 30 to 90 days depending on market demand and quality of piglets (Table 12). Research in Assam indicated that better post-weaning growth could be achieved when weaning was at 42 days than at 28 or 56 days (Gogoi, 2006). The same study revealed that weaning at 42 days did not adversely effect piglet survival. As would be expected, the performance of scavenging pigs was lower than in the other management systems (Table 12), reflecting poorer feeding and other management practices for pigs of lower genetic potential.

4.3. Breeding and reproductive management

The field surveys revealed that the current stock of pigs in the clusters is mainly Large Black crosses (with indigenous pigs) along with some Hampshire. No Ghungroo crosses were reported in the surveyed areas, unlike in Kamrup district. There were reported to be a few purebred indigenous pigs in Singhasan Hills, but the area was not visited because of social-political disturbances. Apparently, there was no systematic crossbreeding practised by pig producers so it was not possible to ascertain the degree of exotic blood in the different crosses, though it was assumed that there is large variation. There were also few purebred exotic pigs, although some were available from the two AHVD breeding farms at Diphu and Donkomoka which have Hampshire (the majority) and Saddleback piglets. About 40% of interviewed farmers reported insufficient supply of quality piglets as one of their major constraints. This might be because of the reported poor quality of piglets from Dimapur, Golaghat and Nagaon and the inadequate supply of quality piglets from government pig breeding farms. Generally, observations in the field indicated that the pigs in Karbi Anglong had poorer breed characteristics than those in Kamrup or Dhemaji districts.

Pig producers in Karbi Anglong bought breeding stock from four sources: small-scale breeding units, stall-fed units, AHVD breeding farms and other districts in Assam. It is estimated that of all the available breeding stock in the district, 75% comes from small-scale breeding units, 20% from other districts and 5% from stall-fed units in the district. Very few piglets were available from the AHVD breeding farms relative to the annual demand of about 350 piglets. About 70% of producers purchase crossbred piglets from nearby weekly markets where they check the piglets' health status, age and price and take into account their previous experience of rearing similar pigs. The producers prefer

to purchase locally available crossbreeds (especially Large Black crosses) rather than pigs imported from other districts, in part because of possible disease threats. It was reported that producers with stall-feeding units always tried to purchase piglets from government or well-managed private farms.

Natural service was the only breeding method used by producers in the district; there was no reported use of AI. Boars and sows are used for breeding until they are three to four years of age. Thereafter, the parent stock is usually replaced by its own progeny. Around 20% of the households using the tethered/penned system kept one or two sows, some with a breeding boar. About 10% of breeding households kept a boar, while those without a boar used one from other households in the village and paid Rs. 200 to 700 or one piglet (after weaning) for each service. Informants estimated that a boar gives three to five services a month, which is less than the intensity of services by boars in Kamrup district. This indicates that there are more households with boars in Karbi Anglong than in Kamrup. The intensity of service was almost the same throughout the year, although producers preferred for the pigs to mate during June to September so that litters are born during October to January and piglets are ready for sale between December and March when they fetch higher prices. Research findings suggest that the largest and heaviest litters at birth and at weaning occur when sows farrowed during the post-monsoon season (Phookan, 2002; Deka *et al.*, 2004; Roychaudhury, 2005).

Although rural pig producers try to take advantage of seasonal price variation, they are less aware of performance variation amongst crossbreeds, beyond a general preference for Large Black crosses. There was no evidence of systematic crossbreeding, of organized selection of breeding boars or of efforts to maintain specific male: female ratios of breeding stock in a village. Sows were usually served by the boar available with a neighbour. Apparently, in the surveyed areas there had been no awareness or training program by government or NGO agencies on crossbreeding or within-breed selection, yet the adoption of crossbreeds to replace indigenous breeds has been a major management change. Other changes include some fattening units incorporating breeding, the establishment of stall-feeding units and, recently, the use of deworming drugs and mineral and vitamin mixture by a section of farmers in pig production systems especially in the Silonijan and Manja areas.

Piglets were weaned and sold at 30 to 50 days of age in order to reduce the farrowing interval and obtain two litters in a year, although the reported average field performances did not achieve two litters annually (Table 12). In Howraghat area, most breeders who had good stock said that they practised early weaning of their piglets in response to the high demand in the market. There were instances when breeders were paid in advance for piglets even before the piglets were born.

Box 2: Chandra Mohan Boro, a progressive pig farmer in Howraghat

Mr Chandra Mohan Boro, a progressive pig farmer from Dumukhi Jal Juri Village, Howraghat has a Large Black breeding unit of three sows and one boar. Pig rearing is the primary source of livelihood for his family of five. The income maintains his family and in the last five years he has bought 1 ha of cultivable land and a rice huller mill. He weans his piglets at 1 to 1.5 months of age, in response to the high demand for piglets in his village. On many occasions, he is paid in advance for the piglets. He also gets income from providing his boar for mating his neighbours' sows.

Breeders felt that early weaning did not have any adverse impact on the survivability or growth performance of piglets. But the local veterinary surgeon in Howraghat said that some pre-weaned piglets suffered from general weakness that ultimately led to death. Research in Assam by Nath *et al.* (2003) reported higher death rates with shorter farrowing intervals of 200 days. During the surveys, it was apparent that the breeders were not aware of any recommendations related to age at weaning. This was partly understood from the late weaning practices adopted by breeders with poor quality breeding stock and areas like Silonijan with lower market demand for piglets. Farmers in Silonijan preferred to keep the piglets with the mother even up to 5 months of age to make them healthier while using less feed.

4.4. Feeding management

As reported in section 3.2.2, in Karbi Anglong (as elsewhere in Assam), the large majority of households feed their pigs using family labour and feeds gathered or produced by the household. Poor farmers who do not having sufficient land for paddy cultivation mainly depend on procured feed, especially rice polish and *juguli*.

