Kokrajhar'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 Kokrajhar; the other districts were Kamrup, Karbi Anglong, Dhemaji 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, 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 Kokrajhar 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 Kokrajhar; the other districts were Dhemaji, Golaghat, Kamrup and Karbi Anglong. 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 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 Kokrajhar district the three selected clusters were Kachiapara, Bangtol and Cerphanguri. The clusters were visited during the third week of November 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 Kokrajhar relative to the other surveyed districts were:

- located in the foothills of the Himalayas representing the northwestern bank of the Brahmaputra and the entry point to the NE states;
- dominated by the Bodo community;
- the major tribe in Assam;
- traditional system of rearing with crossbred pigs;
- concentration on the production of fatteners; and
- pig products are mostly consumed in the district itself.

Kokrajhar district, centred on Kokrajhar town, has seen several administrative changes, most recently in 2005 when it was divided into Kokrajhar and Chirang districts. For the current study, Kokrajhar district pre-2005 was surveyed for consistency with the available secondary information. Located in the extreme northwest of Assam, the district is the entry point from the rest of India to the NE region. It shares boundaries with West Bengal state and the Himalayan Kingdom of Bhutan. It has small ranges of low hills in the north and flat plains in the south. Rivers that originate from the hills cause heavy flooding in the plains during the monsoon. The district belongs to the Bodoland Territorial Council (BTC), an autonomous administrative body created for the local administration of Kokrajhar, Chirrang, Baska and Udalguri districts which are dominated by the Bodo community. In the 2001 census, Kokrajhar's population was 0.9 million (approximately 170,000 households), of which less than 10% was urban. Of the district's four urban centres, Kokrajhar has a population of about 30,000 while each of the others has a population of less than 15,000. Two-thirds of district residents are Hindus; other major religious groups are Muslims (20%) and Christians (14%). A third of residents belong to the Scheduled Tribe (ST) community; this figure is three times the state average. Of the many tribes in Kokrajhar, Bodo is the largest followed by Adibasi. In the Assam Human Development Report (2003), Kokrajhar had a high Human Poverty Index (HPI); only the indices of Karbi Anglong, Karimganj and Dhubri were higher than Kokrajhar's.

It is a small district; half its area is covered by forest and close to a quarter is net sown area. Smallholder farm households form the large majority of the rural population and its economy. Forestry and non-agricultural enterprises serve as supplementary sources of income. Paddy is the main crop and it occupies 60% of the total cropped area. However, most households are not self-sufficient in rice. Other significant crops are legumes and tapioca. Over a third of Assam's tapioca is produced in Kokrajhar. In

common with Karbi Anglong, the district produces some maize. Livestock (including poultry) are integral to household livelihoods. There is some ethnic/religious species specificity; buffalo rearing is popular amongst Muslims while pigs are traditional components of tribal households. The pigs serve as a source of income and a means of diversifying household risks, and fulfil socio-religious functions. In the 2003 livestock census 102,000 pigs were reported.

It was against this broad background that a detailed overview of Kokrajhar'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 which serve them. Consistent with expectations, pig production was mainly a small-scale market-oriented enterprise of tribal communities. About 90% of rural tribal households (especially Bodo community) reared pigs, mostly crossbreeds. An estimated 70% of households did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. Virtually all households tethered or penned their pigs; there were very few that practised the scavenging or stall-feeding systems of feeding. Nevertheless, traditional feeding practices prevail and these limit pig performance. Slaughter pigs were reported to reach 40 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 the by-products of rice crop: bran and *juguli* (the residue of country liquor). *Colocasia* and tapioca were used less frequently. 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 Kokrajhar town there has been, as yet, little or no private-sector investment in more intensive systems of production.

This competitive small-scale sector in Kokrajhar district has been responding to growing market for fresh pork and slaughter pigs; traders and retailers said that demand had increased – although slowly – over the past five years. Moreover, they were confident that sales of fresh pork would continue to grow slowly but surely as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there has been increased demand for slaughter pigs from both within and 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

Kokrajhar. These changes have resulted not only in more pigs being produced from the estimated 59,000 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, piglets and pork.

These market-driven changes meant that pig producers in Kokrajhar were happy with the income they generated, but, at the same time, they said that they were unable to further increase the size of their herds, especially because of the lack of household feed and financial resources. 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 Kokrajhar's existing stock of pigs and piglets due to the demand from other districts of Assam, the neighbouring state of Meghalaya and the Kingdom of Bhutan. Currently, an estimated 20% of marketed piglets and 10% of slaughter pigs are sold outside the district. Interventions to support the production of piglets and slaughter pigs in Kokrajhar have to be developed taking into account these domestic and external demand factors which suggest that by 2010 the district will no longer be a surplus pig producer unless local pig keepers increase production by intensifying their systems.

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 Kokrajhar 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 a major constraint for piggery development in Kokrajhar. Both pig producers and traders suffer from lack of credit. While pig producers require long-term credit, traders who sell slaughter pigs, pork and piglets require short-term credit. The government-sponsored *Swarnajayanti Gram Sawrozgar Yojana* (SGSY) and *Rastriya Sama Viaksh Yojana* (RSVY) schemes extend credit to self-help groups (SHGs) but not to individual members. It is recommended that credit should be made available so that individuals can achieve incremental changes in their production systems. Micro-credit schemes managed by non-governmental organizations (NGOs) may be a

viable way forward. Capacity building of existing NGOs on project appraisal and financial management would be a first step towards their playing the intermediate role in money lending. Since resource poor rural farmers are risk-averse, group insurance schemes should also be made available with the credit. Integrated with these financial aspects would be technical extension to achieve increased scale and productivity of backyard pig production.

2. Inadequate knowledge about feeding, health care and breeding management was given by producers as their 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. 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 and *juguli*, 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, maize and sweet potato. 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. These feed interventions should be complemented by technical support to improve the housing conditions of pigs, particularly those in the tethering and penned system.
4. A technical constraint reported repeatedly by producers was the lack of quality breeding stock and the absence of systematic breeding programs. A re-assessment of current government breeding programs is required. Innovative community-based systems should 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 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 training program designed for smallholders on the care and management of breeding stock.

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 the pigs and provide first aid treatment.

Marketing and consumption issues

1. Whereas households were faced with constraints to their pig production, the market for their pigs 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 price of outputs 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 Kokrajhar, there is no routine pre- and post-mortem inspection of slaughter pigs, a

result of inadequate manpower and physical resources and the absence of physical infrastructure (like buildings, water and electricity) for slaughtering and selling of pork. 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. Integral to the evaluation would be the needs of the export trade to Bhutan.

3. 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 Animal Products Development Centre, the Philippines.

   See http://www.aphca.org/reference/apdc_ph/apdc_index.html for details.

4. Retailers and consumers reported that pork consumption was exclusively of fresh meat, the demand for which was growing in urban and in rural areas. Therefore, there is no justification for any public investment in supporting the processing of pig meat beyond the recommendation in the two previous points for making available training in meat hygiene and food safety.

5. Notable results from the key informant interviews and the field surveys were that there was no price differential between lean and fat pork and that pork from indigenous pigs was more expensive than 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. However, it was clear that market-oriented pig production is integral to the livelihoods of many thousands of resource-poor rural households in Kokrajhar. And what is more, the continuing increase in the demand for pork represents a major opportunity to improve livelihood security and increase incomes, particularly amongst marginalized groups like the tribals and 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 mindset change by government officials, an increased role by NGOs and building upon local social infrastructure, e.g. successful 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), National Research Centre on Pig (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 an option for capacity building in participatory methods is 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. In addition to 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 need 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 the productivity and profitability of Kokrajhar's pig production, pig and pork marketing and the consumption of pork, it has been possible to identify some specific actions to improve the contribution of the pig sub-sector 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 Kokrajhar 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 with the 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, and to generate employment. 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 during the development of 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 relevant to Assam and the collection of primary data through semi-structured interviews in selected districts 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 population 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 from the state's 23 districts (as at 2004). The sample districts – Dhemaji, Golaghat, Kamrup, Karbi Anglong and Kokrajhar – were selected based on their diversity of ethnic groups, geographical location, agro-climatic zone, production system, pig population and market opportunities and how these factors were thought to influence the variability of pig systems in the state. The choice of sample districts was guided by the information available from secondary sources and the field knowledge of the key resource persons.

The resource persons considered that the distinctive features of Kokrajhar district were:

- Foothills of Himalayas representing the northwestern bank of River Brahmaputra and the entry point to all northeastern states
- Dominated by Bodo community, the major tribe in Assam
- Traditional system of rearing with crossbred pigs
- Pig production means production of fatteners
- Products are mostly consumed in the district itself

Within each of the sample districts – Kokrajhar in this case – and in consultation with the key resource persons, district veterinary officials and some district-level market agents, three cluster areas were identified where the semi-structured interviews would be carried out at village and household levels. For each cluster, the interviews were carried out in two villages and in three households in each of the villages. In each of the surveyed districts, one cluster was selected within 5 to 10 km of the district headquarters/major town of the district and the other two clusters in two different directions 30 to 70 km away from the district headquarters. Efforts were made to include the principal areas of pig production and the expected variation for ethnic group, production system and market opportunities. Likewise, within each cluster two villages were identified from a list of about ten villages after detailed discussion with the staff and veterinary assistant surgeon (VAS) of the local veterinary dispensaries about the demographic and livelihood patterns, the roles of crop agriculture and livestock, the concentration of pigs, the variation in ethnic groups and the proximity to

markets. For the pair of villages within a cluster, one was selected nearer to the market. Variation for ethnicity and concentration of pigs was also considered.

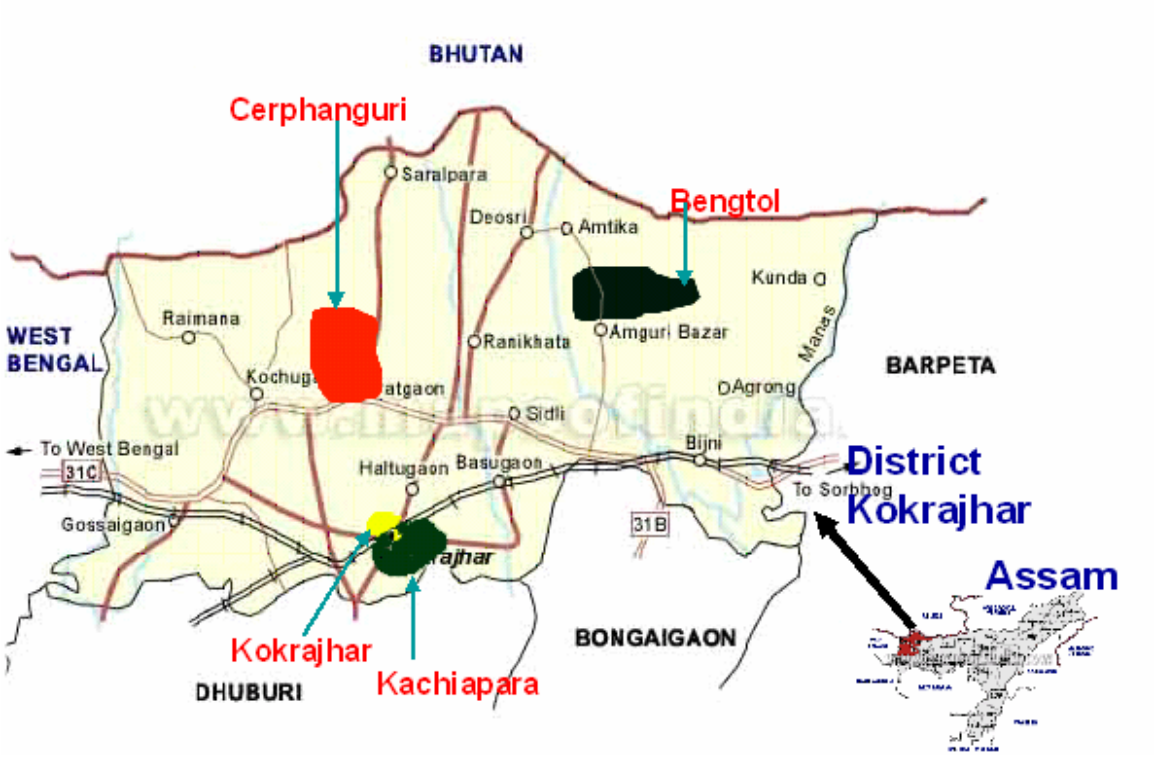


Figure 1: Map of Kokrajhar district showing the pig clusters.

In Kokrajhar district the three selected clusters were: Kachiapara, Bangtol and Cerphanguri (Figure 1). Table 1 lists the villages and markets which were surveyed. They were visited during the third week of November 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.

This report draws on the field data collected in Kokrajhar and the secondary information gathered through visits to the major R&D organizations and during the literature review. The report provides a description of the pig systems in Kokrajhar district and a preliminary analysis of the constraints to and opportunities for increasing their contribution to improving livelihoods and generating employment.

Table 1: List of surveyed clusters, villages and markets surveyed in Kokrajhar district

Clusters	Villages	Daily Markets	Weekly Markets
Kachiapara	Kachiapara		
	Bhatgaon Medhpara		
Bengtol	Bengtol No.1	Bengtol	Kajalgaon
	Dunabari		
Cerphanguri	Cerphanguri	Cerphanguri	Cerphanguri Nepal Por
	Kalbari		Gosaigaon and Chandrapur
Kokrajhar town		Kokrajhar	Kokrajhar
		Titaguri	Karigaon

1.4. Expected outputs

Based upon the plans for the appraisal drawn up prior to its implementation, the expected outputs were:

- A better understanding of current pig production and marketing systems in Kokrajhar 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 ALPCo, AHVD and the Welfare for Plain Tribes and Backward Classes (WPT&BC) department 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 Kokrajhar'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 Kokrajhar report and the equivalent ones for Dhemaji, Golaghat, Karbi Anglong and Kamrup districts (Deka *et al.*, 2007).

2. Historical and demographic overview

2.1. Kokrajhar and its people

Kokrajhar as a district of Assam came into being on 1 July 1983 with its headquarters at Kokrajhar town. Kokrajhar was originally a part of the undivided Goalpara district. In 1989, there was further reorganization of the districts in which a part of Kokrajhar district was carved out for inclusion in the new district called Bongaigaon. In 2005, the district was divided into Kokrajhar and Chirang districts. However, for the current study the undivided Kokrajhar district (its pre-2005 status) is considered mainly because of the availability of secondary information in that status.

The district is located in the extreme northwestern part of Assam. It is the entry point to all of NE India. The district shares its boundary with Dhubri, Bongaigaon and Barpeta districts of Assam, the Indian state of West Bengal and the Himalayan Kingdom of Bhutan. It lies roughly between 89.46°E to 90.38°E longitude and 26.19°N to 26.54°N latitude. The district currently belongs to the BTC, an autonomous administrative body created for local administration of Kokrajhar, Chirrang, Baska and Udalguri districts of Assam that are mostly dominated by Bodo community.

As per the 2001 decadal population census, Kokrajhar's population was about 0.90 million[2], less than the total population of Guwahati, the state capital. Less than 10% of the population lives in urban areas. There are four urban centres: Kokrajhar, Basugaon, Gosaigaon and Salakati (Figure 1). Kokrajhar's population is about 30,000 while that of each of the other centres is less than 15,000. Kajalgaon area is also growing quickly as an urban centre it was declared the district headquarters of the newly-formed Chirrang district. The district is thinly populated with a density of 256 people per square km, in contrast to the state average of 340. Table 2 presents descriptive statistics of the district's social structure, infrastructure and some indicators of its development relative to other districts in Assam.