The major feed sources are rice polish and *juguli* (Table 13). Other common feed resources are *Colocasia* (*Colocasia esculenta*), locally known as *Kachu*, and some vegetables including pumpkin, gourd, papaya and banana. The proportions of these

items vary depending on the food habits of the ethnic group, availability of feed resources, the price of feed ingredients and the availability of household labour to collect these ingredients. For instance, the Kuki households that reside in Manja area, being Christian, do not prepare or consume country liquor resulting in limited use of *juguli* as pig feed. Rather, they mainly provide rice polish and *Colocasia* along with some vegetables and water hyacinth. On the other hand, the Dimasa community prepares and consumes country liquor but pig rearing is not a very popular farming activity among them. Those Dimasa people who rear pigs mostly feed *juguli* along with rice polish, pumpkin, banana, gourd etc. Tea labourers and Nepali community generally do not prepare country liquor so they mostly depend on rice polish. Use of tapioca/cassava as pig feed was not observed in the surveyed areas. However, *Colocasia* was invariably used as a feed ingredient irrespective of geographical or ethnic variation. The whole plant is harvested, cut into pieces and boiled before being fed to pigs mixed with rice polish and *juguli*. Use of *Colocasia* is more frequent among poor farmers who cannot afford to buy rice polish or *juguli*. The demand for *Colocasia* has resulted in its scarcity in many places like Silonijan and Howraghat where a few farmers bought it from a vendor at Rs. 5 to 10 per bundle (depending on the size of bundle) or collected it from the jungle using wage labour at the rate Rs. 50 per day.

Box 3: Sadanda Deka, a landless pig producer in Manja

Mr Sadanda Deka, a landless farmer from Manja area, occupies a small plot of government land. His breeding stock of six pigs is a major source of livelihood for his family of three. To reduce feed costs and overcome feed scarcities, he cultivated a popular variety of *Colocasia*, locally known as *Nal Kachu*, on a small plot of land adjacent to a stream. He said that because he transplants the *Colocasia* in the stream, it does not dry up during winter, increasing the availability of *Colocasia* in that season.

Kitchen and hotel food waste are also fed to pigs, the latter especially in peri-urban areas (Tables 13 and 14). Some producers (ex-tea labourers in Silonijan) said that kitchen and hotel waste can cause diseases, especially if it has leftover pork, offal or waste water from diseased pigs. On the other hand, a hotel owner-cum-pig producer from Silonijan area, who fed a herd of 18 pigs on hotel waste (including leftover pork), did not report any major disease problems except for the frequent incidence of constipation. Research findings opined that the availability of hotel waste might explain the significantly higher body weights of piglets maintained in peri-urban areas compared to rural areas of India (Kumar *et al.*, 2005).

Table 13: Feed resources used by different ethnic groups in Karbi Anglong district

Ethnic groups	First major component	Second major component	Third major component	Occasional feed resources
Karbi	<i>Juguli</i>	Rice polish	<i>Colocasia</i>	Vegetables
Bodo	<i>Juguli</i>	Rice polish	<i>Colocasia</i>	Vegetables
Kuki	Rice polish	Vegetables	<i>Colocasia</i>	<i>Juguli</i>
Dimasa	<i>Juguli</i>	Rice polish	<i>Colocasia</i>	Vegetables
Tea labourers/ Nepali	Rice polish	<i>Colocasia</i>	vegetables	<i>Juguli</i> , water hyacinth
Stall-fed units	Rice polish	Wheat bran, <i>Colocasia</i>	Maize, fishmeal, mineral and vitamin mix	Kitchen waste, vegetables, banana, water hyacinth

Source: Primary household survey

The use of concentrate feed was limited to only a few stall-fed units including government pig breeding farms and a few SHGs, especially those promoted by the NGO *Jirsong Asong* because supply of concentrate feed was one of this NGO's project components. Therefore, the use of commercial concentrate feed was negligible: much less than 1% of total feed. However, one feed supplier in Diphu town selling concentrate feed reported that there was a feed mill that supplied feed in bulk at a lower price (say Rs. 8 per kg instead of the current price of Rs. 10), he would be able to sell at least 10,000 kg of feed per month. In our survey, some producers (especially breeders) provided wheat bran, oil cakes, fishmeal and mineral mixture to their pigs while many reported that they gave eggs to breeding boars before and after natural service. But the large majority of backyard producers were not aware of the existence of such feeds or their nutritional qualities.

In Diphu and Howraghat areas, mineral and vitamin mixture was being used, perhaps reflecting the higher level of technical awareness among the farmers in those areas as reported by local veterinary staff. In contrast, some farmers in Silonijan did not use salt in their pig feed. It is worth mentioning that although Karbi Anglong is the highest producer of maize in Assam, use of maize as pig feed was negligible. This might be because of majority of maize growers were from the Bihari community who usually do

not rear pigs. It is also important to note that the major maize-growing areas were not visited during the field surveys because of socio-political disturbances in those areas.

Table 14 presents the reported seasonal availability of the feed resources used in the surveyed areas. Rice polish tended to be scarce and costly in September and October when the old stock of paddy was exhausted and the new crop had not yet been harvested. During this period, producers substitute rice polish with *Colocasia*. *Colocasia* tends to be scarce during November to April when it is substituted with rice polish. *Colocasia*/taro is a common pig feed in other parts of the tropics and there are current research projects by the Australian Centre for International Agricultural Research (ACIAR) aiming to improve taro production. The results of these projects could be relevant to Assam and elsewhere in India (<http://www.aciar.gov.au/web.nsf/doc/ACIA-6NE7TR>).

Table 14: Seasonal availability of feeds in Karbi Anglong district

Main feeds	Jan- Feb	Mar- Apr	May- Jun	Jul- Aug	Sep- Oct	Nov- Dec	Fresh or cooked
<i>Juguli</i>	A	A	A	A	A	A	Fresh
Rice bran/polish	A	A	A	Sc	Sc	A	Fresh/cooked
<i>Colocasia</i>	NA	NA	A	A	A	SC	Cooked
Banana/vegetables	A	A	A	A	A	A	Fresh/cooked
Water hyacinth	NA	NA	A	A	Sc	Sc	Fresh/cooked
Kitchen waste	A	A	A	A	A	A	Fresh
Hotel waste	Sc	A	A	A	A	Sc	Fresh

A: Available NA: Not Available Sc: Scarce

Source: key informants during field survey

It is clear, therefore, that the reported feeding practices are almost invariably dependent on locally available feed sources which, when fed at traditional levels to young crossbreeds, result only in moderate growth rates (Table 12). The major feeds, rice polish and *juguli*, are good sources of energy but the traditional diets fed to pigs are not balanced for energy, protein and micronutrients, and without purchased supplements or additional home-grown feeds, growth rates at the different stages of the weaner-to-slaughter cycle will not improve (Yadav and Gupta, 1994; Kumar *et al.*, 2002; Sailo, 2005; Kumarsean *et al.*, 2006; Gupta, 2006). Research has shown that crossbreeds fed on local feed rations respond well in terms of growth rate if supplemented (Pal *et al.*,

2001). Options that have been explored in Meghalaya include buckwheat and various legumes (Gupta and Bujarbaruah, 2005), maize grain up to 80% and rice polish up to 50% along with good quality vegetable protein and mineral mixture (Gupta, 2006) and raw sweet potato tubers up to a maximum level of 40% dry matter (Yadav *et al.*, 2005). Other studies in Assam have examined factory tea waste (Chetia *et al.*, 1991), garbage (Bora, 1999) and cabbage (AICRPP, 2005). Presenting these options to pig producers, using participatory methods to evaluate their fit relative to the availability of household labour, land and other resources, would be one way to move towards faster growth rates and increased throughput from existing units. Other options, such as ensiled sweet potato vines and tubers (Gupta, 2005; Peters *et al.*, 2005; Beckmann, 2006; Ilangantileke, 2007), quality protein maize (Consultative Group on International Agricultural Research (CGIAR), 2005) and forages and other feeds being researched by the International Centre for Tropical Agriculture (CIAT) and its partners in Southeast Asia (Chanphone and Choke, 2003) should also be considered. However, it must be remembered that in small-scale units that use few purchased inputs, other demands on family labour, land and other resources may take precedence over improving pig growth rates, particularly if the level of risk associated with new feeds is unclear or unacceptable.

4.5. Health management

Veterinary staff and pig producers in the surveyed areas cited swine fever, piglet diarrhoea, pneumonia, piglet anaemia, haemorrhagic septicaemia (HS), internal worms, mange, hernia and foot and mouth disease (FMD) as the most important diseases. Veterinary staff said that of these, worm infestation was most common followed by piglet diarrhoea, swine fever, pneumonia and some non-specific problems like hernia and closed anus/eyelids among piglets. Another important cause of piglet mortality was stampeding or trampling by the sow. Respondents during the field surveys reported that swine fever was more prevalent in Manja and Howraghat than in Silonijan. Veterinary staff reported higher incidence of swine fever during May to July than other months. Reports from the field surveys confirmed that parasitic infestation was more common when pigs scavenged or were tethered, as reported by Bandyopadhyay (2002). During the field surveys in Silonijan, it was reported that the incidence of disease was low and farmers were not very concerned about the risk of disease. Except for mortalities from swine fever, trampling, piglet diarrhoea and pneumonia, losses from other causes were

few. As informed by some of the breeding units in the Howraghat and Silonijan, mortality among the piglets depended on the size of the litter. If the litter size was about 12 to 16, there was possibility of the death of two to four piglets in a litter, especially due to trampling. Stillbirths were also common when litters were large. Farmers reported that piglet mortality in indigenous pigs was very low or nil although only three to six piglets are born in a farrowing. Several studies have suggested that local (indigenous) pigs are very susceptible to piglet diarrhoea and pneumonia (Pal *et al.*, 2000), while it has also been reported that diarrhoea, pneumonia and trampling are the major causes of piglet mortality (Murugkar, 1998). These findings are consistent with the reports in our interviews. Nevertheless, diseases were not said to be major constraints to pig production in the surveyed areas, particularly in Silonijan. On the other hand, the practice by producers of slaughtering and selling diseased adult animals reduced the financial losses resulting from disease but presented risks to public health.

Despite the prevalence of swine fever and the mortalities it caused, the primary survey revealed that none of the interviewed producers vaccinated their pigs against the disease. This was apparently because of their inadequate knowledge of this preventive measure, the poor availability of the vaccine and the fact that the vaccine, when available, comes in a vial of five doses, more than required by most pig units. Moreover, the key veterinary informants in all the surveyed areas reported that in 2005 there were failures of the swine fever vaccine which discouraged many producers from vaccinating their pigs. It was also learnt that for a long time the AHVD had lacked adequate stock of swine fever vaccine and supply from the private veterinary clinic (located at Diphu) was irregular. Given these circumstances and experiences, it is not surprising that many producers in Karbi Anglong were not motivated to vaccinate their pigs against swine fever. As informed by the VAS of Silonijan Veterinary Dispensary, most of the pigs bought using bank loans were vaccinated against swine fever.

A private veterinary practitioner with a clinic in Diphu town reported that most (about 90%) of his customers buy deworming drugs. About 80% of customers buy liver tonic (perhaps because liver tonic is always accompanied by deworming drugs), 60% anti-diarrhoeal drugs, 40% mineral and vitamin mixture and 20% antibiotics. This demonstrates a higher level of awareness among farmers about parasitic infections in pigs. However, during the household survey, only 25% of farmers reported using

deworming drugs and some were not even aware of the importance of using these drugs.

In the event that their pigs fall sick, producers generally buy medicine from a veterinary dispensary, private veterinary clinic or human clinic, based on their description of the pigs' symptoms. Richer producers, especially breeders, called a veterinarian to treat their diseased pigs at a cost of Rs. 50 to 100 per visit, including some cheap medicine. Some producers (e.g. Mr Mangalo Ao of Silonijan and Mr Chandra Mohan Boro of Howraghat) treat their own animals. These farmers mostly have breeding stock and the male counterpart is fully involved in the management of the unit. It was reported that poorer producers usually sought advice from the experienced producers of the village or those whose pigs had been treated by a veterinarian. The use of some jungle herbs to treat pigs was also reported; hemp (locally known as *ganja* or *bhang*) was used to treat piglet diarrhoea in Manja area. Castration of male piglets was generally performed by local skilled persons in the villages at the cost of Rs. 10 to 40 per castration. Interviewed farmers said that piglets often suffer from maggot-infested wounds after castration because of poor or no use of antibiotics and/or antiseptic.

The surveys showed that the level of awareness among producers of the diseases that affect their pigs and the possible preventive measures was low. Research in India (as elsewhere) has shown that education level, size of farm, socio-political participation, and exposure to mass media and extension agencies positively affect attitudes towards vaccination (Sasidhar, 2001). However, government and non-government extension services were said to be very poor in all the surveyed areas.

4.6. Main issues in production systems

From the field surveys and the information gathered from secondary sources, various conclusions can be drawn about the pig production systems of Karbi Anglong district. There are also some important issues that relate to the constraints to and opportunities for improving pig production for income generation and increased livelihood security.