[2] Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Government of Assam

Table 2: Some key statistics for Kokrajhar district

Particulars	Kokrajhar	Assam
No. of villages	951	26312
No. of towns	4	125
Total households	168619	4,914,823
Population density (per sq. km)	256	340
Sex ratio (female per 1000 males)	943	935
Decadal population growth (1991-2001) %	12	18.9
Literacy rate (%)	51.63	63.3
Road length per '00 sq. km of geog. area	30.3	47.8
Percentage of village electrified	89	77
Population per hospital/dispensary/PHC	19690	30,359
Heads of cattle per veterinary hospital, dispensary or mobile dispensary	15,703	17,614
Per capita Gross District Domestic Product at current price (2000-01) (Rs.)	11081	11,937
Human Development Indicator[3](state)	0.354 (Rank 15 in Assam)	0.407
Income Index	0.145 (Rank 14)	0.286
Education Index	0.474 (Rank 22)	0.595
Health Index	0.443 (Rank 9)	0.343
Human Poverty Index	31.51 (Rank 4)	23.24

Sources: Statistical Hand Book (2005); Department of Economics and Statistics and Human Development Report (2003)

In respect of religion groupings, the majority of Kokrajhar's people are Hindus (66%) followed by Muslim (20%) and Christian (14%). The ST community is 34% of the district population in contrast to the state average of 12%. It is the fourth highest tribal-dominated district in the state after North Cachar Hills, Karbi Anglong and Dhemaji and is home to many tribes including Bodos, Adivasis (Santhal) and Rabhas. There are also people from Rajbongshi, Yogi, Nepali, Bengalee and Assamese-speaking general community. Bodo is the largest tribe followed by Adibasi. Bodo people reside predominantly throughout the district, while the Adibasi people reside on northern side

[3]Assam Human Development Report (2003)

of National Highway 31, especially in Gossaigaon sub-division. The Rajbongshi people are reported to be concentrated in Kachiapara, Balagaon, Gosaigaon and Shakti Ashram area. There are also areas where Jogi people reside that include Gendra Bill, Bhutiapara and Fakiragram. Naigaon and Magur Mari areas are predominantly inhabited by Rabha people. In all the urban centres there is a mixture of the different communities, especially Bengali, Assamese-speaking general community and Bodo.

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
Kokrajhar	313	145	87	2	168	56
(%)			28	1	54	17
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
Karbi Anglong	1033	181	123	**	314	596
(%)			12		30	58
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. Total cropped area is not calculated under the total area.

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

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

The district covers 3538 square km[4] which is only about 4.5% of the state. More than half (about 52%) of the geographical area is covered by forest, the highest amongst the districts of Assam (Table 3). Total net sown area is about 28% and the remainder includes land not available for cultivation, other uncultivable land and fallow land.

[4] Handbook of Agricultural Statistics, 2005-06, Directorate of Agriculture, Government of Assam

Topographically, the district can be divided into two parts: flat plain in the southern part and small ranges of low hills in the northern part at the foothills of the Himalayan Kingdom Bhutan (http://industriesassam.nic.in/kokrajhar.doc). While the southern part is alluvial flat plain, the northern part is dry. Rivers such as Ai, Gaurang, Champabati, Sarlabhanga, Sankosh and few others that originate from the Bhutan hills run throughout the district and cause heavy floods in the low-lying plain valleys during the monsoon.

The climate of the district is moderate in winter and hot in summer. The average temperature in the district ranges from 9°C to 32°C throughout the year. Heavy rainfall and high temperatures cause high-humidity climate in the district. The Assam Human Development Report (2003) shows Kokrajhar as having the fourth highest HPI. The districts with higher poverty indices than Kokrajhar are Karbi Anglong, Karimganj and Dhubri (Table 2).

2.2. Rural economics and the role of pigs

In the absence of any major urban centre in Kokrajhar, the district's economy can be characterized as a rice-based rural economy. Smallholder farm households form the majority of the rural population. As well as their main crop paddy (rice), they cultivate other cereals, pulses, oilseeds, fibre crops and vegetables. Livestock, fishing, non-agricultural enterprises (especially petty trading) and day wage labour serve as supplementary sources of income for these farming families.

Operational holdings are small and fragmented with about 63% of the farm families in the marginal group[5] (farm sizes of less than 1 ha), 21% on small holdings (1 to 2 ha) and 16% on large farms (over 2 ha) (Table 4). Farmers in the marginal group hardly meet their household year-round requirements for paddy. Paddy cultivation occupies approximately 61% of total cropped area. There are three types of paddy: *sali* (winter rice), *ahu* (autumn rice) and *boro* (summer rice). *Sali* is the major type of paddy (61%) followed by *ahu* (30%) and *boro* (9%). In Kokrajhar, the paddy yield of 1231 kg/ha is less than that in many other districts of the state. The state average yield is 1476 kg/ha. Kokrajhar's low yield is possibly because of limited use of irrigation and fertilizer. Use of high-yielding variety rice seed is reported to be higher in Kokrajhar (32% of land

[5] Handbook of Agricultural Statistics, 2005-06, Directorate of Agriculture, Government of Assam

under paddy) than in some other districts of the state. Only about 13% of the net cropped area is irrigated, mainly by shallow tube wells and diverting the streams flowing through plain valleys to cropland.

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

District	Marginal	Small	Large	Total
Kokrajhar	59.5	19.7	14.6	93.8
(%)	63	21	16	
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	
Karbi Anglong	16.0	20.8	16.4	53.2
(%)	30	39	31	
Assam	1669.3	561.0	452.7	2683.0
(%)	62	21	17	

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

Apart from paddy, other significant crops are black gram, lentil, nizer, sesamum, jute, mesta and tapioca. Kokrajhar is the highest producer of tapioca, producing about 37% of Assam's total production. Like Karbi Anglong and North Cachar Hills districts, Kokrajhar produces considerable quantities of maize (598 tons). Jack fruit, banana, papaya and pineapple are notable amongst the fruits grown in the district. Potatoes, tomatoes and cabbages are also grown in the backyard of majority of households. These homestead crops and vegetables not only meet household consumption needs, but also generate cash and partly serve as feeds for pigs.

Crop agriculture, livestock and poultry rearing and forestry are integral to the livelihoods of these farm families. Whereas it is more common for general community farmers to rear cattle, goats and poultry, the tribal communities prefer to rear pigs and poultry (mostly chicken). Buffalo rearing is also a popular livestock activity amongst the Muslim community. Except for a small number of dairies with crossbred cattle

(managed by the Nepali community), the majority of the livestock (including pigs) and poultry are indigenous breeds or their crosses managed using traditional practices. Common property resources like hillsides, forestlands, 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, piggery requires only a low level of investment. Feed for the pigs come mainly from the by-products of paddy and other crops and from common property resources (CPR). Pigs, therefore, serve to convert existing resources into high-value animal-source food for sale. As with other livestock, keeping pigs helps both rural and urban households to diversify their risks and improve livelihood security (Table 5). Pig keeping also serves as a source of cash at times of need, for example, when farm households need cash to repair their houses, to take land on lease, to pay school fees or to meet their day-to-day household expenses. Apart from pig rearing, a small section of people are also engaged in selling pork, slaughter pigs and piglets to earn their livelihoods. Unlike in other districts, these functions of income generation and diversifying risk are utilized by significant numbers of urban households (Table 5), possibly because most of the urban population is from the general community, especially Bengali.

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

Source: 17th livestock census (2003)

In addition to the farming households, many rural dwellers work either full- or part-time as farm labourers. About 23% of all workers are labourers on farms. Apart from agricultural labourers, some people engage in wage labour, carpentry, transport

operation, mechanics and petty trading in small temporary retail shops (i.e. selling of fire wood, beetle nuts, rice, country liquor, vegetables and fruits). In the study area, the rate of female participation in activities like vegetable selling and piglet trading was found to be high. In common with Karbi Anglong and Dhemaji districts, Kokrajhar is not industrially developed and therefore, unlike in Kamrup, the employment rate in the manufacturing and service sectors is low (about 11%). Long years of Bodo movement and other socio-political disturbances, including ethnic violence and terrorism, are likely to have contributed to the poor growth of the secondary sector, despite the district's geographically advantageous position as the entry point to the NE region. But of late, with the formation of BTC and laying down of arms by several militant groups, normalcy is coming back to the district.

Of Kokrajhar's total population, only about 1% engages in weaving; for a little above half it is a part-time occupation. Women weave their own *dokhanas* (a tradition dress of Bodo women) and shawls in handlooms. Some of them even weave traditional dresses for sale. Only about 5% of rural households are involved in sericulture. Of the three sericulture activities, only *eri* is predominant; the other two (*muga* and *mulberry*) are not very common.