1. Consistent with the hypotheses presented in section 2.3, piggery in Karbi Anglong is invariably a marketed-oriented small-scale backyard enterprise practised mainly by ST and other-than-ST communities (especially Ahom and Chutiya who belong to

the OBC) to generate income, accumulate capital and fulfil socio-cultural obligations. These small-scale enterprises depend upon family – mainly women’s – labour and on other local inputs, particularly feed, of no or low opportunity cost.

2. Unlike in Kamrup district, pig production in Karbi Anglong is not concentrated in certain areas but occurs throughout the district. The housing, feeding and herd types vary slightly amongst the different communities (Tables 10, 11 and 13).
3. Although it is a small-scale enterprise (generally one to seven pigs), its contribution to the livelihoods of majority of the tribal households is significant. Many of the poor tribal households’ plans for the family (e.g. repairing of houses, taking land on lease, purchasing farm inputs, treating patients and paying school fees) are based upon the income generated from pigs.
4. The quantity and quality of locally available feed resources – mainly from the household’s crop by-products – are major factors that limit the scale and efficiency of pig production. By-products of rice were major feed sources, such that herd sizes tended to be larger in areas where these feeds were cheap. *Colocasia* (taro) was also extensively used and procured from vendors in some areas, indicating the opportunity for its commercial cultivation. Nevertheless, the overall context was one of inadequate feed resources, such that improved feed and feeding practices will be key interventions to increase productivity and profitability. Participatory methods will be required to evaluate their fit relative to the availability of household labour, cost, convenience, land and other resources.
5. As elsewhere in Assam, current feed resources mainly supply energy but are deficient in protein, mineral and vitamins. This deficiency could be offset by feed milling units or feed suppliers selling a low-cost feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units.
6. Other possible interventions are the promotion of non-conventional feed resources (e.g. rice bean – *Vigna umbellata* – and legume forages) and improved varieties (e.g. tapioca, *Colocasia*/taro, sweet potato) documented by various R&D organizations. The expertise of animal nutritionists from the R&D organizations will be critical to the success of this process.
7. Traditional management practices continue to dominate pig production systems in Karbi Anglong, with a few exceptions. Most indigenous pigs have been replaced by crossbreeds, with crosses of the Large Black breed preferred over other exotics; some fattening units have evolved to include breeding stock; and 25% of pig producers are reported to use deworming drugs.

8. Despite the farmers' preference for the Large Black breed of pigs, government breeding farms promote other less popular breeds like Hampshire and Saddle Back. Therefore, the government breeding programs should be re-assessed, innovative community-based systems developed and private-sector investments encouraged to better meet the unsatisfied demand for improved breeding stock and quality weaners. AI may have a role to play.
9. Respondents during the field surveys repeatedly reported inadequate supplies of quality piglets because only a small proportion (about 20%) of pig producers in Karbi Anglong kept breeding stock. In addition, supplies from government pig breeding farms are scarce and relatively costlier. This scenario highlights two issues: (i) most pig-keeping households produce a few pigs for slaughter rather than keep sows, presumably because of the limitations of available feed resources and (ii) inadequate information is provided in the markets and by market traders about the origin of the piglets on sale. The first issue can be addressed by adaptive, participatory feed R&D (points 4, 5 and 6 above) and the second by formalizing linkages between areas which have a deficit and those which have a surplus of weaner production and/or by a certification scheme for breeders who source the weaners.
10. Closely related to these breeding and feeding issues were reports by the majority of interviewees that they had inadequate knowledge about breeding, feeding and health care management (medication and vaccination). A systematic government approach to address this lack of access to technical extension advice (section 5) was not observed, although there were some sporadic initiatives in form of training on intensive management of pigs though these were not very popular amongst the farming communities. No government initiative was reported to address the issues of smallholder pig producers, who constitute about 85% of all pig producers. Therefore, much more work is required to ensure that extension programs are needs-based and client-oriented. The extension approach should address how to improve production through incremental steps achievable within the limits of current household resources, especially feed and female labour.
11. Despite swine fever being reported as a major disease constraint, there were no adequate attempts to confirm its diagnosis, to identify the possible causes of vaccination failure or to assess the economic losses resulting from the disease. No awareness campaign had been carried out amongst producers, suppliers and vaccinators about the importance of supply, storage and use of quality vaccines,

e.g. frequent power failures made it difficult to maintain a cold chain for vaccine storage. Alternatives to vaccine control are required through community-based programs that pay locally-based veterinary assistants to supply a variety of services. An important component should be community-based training in the early clinical diagnosis of swine fever and the collective actions required to prevent the spread of infection.

12. In general, veterinary services through government dispensaries and private clinics would benefit from strengthening by receiving support from unemployed veterinary graduates and skilled village-level persons; this may be an important area of intervention. The village-level persons may be trained in vaccination, castration and first aid treatment.
13. Lack of working capital was a recurring constraint observed during the field survey, resulting, for example, in the *adhiary* system being more common in Karbi Anglong than in Kamrup. It would appear that more effective schemes for availing credit are required. Extension of micro-credit through NGOs may be a viable alternative to address this credit need of poor rural households.
14. Currently, insurance coverage of pigs in Karbi Anglong is either nil or negligible. Insurance companies are also not very interested in insuring smallholder pigs. Therefore the Group Insurance Scheme from nationalized insurance companies may be suggested to SHGs.
15. Finally, although Karbi Anglong was noted to be deficient in pork production and demand for pork was increasing, there was a marked lack of investment in more intensive production systems.

5. Policy and institutional issues

5.1. Regulatory environment

Statutory regulations affect five stages in the pig production and marketing chain of Karbi Anglong:

- registration and inspection of pork outlets
- veterinary services
- extension services
- transportation
- market levies

1. Unlike in Kamrup district, veterinary staff in Karbi Anglong were not aware of specific regulations for registration and inspection of pigs and pork outlets in Diphu town or for pig rearing because such information was not communicated to the AHVD veterinary officer responsible for meat hygiene and marketing. Therefore, the official supervision of pork marketing was limited to a few surprise visits by the veterinary officer. Poor coordination was also reported amongst the town committee, AHVD and police administration, again limiting any action against malpractices.
2. There is a government regulation that VAS should be transferred within three years from one dispensary to another but on many occasions they are transferred earlier than that. In between, they do not get sufficient time to understand the problems of livestock producers in the area and to take up necessary measures to overcome the problems. Therefore, interviewed veterinarians suggested that the period before their transfers should be extended to at least five years.
3. Although there are a few veterinary extension officers under AHVD, they are generally involved in other non-extension activities owing to lack of physical (vehicles, information, extension and communication materials) and financial resources. This has contributed to the poor level of awareness and knowledge amongst small-scale pig producers about pig management. Furthermore, there has been no systematic effort by the government or by non-government agencies to ensure an effective, farmer-oriented extension service.
4. In respect of the licensing of vehicles to carry live pigs and pork, the Department of Transport Regulations permits vehicles to transport goods and livestock. However,

all the interviewed pig/pork sellers reported that they were harassed by the police who ask for money or a separate permit to transport pigs/pork. This harassment and “rent-seeking” has discouraged many traders from the business.

5. At markets, pig/pork/piglet sellers and piglet traders pay a cess/levy to the local market management committee or to the local *mahaldar* (lessee). The cess varies between Rs. 10 and 50 per day, depending on the market.

5.2. Government and donor participation in the pig sub-sector

The programs and projects being implemented by the government and donor agencies in support of Karbi Anglong’s pig sub-sector supply improved breeding stock, production training, extension and credit.

1. Two government pig breeding farms at Diphu and Donkamoka (under the AHVD) rear Hampshire and Saddleback pigs. The main objectives of the farms are to produce quality piglets for sale or distribution and to serve as demonstration units. About 50% of all piglets are sold to farmers, especially for breeding, while the remaining 50% are distributed amongst the SHGs that were formed with support from the farms. Each farm distributes or sells about 350 piglets a year. In 2006, about 78 SHGs were trained in improved pig management practices. Political influence was found to play a key role in the selection of the farmers and NGOs that receive training and other assistance; as a result, impacts on the ground are poor.
2. The AHVD will implement a program called *Rastriya Sama Viaksh Yojana* (RSVY) in Karbi Anglong with the financial assistance from the Government of India. Although the required funds were approved, they have not yet been disbursed. Recently, a few SHGs were assisted by other line departments to rear pigs under this program. One such group in Silonijan (Purana Silonijan Bahumukhi SHG) reported that it had received three piglets, five bags of feed and training from the department, but that it could not rear the pigs successfully because of their internal problems (conflict among the members in respect of sharing of labour). To satisfy the pre-conditions of the project, the SHG spent almost Rs. 20,000 from its savings to construct a concrete shed adequate for three piglets. This led to poor economic status of the group and gross dissatisfaction among the members.

3. In Karbi Anglong, the DRDA is promoting SHGs in each block under the *Swarnajayanti Gram Swarojgar Yojana (SGSY)*¹³. The number of SHGs formed in the project districts along with some of their details are presented in Table 15. About half of the SHGs are involved in pig keeping, indicating the importance and growing opportunities for piggery in supporting livelihoods of the rural poor. However, given the small percentage of SHGs receiving revolving fund, credit or subsidy, the sustainability of SHGs may be doubtful, bringing into question the official record which shows no defunct SHG. One SHG in Howraghat reported that it obtained project finance of Rs. 250,000 for pig rearing but utilized only a small part to buy piglets, diverting the remainder to take land on lease and extending credit to other groups at a higher interest rate (5% per month). Veterinary key informants reported that only five out of 15 SHGs in Howraghat that had obtained project finance were running pig units successfully.

Table 15: District-wise status of self-help groups (SHGs) in Assam

District	No. of SHGs formed	Approx. % of SHGs rearing pigs	% of women members	% of SHGs received revolving fund	% of SHGs received credit and subsidy	% of defunct SHGs
Karbi Anglong	2859	50	76	8	6	0
Dhemaji	3597	60	86	19	5	1
Golaghat	4949	20	70	38	10	1
Kamrup	7369	25	75	46	7	0
Kokrajhar	2640	40	67	12	3	0

Source: Department of Panchayat and Rural Development, Government of Assam, 2006

4. The NGO *Jirsong Asong* has a school in Manja where school dropouts are trained on various agricultural activities. The NGO has also organized 242 SHGs in 30 villages throughout the district, 70% of which were involved in pig rearing. The

¹³ Organizing farmers into a group of 10 to 20 members, imparting training on organizational management, motivating a habit of savings, providing assistance for income-generating activities and providing a revolving fund of Rs.10,000 and project finance of Rs. 200,000 and above to eligible groups in a phased manner to promote the relevant activities.

SHGs offered training and linkages with various banks, insurance companies and input suppliers. One SHG in Manja area visited during the survey had received support and rearing stall-fed pigs. Since the program had started only few months earlier, it was too early to assess its impact.

5. Under the Assam Agricultural Competitiveness Project (AACP), the Agricultural Technology Management Agency (ATMA) proposes to give training and exposure visits on feeding, health care and management of pigs to producers in Manja and Howraghat. During the time of our study (October 2006), only the baseline survey was going on.

5.3. Delivery of livestock services

5.3.1. Clinical and preventative veterinary services

The AHVD's veterinary dispensaries are the main veterinary service providers in the district. There are veterinary dispensaries in Diphu, Manja, Silonijan and Howraghat, each headed by an assistant VAS with two to three veterinary field assistants and support staff. They treat the animals brought to the dispensaries or visit the homestead if they are called. In the dispensaries, the supply of medicines and vaccines is grossly inadequate and pig producers only get advice from the VAS and some first aid treatment.

Apart from government veterinary dispensaries, there is a private veterinary clinic in Diphu town run by a qualified veterinary practitioner who sells medicine and other farm inputs (piglets and feed) to pig producers and offers other veterinary services. In the other surveyed areas, human clinics were reported to contain veterinary medicine. *Jirsong Asong* also provides technical advice to the SHGs that it promotes.

5.3.2. Breeding services

As described above, two AHVD breeding farms supply piglets to producers for breeding purposes. Piglets are usually not sold for fattening, although there were instances of producers using the piglets for fattening rather than for breeding. Piglets were said to be mostly distributed amongst the trained SHGs. Apart from supplying piglets, the farm specialists also give advice to the producers. As mentioned previously, AHVD has not introduced AI into Assam.

5.3.3. Production and health extension

In the surveyed areas, there appeared to be an ineffective extension service. As mentioned in section 5.1, AHVD had a few veterinary extension officers but was mostly involved in non-extension activities. When interviewed, farmers said that government agencies had no major initiatives except some short-term training on management of stall-feeding units. Further, there was no follow-up mechanism to assist these trained groups of farmers or to assess their current status and needs.