In the absence of significant manufacturing units, the secondary sector contributes only 12% of the total Gross District Domestic Product (GDDP)[6]; the remainder comes from the primary (33%) and tertiary (55%) sectors (for 2000-01 at current price).

In summary, Kokrajhar's rural economy is agro-based. It seems that for the 34% of the population that is tribal, piggery is an integral part of their 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). It was also not obvious whether the importance of piggery for tribals is increasing or declining. Equally, it was not apparent whether there is any tendency or trend for other communities to engage in piggery as an enterprise for improving their livelihoods.

[6] Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Government of Assam

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 piggery's contribution to the livelihoods of the state's marginalized people, principally the tribal communities. Others consider factors that may change the size and structure of the pig sub-sector. These hypotheses included:

1. In Assam, piggery is invariably a small-scale backyard enterprise that is practised by tribal rather than other communities.
2. Pig production by tribals serves several livelihood objectives including generating income, accumulating capital and providing a low-cost source of meat.
3. Current systems of pig production depend upon 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.
4. Traditional management practices continue to dominate production systems with the exception that indigenous pigs have largely been replaced by crossbreeds.
5. 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.
6. 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 and children of the household.
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, the consumption of pork has traditionally been associated with tribal communities but with changing food habits, consumption of pork is picking up amongst other communities as well.
10. If demand for pork increases, it is expected that production will shift from small-scale rural backyard enterprises to larger-scale peri-urban units using purchased

inputs (particularly feed), i.e. traditional rural production will not be competitive 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 high-grade exotic crossbreds 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.

In addition to the hypotheses listed above, it was expected that others would result from the findings of the field surveys and related discussions.

3. Marketing of pigs and consumption of pork

As elsewhere in NE India, 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 (Others in Table 6). The average per capita consumption of pork is lower in both rural and urban Assam than in the neighbouring states of Meghalaya and Nagaland, reflecting the lower proportion of ST people in Assam relative to the other two states (Table 6). In the same way, 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 the figures are over 30% for both rural and urban households.

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)

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)

The NSSO data also illustrate the wide variation in pork consumption amongst the districts surveyed in this study (Table 7) with Dhemaji district, which has a high proportion of tribal people living outside the district capital, having the highest

consumption level of pork. Kokrajhar also has many tribal people (over 30%) and non-tribals who consume pork so, at least for Kokrajhar, the NSSO statistics in Table 7 do not reflect field reality. It was against this background that the field surveys examined the current marketing of pigs and consumption of pork.

3.1. Projections of demand and supply of pork

Information from the field survey, supported by the data from secondary sources, showed that the district was self-sufficient in slaughter pig production. Surplus pigs (about 500 per annum) were bought by traders from Meghalaya state. In addition, about 200 tonnes of pork per annum were sold to the neighbouring Himalayan Kingdom of Bhutan. In contrast to the information from our field survey, district key informants mentioned that the district was deficient in slaughter pig production. However, pork retailers, pork and live-pig wholesalers and pig producers consistently indicated that current local demand for pork was being fully met by supplies from within Kokrajhar. Similar to Dhemaji district, pork retailers neither have to travel long distances (beyond 10 km) in search of slaughter pigs nor close their businesses for want of pigs.

Table 8 aggregates the quantities of pork sold at the different daily and weekly markets in the district based on the information gathered from the various markets and from key informants for the markets in other areas of Kokrajhar. From this information, it is estimated that the total volume of pork traded in Kokrajhar district is about 36,300 kg weekly or 5186 kg per day. This is less than in Kamrup (7100 kg/day) and Karbi Anglong (7900 kg/day) districts, reflecting Kokrajhar's lower per capita consumption.

Pork retailers who were interviewed in Kokrajhar, Gosaigaon, Cerphanguri, Kajalgaon and other surveyed markets, said that the demand for pork had increased, but only slowly, over the last 10 years, possibly because of the breaking down of the household economy of many tribal households during the Bodo movement and ethnic violence. However, they anticipated that demand would increase more quickly during the next few years because of current favourable socio-political environment and growing economy in the district. Pork retailers reported that in the last 10 to 15 years the average consumption of pork per household decreased from between 0.75 and 1.5 kg to between 0.25 and 1 kg. Consumers who now purchase Rs. 20 to 30 worth of pork

(300 to 400 gm) spent the same amount before but received more pork due to lower prices, suggesting reduced purchasing power. For some households, especially of the Adibasi community, pork consumption is even considered a matter of pride, but as they hardly consume pork even once in a month because of extreme poverty, they will generally only afford to purchase pork when a special guest visits their house.

Table 8: Quantity of pork sold in markets in Kokrajhar district, November 2006

Markets	Daily markets (kg)	Weekly markets (kg)	Weekly total (kg)
Kajalgaon	300	1200	3300
Kokrajhar (bi-weekly market)	400	1200	4000
Titaguri	150		1050
Gosaigaon	300	1000	3100
Bangtol	150		1050
Cherphanguri	100	500	1200
Chandrapur	100		700
Karigaon	75	500	1025
Three other weekly markets like Kajalgaon	900	4500	10,800
Three other markets like Karigaon	225	1500	3075
Ten other daily markets like Chandrapur	1000		7000
Total			36,300

Source: key informants during market survey

Due to the poor growth of pork consumption in the district, the overcrowding of pork retailers observed in the other surveyed districts was not reported. However, the presence of occasional pork retailers (mainly pig producers-cum-sellers) was commonly observed in the daily and weekly markets, reflecting the increasing role of direct sale of pork by pig producers in Kokrajhar. In the estimates shown in Table 8, the quantity of pork available in the markets includes this share traded by occasional pork retailers and, therefore, it is not shown separately as was done for the other surveyed districts.

Based on the current availability of pork in daily and weekly markets and an estimated human population in 2006 of 0.99 million, the per capita consumption in Kokrajhar

district is estimated at 1.90 kg per annum. On the other hand, the AHVD statistics for 2005-06 report that the total annual production of pork in the district is about 0.56 million kg; this gives a per capita consumption of about 0.57 kg per annum that is 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 of pork as 40 kg per pig. Further, it is interesting to note that despite the presence of about 34% of traditional pork-consuming ST people in Kokrajhar, the per consumption in the district is indicated as nil in the NSSO round of 1999-2000; this is obviously not consistent with field reality.

As reported in the other surveyed districts, non-traditional pork-consuming other-than-ST communities (Rajbongshi, Yogi, Assamese-speaking general community and some other communities) were now regularly consuming pork and their numbers were increasing, perhaps because of the prevailing food habits in the district and the easy access to pork. Only the Bihari, Bengali, Marowari and Muslim communities generally do not consume pork, and they do not exceed 20% of the total population. In light of the above, it can be presumed that the percentage of pork-consuming other-than-ST households in Kokrajhar is above 50%.

Therefore, it is estimated that total requirement of pork by 2010 will be 2.26 million kg with a per capita consumption of about 2.14 kg based on the following projections and estimates:

i. a projected 66,274 pork-consuming households (ST) in 2010 and a current consumption of 0.50 kg/household thrice a month (market source),
ii. 50% of the "other-than-ST" community are estimated to currently consume 0.5 kg of pork twice a month,
iii. about 60% of the "other-than-ST" community will begin to consume pork by 2010,
iv. about 5% of total pork consumption in hotels, restaurants, wine shops and markets
v. a 10% increase in pork consumption between 2006 and 2010 among existing consumers (based on the increased trend of consumption as reported by market agents)

Assuming a carcass yield of 40 kg per pig, 56,000 slaughter pigs will be required in 2010 to meet this increased demand for pork. This is 19% higher than the current estimate of 47,000 pigs. Table 9 presents these calculations.