No program dealt with the backyard (tethered/penned) system of pig management which dominates pig production in Karbi Anglong. The DRDA organized some training programs for SHGs mostly on stall-feeding, a system which is not usually taken up by the groups. Under the SHG program, DRDA offers a group Rs. 10,000 as a revolving fund with credit of Rs. 15,000 from a commercial bank six months after the group's formation. Thereafter, potential pig-rearing SHGs are trained on the scientific management of pigs and linked with commercial banks for credit of up to Rs. 250,000 (of which about 50% is a grant up to a maximum of Rs. 125,000). SHGs were observed to rear pigs in two different systems, in one of which group members jointly rear pigs on a common plot of land and all members participate in the management. This system was reported not to be very successful with cases of conflict over the sharing of labour and other resources. In the second system, SHGs buy 20 to 30 piglets and distribute two or three to each group member to rear independently. The money generated from the sale of the piglets is used to repay the group's loan. As mentioned in section 5.2, some SHGs diverted part of the loan to other income-generating activities. This indicates that SHG members have priorities other than pig rearing when they receive credit. Learning about these decisions and understanding their basis will be an important source of information to consider in designing new public-sector initiatives related to piggery development.

Under the DRDA, *Gram Sewok/Sewika* (village extension workers) are responsible for providing extension services to the SHGs but they were reported to provide organizational rather than technical support. From DRDA/Block officials and the SHGs, it was understood that the DRDA extension staff did not have missionary zeal to make their programs a success and, as a result, they were not effective. At the request of agencies like DRDA, some NGOs organized occasional training programs. Unlike in Kamrup district, AAU did not conduct treatment and vaccination camps in rural areas.

It was reported that AHVD vaccinated the cattle population around the forest with the help of an NGO called “Early Birds” but no such vaccination program was adopted for pigs. Common to all these extension activities is that they were sporadic in nature and lacked any systematic approach. AHVD staff pointed out that there had been no training-needs analysis and, therefore, it was unlikely that the training programs were client-oriented or needs-based.

5.4. *Producer organizations*

In the surveyed areas, other than SHGs, there were no producer organizations like cooperatives or Farm Management Committees (FMC). Thus, the SHG programs were the only example of attempts to develop collective action amongst pig producers.

5.5. *Institutional linkages*

The information gathered from the various interviews in Karbi Anglong demonstrated that coordination was poor among the different organizations that promote pig production, especially NGOs and AHVD. Nevertheless, some joint efforts have been initiated in the recent past. A major example is DRDA’s program to organize farmers into SHGs in which AHVD and NGOs impart training and a commercial bank extends credit. On the other hand, it seemed that insurance companies were not well linked with other stakeholders in the pig sub-sector and had little interest in insuring livestock and poultry.

5.6. *Main policy and institutional issues*

From the descriptions in sections 5.1 to 5.5, it is clear that there are some policy and institutional issues that constrain pig production and marketing in Karbi Anglong district and that there are opportunities, via policy and institutional interventions, to improve livelihood security and increase incomes.

Principal amongst the constraints was the poor effectiveness of the publicly-funded production and veterinary extension services, which resulted from a variety of causes but particularly the lack of a needs-based client orientation, inadequate incentives for staff and poor operational resources. However, it was clear that market-oriented pig

production is integral to the livelihoods of the majority of resource-poor rural households and that the continuing increase in the demand for pork means that pig production represents a major opportunity to improve livelihood security and increase incomes. What is lacking is effective extension support to these communities and to other groups like educated, unemployed youths.

Given this scenario, it is critical that development policy and its implementation focuses on the large majority of pig producers who are resource-constrained, particularly for feeds and labour, and, that the policy recognizes that improvements in productivity and profitability will come from incremental production changes developed by innovative, community-based programs implemented by staff oriented towards the needs of their clients.

Central to these programs should be participatory approaches that address the shortage of cost-effective feeds and quality piglets and breeding stock. Programs based on producer participation (with the involvement of women critical to success) will ensure that their preferences are recognized (e.g. for Large Black pigs rather than the Hampshire and Saddle Black breeds supplied by government farms) and will develop the improved feed resources essential for increasing the productivity of the small-scale production units. At the same time, the development policy has to incorporate institutional interventions to reduce the vulnerability of these resource-poor households through addressing the threats to their pigs from epidemic diseases, especially swine fever. Improved veterinary services are required that deliver quality swine fever vaccines even to the rural areas where poor electricity supply makes it difficult to maintain a cold chain. Community-based training is also required in the early clinical diagnosis of swine fever and the collective actions required to prevent the spread of infection.

Policies and institutional approaches that encourage participatory methods will also help to overcome the problems observed in the SHG programs which lacked effective orientation and awareness among the members, whose needs for credit were being served but not, apparently, their needs for technical assistance. These and related programs illustrated what appeared to be inadequate coordination among the varied R&D stakeholders like CVSc, ICAR-NEH, AHVD, SIRD, ALPCo, commercial banks and insurance companies. This issue can be addressed within an overall policy on pig sub-

sector development and a pro-poor strategy for its implementation. Integral to the strategy and its participatory approach should be the provision of financial resources to ensure the exposure of the research community to field problems and to support the extensive participatory field testing of promising research findings. As the risk-averse practices of individual resource-poor pig producers may inhibit the adoption of new technologies, micro-credit and insurance through community-based schemes should be an integral part of these programs.

Just as in the production phase, there was also lack of coordination amongst public bodies in the pre- and post-slaughter phases. Public health issues resulting from current slaughter and meat-handling practices merit attention from the various government and civic bodies responsible for food safety. Improvements in hygiene should be sought while being conscious of the limit to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices. Given that in Karbi Anglong a high proportion of pigs are slaughtered and their meat sold directly to consumers by producers, it is important that these producers receive training in meat hygiene.

6. Conclusions and recommendations

Through consultations along the market chain from consumers of pork to retailers, pig traders and pig producers and with the organizations which serve them, we compiled a detailed overview of Karbi Anglong's pig sub-sector. Consistent with expectations (section 2.3: Hypotheses), pig production was mainly a small-scale market-oriented enterprise of tribal communities. About 75% of rural tribal households reared pigs, mostly crossbreeds. The majority of households did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. However, traditional feeding practices limit pig performance. Slaughter pigs were reported to reach 50 to 60 kg live weight at 10 months of age with the lower weights being more prevalent. A major contributing factor was the poor diet quality (low protein) because feeds were mainly by-products of the rice crop – bran and *juguli* – along with *Colocasia*/taro. However, because these and other local feed resources were of low or no opportunity cost and the labour for caring for the pigs was provided mainly by the women of the producer households, pig production was an attractive, profitable business. Furthermore, even close to Diphu town there has been, as yet, little or no private-sector investment in more intensive systems of production.

This competitive small-scale pig sector in Karbi Anglong has been responding to a vibrant market for fresh pork; traders and retailers said that demand had increased by about 50% over the last five years. They were also confident that sales of fresh pork would continue to grow as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there have been limited inflows of slaughter pigs from other districts of Assam and from other states, it is clear that small-scale production must have expanded considerably during recent years to satisfy the increased demand for pork in Karbi Anglong. These changes have resulted not only in more pigs being produced from the estimated 66,000 small-scale units with benefits to the livelihoods of tribal producer households, but there are also many more people earning a living from the marketing of pigs and pork and from the provision of services.

These market-driven changes meant that pig producers in Karbi Anglong were happy with the income they generated but, at the same time, they said that they were not very keen to further increase the size of their herds especially because of the lack of

household feed resources and labour. Hence the conundrum; the market is continuing to demand more pork but the input constraints now faced by the majority of producers – the many thousands of resource-poor, tribal households – are limiting their capacity to respond. Pressure is also increasing on Karbi Anglong's existing stock of pigs due to shortage of supply from Dimapur because of increased transport costs and "hidden expenses". To meet this shortfall, Karbi Anglong procures some slaughter pigs from the nearby Nagaon and Golaghat districts and some piglets from Golaghat, Nagaon, Lakhimpur and Dhemaji districts. Therefore, interventions to support the production of piglets and slaughter pigs in Karbi Anglong have to be developed taking into account the competition from these other sources of supply. Moreover, there is need to recognize that not only is the district deficient in pork production, it is likely to remain so unless local pig producers increase production by intensifying their systems. The alternative is that the market for pork in Karbi Anglong district, and in Assam generally, will attract significant imports of slaughter pigs in the way that the state imports large quantities of chicken meat, eggs and fish.

Given this demand and supply scenario, what **specific recommendations** can be given to overcome the technical, institutional and policy constraints faced by the pig sub-sector in Karbi Anglong and thereby to exploit the opportunities to improve productivity and profitability, especially amongst the tribal communities?

Production constraints and opportunities

1. The lack of operating capital and limited credit facilities were major constraints for piggery development in Karbi Anglong. One result has been the prevalence of the *adhiary* system. To address this constraint, more micro-credit through NGOs may be a viable way forward. Capacity building of existing NGOs to play an intermediate role in money-lending would be a first step. Since resource-poor rural farmers are risk-averse, group insurance schemes should also be available with the credit.
2. Inadequate knowledge about feeding, health care and breeding management was given by producers another major constraint to improving production. Current extension programs were said to be less effective and limited in their reach. Required are needs-based, client-oriented programs using participatory methods to improve the capacity of pig producers to make more effective use of available feed resources, to maintain their pigs in good health and to breed productive crosses.

3. A technical production constraint reported repeatedly by producers was the inadequate supply of quality piglets, a result of the small proportion of producers in Karbi Anglong keeping breeding stock and the absence of systematic breeding programs. Current government breeding programs should be re-assessed, innovative community-based systems developed and private-sector investments encouraged to better meet the unsatisfied demand for improved breeding stock and quality weaners. It is recommended that key elements should be expanding the stock of the preferred Large Black breed and making available quality boars to all breeders in the villages for use in the widespread fee-paying mating system. R&D agencies should explore the possibility of introducing AI and design an effective needs-based training program for smallholder pig breeders on the care and management of breeding stock.
4. For extension programs designed to improve feeding practices for faster growth rates and better reproduction, a key opportunity results from the main feed sources – rice bran, *juguli* and *Colocasia* – being rich in energy but deficient in protein. This constraint can be offset by three complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forages including soybean; (ii) testing the profitability for pig producers and for feed suppliers of a protein-rich feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units and (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia*/taro, sweet potato and maize. Each of these interventions conforms to the principle of providing farmers with information and technological options that allow them to combine feeds optimally in relation to the cost of production (including family labour) and the contribution of each feed to meeting the nutrient requirements of their pigs for profitable performance.
5. The participatory approach to extension ensures that the interactive, iterative process of identifying constraints, evaluating options to resolve the constraints and assessing the benefits increases the capacity of pig-producing households to improve their husbandry through continuous knowledge sharing within their communities and with their R&D partners. The process will also facilitate the strengthening of institutional linkages and effectiveness amongst the R&D organizations, including the agencies that give credit, the provision of which is likely to play a key role in supporting the adoption of technical innovations.

6. The same participatory process should also be applied to evaluate the impacts of pig diseases and their threats to the viability of small-scale herds, particularly in relation to designing effective prevention and control systems for swine fever. Current systems for vaccine delivery do not work and alternatives are required, probably through community-based schemes where locally-based veterinary assistants are paid by the community to supply a variety of services. Local skilled persons may be trained to castrate and vaccinate pigs and provide first aid treatment.

Marketing and consumption issues

1. Whereas households faced constraints to pig production, the market for their pigs (output market) generally worked efficiently with attractive prices for producers and reasonable margins for market agents. But rent-seeking (“hidden expenses”, i.e. bribes) by police added to marketing costs during transport of piglets, slaughter pigs and pork, increasing the retail price of meat and reducing profits for producers. To overcome this problem, it is recommended that there should be an awareness program involving all participants in the market chain: producers, traders, police and other officials.
2. In need of improvement was the food safety of pork. With pork consumption rising and the number of market participants between producer and consumer increasing, the risks to public health from unhygienic practices are growing. Currently, even in Diphu, there is no routine pre- or post-mortem inspection of slaughter pigs because of inadequate coordination among the AHVD, town committee and police administration, inadequate manpower and physical resources and the absence of physical infrastructure (like building, water and electricity) for slaughtering and sale of pork.
3. These deficiencies in public health measures should be addressed through a structured evaluation of the practices of pig slaughterers, pork wholesalers and retailers. The evaluation should assess the requirements for improved infrastructure and inspection (manpower and physical resources) and for training in meat hygiene and food safety based upon consumers’ needs, perceptions and willingness to pay.
4. One specific aspect of public health is measly pork (infestation of pork by the zoonotic tapeworm *Taenia solium*), the signs of which were well-known to consumers, pork retailers and pig traders such that traditional knowledge and food cooking practices reduce adverse impacts on human health and on the

consumption of pork. Nevertheless, it and other zoonotic diseases of pigs should feature prominently in the proposed training in meat hygiene and food safety. The training should be given to all participants along the value-chain: pig producers and traders, pork retailers and veterinary and public health inspectors.