Table 9: Projection of demand for and supply of pork in Kokrajhar district, 2006 to 2010

Particulars	2006		2010	
Projected population	995,000		1,057,000	
ST population (33.67%)	335,016		355,891	
ST households (av. size 5.37)	62,386		66,274	
Pork requirement @ 0.5 kg per household thrice a month		1,122,948		1,192,932
Increment among existing consumers (2006-10)			10%	112,294
Other-than-ST households eating pork (50%)	61451		65280	
Pork requirement @ 0.5 kg twice a month		671,160		783,360
Increment (2006-10)			10%	67,116
Total pork requirement (kg)		1,794,108		2,155,702
Pork consumption in hotels, restaurant wine shop, market etc.	5% of household consumption	89,705		107,785
		1,883,813		2,263,487
Current availability as per market survey (kg)		1,892,890		
Difference in estimation		9077		
Pig requirement (40 kg av. yield/pig)		47,322		56,587
Projected pig population (based on growth trend during1997-03 @ 1.41%)		106,376		112,504
Slaughter pig (45% of total pig pop.)		47,869		50,626
Surplus/deficit of slaughter pig		547		-5961
Say total surplus/deficit pig		500		-6000

The latest livestock census (2003) of Kokrajhar district reported that the pig population was 0.1 million. This gives a pig:person ratio in the district of 11:100, which is much higher than the state average of 5:100. Government statistics suggest that from 1997 to 2003 Kokrajhar's pig population has been growing at an average rate of 1.41% per annum, much lower than the state average of 4.66%. This slower growth rate is possibly because of the sizeable losses of pigs during ethnic violence and the subsequent abandonment of pig rearing by some of the ethnic groups. With the current trend of growth, Kokrajhar's pig population will increase to 0.11 million by 2010. At that rate, there will be a deficit of 6000 slaughter pigs in Kokrajhar by 2010, unless the numbers of pig producers, the herd sizes or the productivity increase to meet the likely increased demand for slaughter pigs from within and outside the district.

3.2. Current supply chain of pigs and pig meat

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

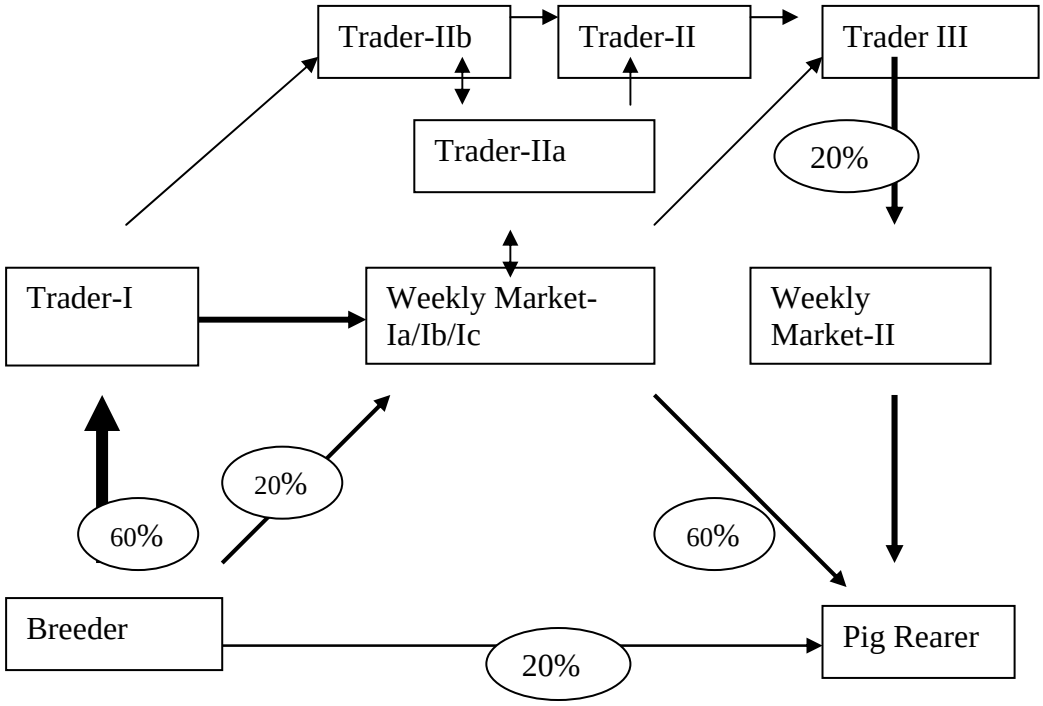
Kokrajhar's output market has three principal products: weaner piglets, slaughter pigs and fresh pork. Weaner piglets are the first product in the production supply chain.

Piglets are produced in pig units, which keep breeding sows. In Kokrajhar, almost all these units were small-scale backyard enterprises, some of which also reared piglets for slaughter. Piglets were marketed in one of several ways (Figure 2), the simplest of which was direct sale by breeders to pig rearers. These transactions were generally within a village or with a nearby village for piglets of known quality from reputed breeding units[7]. On many occasions, breeders also visited the markets to sell their own piglets; the proportion of piglets sold directly by breeders was about 40% of the total sold.

Relative to breeder-to-rearer sales, many more piglets were sold to traders (Traders-I), especially women, who visited villages looking for piglets to procure (Figure 2). The traders transported the piglets to their homes by bicycle, auto van or public bus. There the piglets were kept in a stocking yard until the following weekly market where they were offered for sale. Unsold piglets (30 to 50%) were taken home for sale at another

[7] 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.

market (Weekly market Ia/Ib/Ic) on another day. The percentage of unsold piglets was reported to be higher in the weekly markets (cases reported in Cherphanguri and Gosaigaon market) where visiting traders from other districts were fewer. There were almost no unsold piglets in Kajalgaon market, possible because of the higher demand for piglets from visiting traders (Trader-III, locally called *Pikaries*) from Goalpara, Kamrup and Darrang districts of Assam and the neighbouring state of Meghalaya. Within the market there was a group of intermediate traders (Trader IIa/IIb) who were actively involved in purchasing and selling of piglets from one trader to another, thereby generating a good profit with little investment or effort.



Traders-I: Procure piglets from local breeders to sell in local village weekly markets and/or to visiting traders from outside the district

Traders-II/IIa/IIb: Local traders who procure piglets from the Trader-I/breeder and sell them to other local traders (IIb/IIc)/local pig rearers/ visiting traders from other districts (Trader-III)

Traders-III: Traders from other districts who procure piglets from Trader II/ weekly market/breeder and sell them in their respective markets of the district/state

Market-I: Weekly market of Kokrajhar district

Market-II: Weekly market of other districts

Figure 2: Supply chain for piglet marketing in Kokrajhar district

As mentioned above, visiting traders from neighbouring districts and states visited markets of Kokrajhar in groups of 8 to 10 traders, procured 10 to 20 piglets each from

the breeder/Trader-I/II and transported the piglets collectively by mini truck or multi-utility vehicle to their respective homes. In this way, they reduced the costs of transport and "hidden" expenses. On talking to the visiting traders, it was learnt that due to predominance of local tribal women in the piglet business (Trader I/II), visiting male traders could not get the upper hand in the bargaining process or when procuring piglets directly from breeders. Other major problems encountered by piglet traders were inadequate finance (working capital) to run the business, diseases of piglets and the poor demand in some of the markets. Long distances from the place of procurement to markets and high transport costs were also reported as the other constraints in marketing of piglets. The estimated numbers of piglets brought for sale in each weekly market is given in Table 10.

Table 10: Estimated number of piglets traded in the surveyed weekly markets

Weekly markets for piglets	Estimated numbers of piglets traded
Kajalgaon (Sunday)	400
Kokrajhar (Sunday)	50
Karigaon (Saturday)	50
Serphanguri (Monday)	100
Gosaigaon (Saturday)	200
Total	800

Source: key informants during market and field surveys

Figure 3 presents a summary of the costs that were reported in Kokrajhar for the supply chain for piglets. For comparative purposes, the figures include the results from the other four surveyed districts. In Kokrajhar, as in Dhemaji and Golaghat, middlemen played key roles in the supply chain. Transport was the other important cost. An estimated 240 piglet traders served Kokrajhar and the net daily profit per trader was approximately Rs. 120. Given that in Kokrajhar on average 77% 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 fatteners in the district.