5. Notable results from the key informant interviews and field surveys were that there was no price differential between lean and fat pork and that pork from indigenous pigs was more expensive than that from crossbred pigs, especially in some rural areas, reflecting consumer preferences based on taste. In order to inform private investment and government planning, there is need to better define and quantify consumer perceptions of pork quality, including aspects of taste, appearance and composition. It is recommended to carry out such a study, the results of which will have implications for market opportunities and for the type of pigs to be kept, how they should be managed and how their meat should be presented to consumers.

Policy and institutional constraints and opportunities

1. As was discussed in relation to production, principal amongst the constraints faced by current and potential pig producers was the ineffectiveness of the publicly-funded production and veterinary extension services despite the integral contribution of market-oriented pig production to the livelihoods of tens of thousands of resource-poor rural households in Karbi Anglong. Furthermore, the increasing demand for pork represents a major opportunity to improve livelihood security and increase incomes, particularly amongst marginalized groups including unemployed youth.
2. What is lacking to exploit these opportunities is effective extension support, driven by a policy that recognizes that improvements in productivity and profitability of current producers will come from incremental production changes developed by innovative, community-based programs using participatory methods implemented by staff oriented towards the needs of their clients. The approach requires a mind-set change by government officials, an increased role by NGOs and building upon local social infrastructure, e.g. successful SHGs. To achieve this, it is recommended that a planning and coordination group be established as a platform to catalyze this process and to prepare a policy on pig sub-sector development.
3. To be effective, the group will have to overcome the current inadequate coordination among the various R&D stakeholders like CVSc, ICAR-NEH, ICAR-NRCP, AHVD, DRDA, ALPCo, commercial banks and insurance companies. This

issue can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.

4. As was detailed in section 5.6, it is recommended that integral to the strategy and its implementation through participatory approaches should be the provision of financial resources to ensure the exposure of the research community to field problems and to support the extensive participatory field testing of promising research findings.
5. As well as these production-level interventions, and as was outlined in the “Marketing and consumption issues” section, public health issues related to current slaughter and meat-handling practices merit attention. The awareness and training programs that have been recommended to improve value-chain and institutional capacity for hygienic pork marketing have to be designed to take into account the limits to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices.

By having a better understanding of the current constraints to and opportunities for improved productivity and profitability of Karbi Anglong’s pig production, pig and pork marketing and the consumption of pork, it has been possible to identify some specific actions to improve the pig sub-sector’s contribution to livelihoods in the district, particularly with expected benefits to marginalized groups. A major challenge facing the state and district government departments is to ensure that policies and publicly-funded programs are even-handed in support for small-scale production with its important social equity contribution and its counterpart, the expected emergence of larger-scale, more intensive production units responding to the increasing demand for pork. Monitoring and evaluating these changes in the structure of piggery in Karbi Anglong will be an important responsibility for the proposed planning and coordination group.

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List of abbreviations

AACP	Assam Agricultural Competitiveness Project
AAU	Assam Agricultural University
ACIAR	Australian Centre for International Agricultural Research
AHVD	Animal Husbandry and Veterinary Department
AICRPP	All India Coordinated Research Project on Pig
AI	artificial insemination
ALPCo	Assam Livestock and Poultry Corporation Limited
ATMA	Agricultural Technology Management Agency
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CPR	common property resources
CVSc	College of Veterinary Science
DRDA	District Rural Development Agency
FMC	Farm Management Committee
FMD	foot and mouth disease
HS	haemorrhagic septicaemia
ICAR-NEH	Indian Council of Agricultural Research-North Eastern Hill region
IIRR	International Institute of Rural Reconstruction
ILRI	International Livestock Research Institute
NE	Northeast
NC	North Cachar
NGO	non-governmental organization
NRCP	National Research Centre on Pig
NSSO	National Sample Survey Organization
OBC	Other Backward Classes
R&D	research and development
RSVY	<i>Rastriya Sama Viaksh Yojana</i>
SGSY	<i>Swarnajayanti Gram Sawrozgar Yojana</i>
SHG	self-help group
SIRD	State Institute of Rural Development
ST	scheduled tribe
UP	Uttar Pradesh
VAS	veterinary assistant surgeon

Appendix 1: Key informants interviewed in Karbi Anglong district, the research team and the key resource persons

Name	Designation and address
Dr A. Kakati	District Veterinary Officer, AHVD, Diphu
Dr Mringka Barua	VAS, AHVD, Diphu
Dr Kamal Kanti Das	VAS, Block Veterinary Dispensary, Manja
Dr S.D. Choudhary	VAS, Veterinary Dispensary, Silonijan
Dr Phani Bora	VAS, Veterinary Dispensary, Howraghat
Dr Loni Dutta	VAS, Veterinary Dispensary
Dr Brahmananda Bora	Private Veterinary Practitioner, Poly Veterinary Clinic
Mr M. Das	State Bank of India, Diphu
Mr Sushil Sangmai	<i>Jirsong Asong</i> (NGO), Manja

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Resource persons

Dr A.B. Sarkar, Former Director of Research, CVSc, AAU

Mr Dilip Sarma, Director, Centre for Humanistic Development

Dr M.K. Tamuli, Principal Scientist, NRCP

Appendix 2: Agro-climatic zones

Based on climate, soil characteristics and land use pattern, Assam state has been divided into six agro-climatic zones¹⁴:

1. North Bank Plain: Liakhimpur, Dhemaji, Sonitpur, Dorurang
2. Upper Brahmaputra Valley: Jorhat, Golaghat, Sivsagar, Dibrugarh, Jinsukia
3. Central Brahmaputra Valley: Nagaon, Morigaon
4. Lower Brahmaputra Valley: Kokrajhan, Bengaigaon, Barpeta, Goalpara, Dhrebri, Kamrup, Nalbari
5. Barak Valley: Cachar, Karimganj, Hailakandi
6. Hills: Karbi Anglong, North Cachar Hills

¹⁴ Agriculture Department, official website