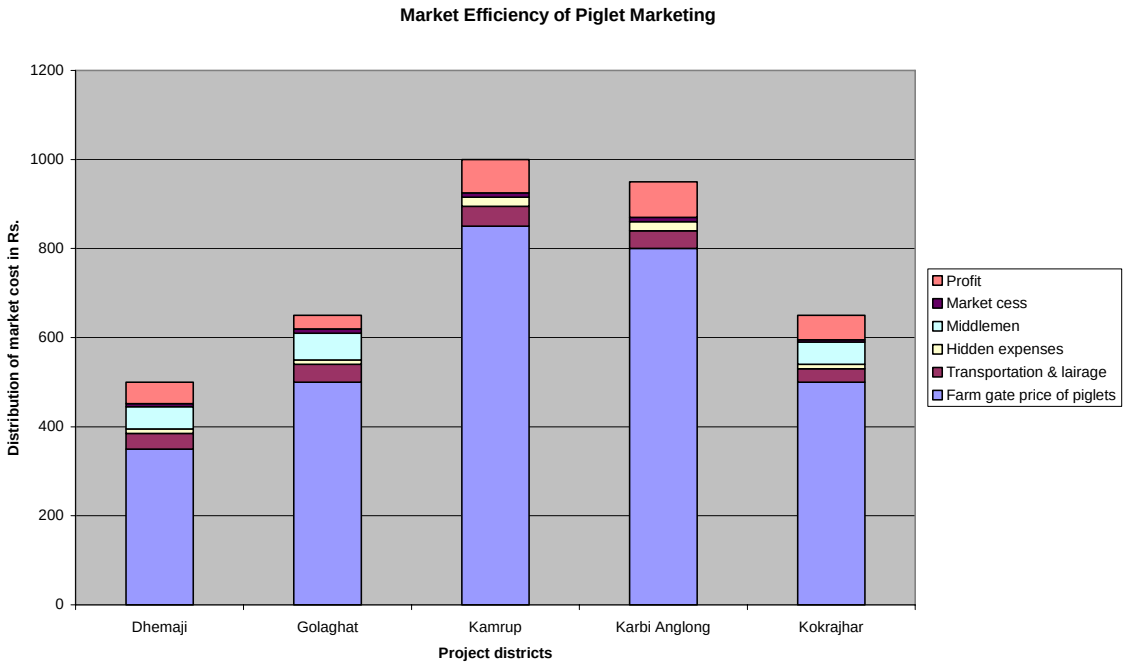


Figure 3: Marketing costs for piglets in Kokrajhar and the other four surveyed districts.

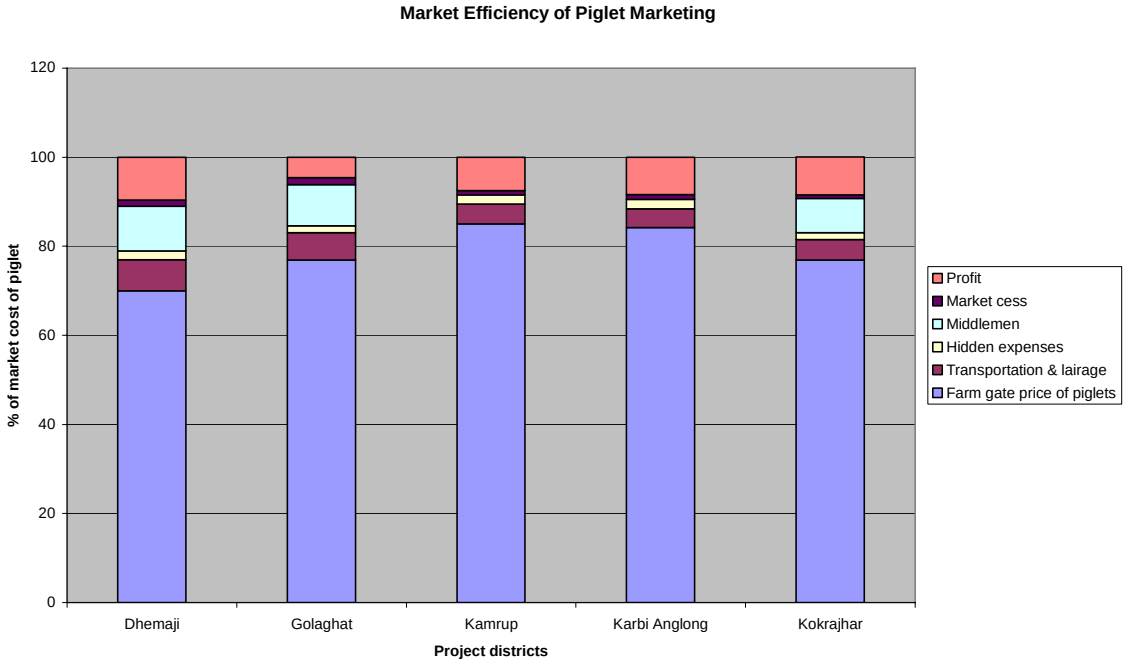


Figure 4: Relative marketing costs for piglets in Kokrajhar and the other four surveyed districts.

Supply chain for slaughter pig and pork marketing

The supply chain for slaughter pigs in Kokrajhar district is presented in Figure 5. Unlike in the other surveyed districts, more producers (30%) slaughter their own pigs and sell the pork in the market, especially in the weekly markets. When interviewed, the pork retailers-cum-producers reported that selling of pork was not always very remunerative because on some occasions they sold pork on credit or bartered it with neighbours/villagers. Even then, they preferred to sell their own pork because by doing so they could immediately dispose of their animals when facing acute financial crises and consume some of the pork (legs, heads, offal etc.) which they otherwise would not afford. In many instances, these occasional pork sellers sold pork at prices much lower than the prevailing market price, forcing the regular pork retailers to sell at a lower price. As a result, these producer-retailers are key actors in the pork market and because their number on any market day is unpredictable, there is considerable fluctuation in the market price of pork. This was also the case in Kajalgaon and Karigaon weekly markets where unsold meat was not taken home by the occasional pork sellers. Rather, they cooked the meat in the market and sold it as pork curry at Rs. 6 per 100 g.

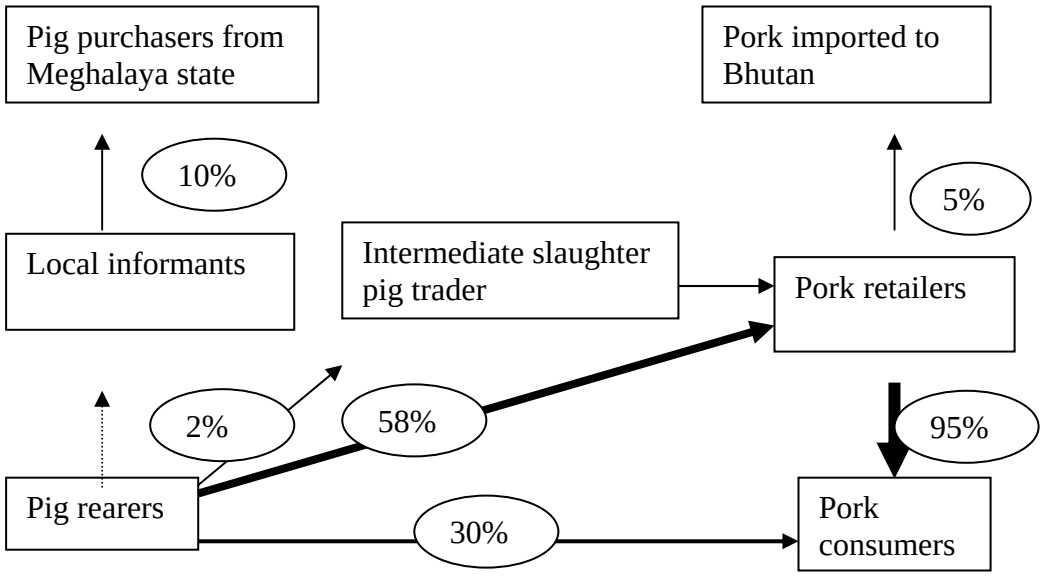


Figure 5: Supply chain for slaughter pig and pork marketing in Kokrajhar district.

Despite direct sales of pork to consumers, about 60% of slaughter pigs are sold by producers to pork retailers (Figure 5). Local retailers visit villages to procure fatteners (slaughter pigs) having received information about their availability from the producers.

The pork retailers reported that if they found sufficient pigs in the villages, they procured their required number of pigs on that very day and paid an advance (Rs. 100 to 1000 per pig) for remaining pigs. These pigs were procured later as per their requirements. Both parties (producers and pork retailers) honoured the verbal agreement irrespective of the advanced amount. But pork retailers did not pay any advance or extend any other assistance during the rearing period, possibly because of the risk of death or loss of pigs during rearing. Traders in Karigaon market reported that on many occasions they paid only half of the price of pig on the day of procurement, while the remaining half was paid after sale of the pork. Otherwise, they generally take loans from local moneylenders at Rs. 20 per Rs. 1000 per day. Pork retailers and piglet traders reported that due to shortage of cash and the absence of a formal money-lending agency, they often depended on local money-lenders; this reflects the need for short-term credit to the retailers/traders.

In order to procure and slaughter the pigs and sell the meat, pork retailers generally did not operate their businesses single-handedly. Rather, three to four people ran the business as a 'party'. One or two people moved about the villages to procure pigs while the others slaughtered the pigs and sold the pork. The purchase price of a pig is fixed, based on the expected weight of pork (about Rs. 60 per kg). Thus, a pig expected to yield about 50 kg of pork costs about Rs. 3000. Procured pigs were transported to the market by bicycle or pulling cart over a distance of 1 to 10 km. Due to the absence of facilities for slaughtering pigs in the market, many traders slaughtered the pigs in their home premises and carried the carcasses to the market.

In Titaguri daily market, there was an intermediate group of traders (Trader-I) between the producers and the pork retailers. Traders-I procured pigs from the producers and sold them to the pork retailers in the market. Pork retailers opined that procurement of pork from Traders-I was less remunerative due to the higher price. Income obtained from selling the heads, legs and offal was the only real profit. Pork retailers available in Titaguri also sold some pork to bulk purchasers (pork sellers-II) from Kokrajhar town. The sale price was Rs. 70 per kg at Titaguri and other rural markets and Rs. 80 per kg in Kokrajhar town.

It was reported that Meghalaya pig traders procured pigs from Kokrajhar district with the help of local market agents. Because of presence of the Meghalaya traders, the

price of slaughter pigs had increased significantly over the last few years as they offer higher prices (Rs. 300 to 500 per pig) than local pork retailers. Therefore, on many occasions local pork retailers had to compete with the Meghalaya traders, which made their businesses less remunerative because the price of pork was lower in Kokrajhar (Rs. 70 to 80 kg) than in Meghalaya (Rs. 100 to 120 per kg). Some incidences of conflict between local pork retailers and Meghalaya traders were also reported.

It was learnt from the pork retailers and market informants that in the Dadgari border (Sunday weekly) market some 400 to 500 kg of pork per weekly market was sold to traders from Bhutan. They procured pig carcasses in bulk from local (Indian) pork retailers paying in Bhutainee currency (one Bhutainee currency is equivalent to Indian Rs. 0.70). This export market has grown over the years and more pork retailers from both sides of the border are targeting the market to procure and sell pork. Indian pork sellers exchange the Bhutainee currency in the nearby wine shop or at the restaurant in the market. It was said that in border areas, Bhutainee currency is accepted by Indian citizens.

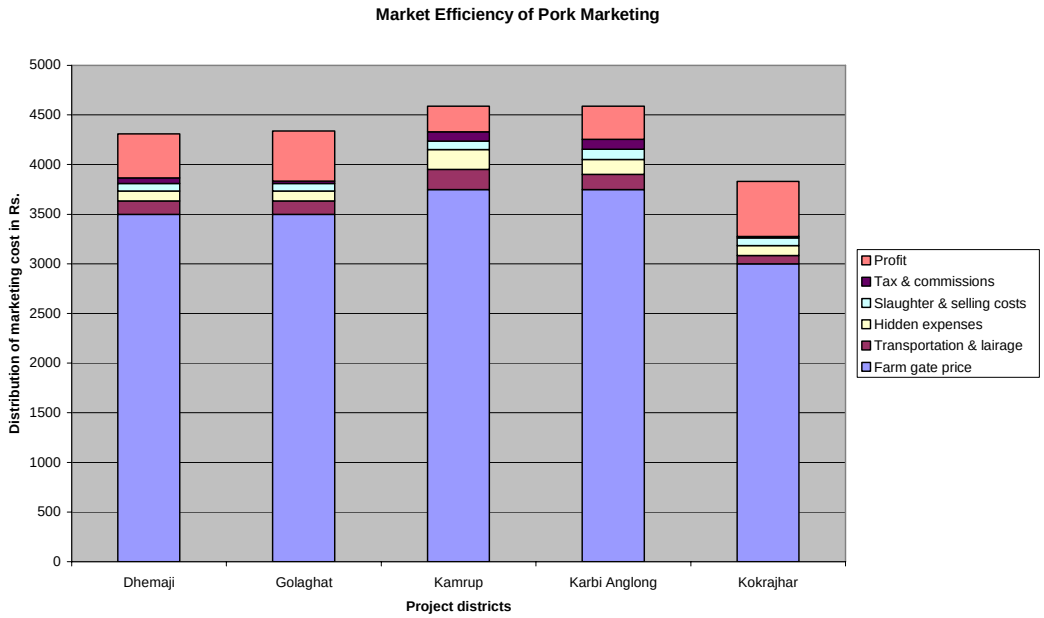


Figure 6: Marketing costs for pork in Kokrajhar and the other four surveyed districts.

Figure 6 presents a summary of the costs that were reported in Kokrajhar 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 comparative purposes. It can be seen that 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. 120 and that that there were approximately 260 pork traders in Kokrajhar. That estimate, together with the 78% of pork retail value that is paid to the pig producer (Figure 7), suggests that the market chain efficiently serves the producers, traders and consumers in the district.

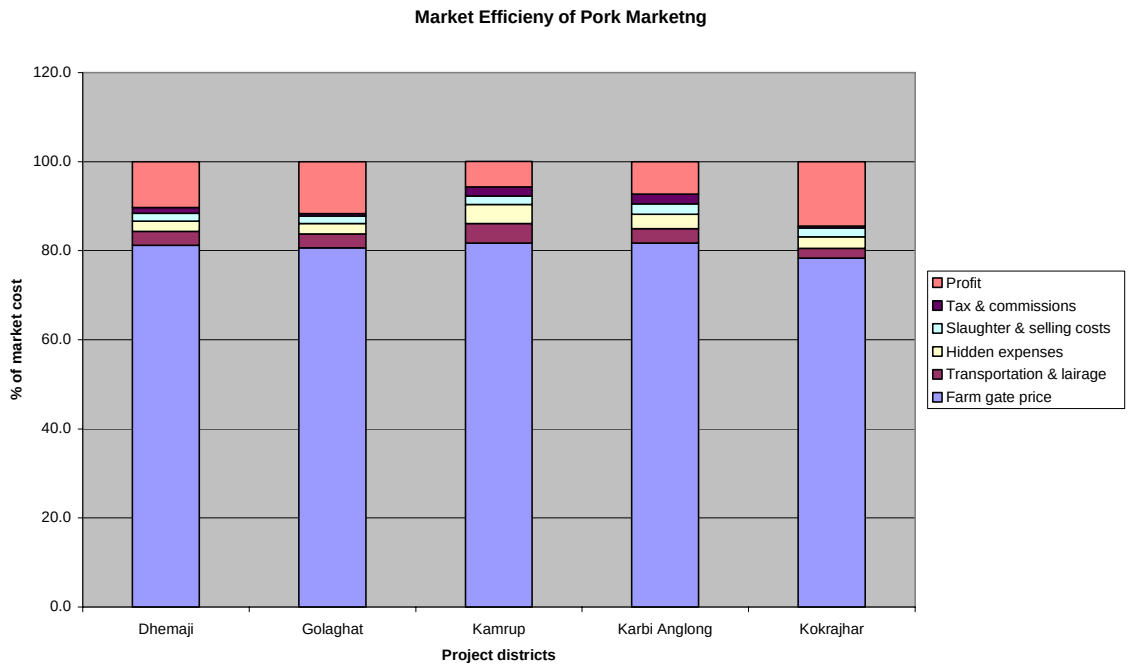


Figure 7: Relative marketing costs for pork in Kokrajhar and the other four surveyed districts.

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

The major inputs for pig production are piglets, labour, feed and veterinary supplies. In Kokrajhar, while some piglets are procured directly from breeders, most are bought through the weekly village markets (section 3.2.1). Relative to these large numbers of piglets, the supply from public-sector sources (government breeding farm) is negligible; only 12 piglets were supplied in 2006. Prices of piglets vary depending on breed, age, sex, growth performance and source. Live weight for age has a strong bearing on the price of the piglets. Kokrajhar pig keepers mostly prefer Large Black crosses (locally called "Australian") and Ghungroo crossbred pigs (locally called "Nepali"). They are preferred because of their black colour, faster growth and larger litter size; the Large White Yorkshire and Hampshire breeds are less popular. These preferences were common to all sections of producers in all the surveyed markets. In the markets male piglets fetched higher prices (Rs. 100 to 300) than female piglets possibly because of

higher growth performance (as perceived by market agents, *Mahaldar* and producers), higher demand for male slaughter pigs, higher dressing percentage and convenience of rearing (castrated males are easier to rear because of their calm and quiet nature).

Season greatly influences the price and availability of piglets, which 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 surveyed markets of Karigaon, Kokrajhar, Gossaigaon and Kajalgaon, prices of piglets varied from Rs. 300 to 900 depending on the variables mentioned above. In each weekly market, sellers paid Rs. 5 to 10 per piglet to the market committee or lessee as a market cess.

In Kokrajhar, as elsewhere in Assam, pig production is mainly based on family labour and feeds gathered or produced by the household. Purchases of feeds, apart from some crop and milling by-products, are not frequent. Except for a few small-scale commercial units and the government pig farm, 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. Unlike in Kamrup and Karbi Anglong districts, different qualities of rice polish (Nos. I and II) were not reported and the price of rice polish was the same irrespective of quality. However, seasonal scarcity of rice polish was reported. Its price is generally higher in July to October (Rs. 4 to 5 per kg) than in other months (Rs. 2.50 to 3) when the old stock of paddy is exhausted and the new crop has not yet been harvested. 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 10 per tin of 5 kg rice. The women in farming families that keep pigs are generally active in procuring piglets and feed.

In respect of veterinary supplies, Kokrajhar town had a private veterinary clinic but there was none reported in other surveyed areas. In these areas, veterinary medicines are sold in clinics that sell human medicines. Pig keepers travel long distances from remote rural areas to procure medicine from these private veterinary clinics or dispensaries.

3.3. Pig meat consumption and preferences

Marketed non-vegetarian food in Kokrajhar mainly comprises of pork, chevon, chicken, fish and eggs (milk and dairy products are classed as vegetarian food). Since about a third of people living in Kokrajhar are from the ST community, the demand for pork is presumed to be higher with that of chevon. Bengali, Assamese and Rajbongshi community generally prefer chevon to pork. Preference towards beef is only in the Christian and Muslim dominated areas of the district. People who cannot afford to buy chevon or pork catch fish in nearby ponds or marshy land. Tribal people (especially Adibasi community) who used to hunt wild animals and birds for consumption have now abandoned the practice because of the reduced number of wild animals and birds and changes in their lifestyle. Information from our interviews suggested that all tribal people consume pork, irrespective of age, sex or education level. At the same time, it was reported that the food habits of the general community people, especially the younger generation, were gradually changing such that demand for pork was increasing in the district.

Consumers prefer fresh pork. Preference for fat or lean meat varies depending on individual choice (mostly guided by age and health status of the individual and taste of the particular portion of pork as perceived by consumers). However, it was reported that equal quantities of fat and lean meat were sold and there was no price difference. Tribal people mostly prefer lean meat. The price of pork from indigenous pigs (which have less fat) is higher (Rs. 90 per kg) than pork from crossbred pigs (Rs. 70 to 80 per kg). To convince consumers of its origin, pork retailers generally display the head of indigenous pigs (with erect ears) in front of the pork outlets. Some poor people also consume the feet, head and offal, which are sold at Rs. 30 to 40 per kg.

The demand for pork was higher during winter months. Pork consumption was high during festivals like New Year's Day, *Magh Bihu* (the agriculture-based festival of the Assamese community), *Dewali* (festival of light), *Bathou puja* (a religious festival of the Bodo community), *Holi* (the festival of colour of the Hindu society) and Christmas. Demand for pork was higher on the weekly market day in rural areas, possibly because of easy access to the market. The price of pork usually did not vary by season because it was controlled by the market committees. However, once the price increased, often

during the festival season, it generally remained at that level for at least another year. The price of pork in rural and urban markets rose moderately from Rs. 50 to 60 per kg five years before to Rs. 70 to 80 per kg at the time of the survey (November 2006). Preference was exclusively for fresh, warm, newly-slaughtered pork although some consumers preferred smoked pork. Consumption of frozen or processed pork was not reported in the district.

The price of pork was lower than that of chevon and indigenous chicken and similar to that of broilers. Interviewed consumers opined that though the price of pork was relatively lower, taste rather than price was the prime criterion for consumption. Among tribal people, pork was the first choice, irrespective of its price. Customers were said to be good bargainers in rural weekly markets where prices were higher at the beginning of the day and lower later in the day. Therefore, to minimize losses, retailers usually cooked the unsold pork in the market and sold it as pork curry to customers who generally eat it with country liquor that is also available in the market.

Responses during the household interviews indicated that the higher income groups spent about 24% of their total expenditure on food (excluding the food produced by the household). About 38% of food expenditure was on non-vegetarian food of which 53% was spent on pork. For lower income groups, as would be expected, almost 48% of their total expenditure was on food; 32% of food expenditure was on non-vegetarian food of which 50% was spent on pork.

From the interviews with the wide range of informants, it was concluded that in addition to the tribal communities who are the traditional consumers of pork, about 50% of non-traditional consumers in the district now eat pork. It was also concluded that the trend of pork consumption is expected to increase as a result of prevailing peace after long years of socio-political disturbance and a growing economy in BTC area; these factors have led to increased purchasing power and a growing preference for pork. Current trends suggest that the quantity and frequency of pork consumption will increase slowly among current consumers within their households 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 other-than-ST community will be a driving force behind the increased demand for pork.

Consequently, the pace of the growth of pork consumption in Kokrajhar will be relatively higher.

3.4. Food safety and human nutrition issues

One potential food safety risk associated with pigs is the infestation 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 consumption of pork. Consumers who were interviewed said that they always cook pork by boiling it for a long time in order to reduce the risk of worm infestation. Moreover, when buying pork, experienced consumers always looked for the presence of cottonseed-like follicles in the meat (measly pork) and did not buy the pork if these were present. Likewise, pork wholesalers and retailers also reported taking utmost care at the time of procuring slaughter pigs from producers. They looked for cottonseed-like follicles in the eyelids and tongue of the pigs, which is an indication of infestation with worms, and thus avoided buying infected pigs. Therefore, it appears that in Kokrajhar district, traditional cooking practices and knowledge of the disease and its manifestation greatly reduce the risks to human health from cysticercosis.

In Kokrajhar, as elsewhere in Assam and throughout the NE, there is little or no formal infrastructure for slaughtering pigs or displaying pork, especially in rural markets. Generally, pork is sold at the roadside or weekly market place displayed on a gunny bag or polythene sheet and without any measures for hygienic slaughtering or sale of the pork. Personal hygiene of pork retailers is also not given due consideration by pork retailers or consumers. Moreover, pork retailers mostly clean the offal with water from ponds, tanks or rivers which may pose health hazards to the consumers. Other serious risks to human health can arise from the practice of slaughtering diseased pigs and selling the meat to consumers. Leftover pork was also reported to be sold the following day by retailers, most of whom did not have access to refrigeration.

In respect of nutritive value, consumers are not very aware about the nutritive value of different types of meat apart from knowing about the relatively higher fat content in pork than in other meats. Thus, those who suffer from lifestyle diseases like hypertension and diabetes are reported to be less inclined to consume pork. With the

trend to consume more meat amongst most sections of both 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 Kokrajhar district.

1. Pork is the first choice of meat amongst the ST people in Kokrajhar. Consumption of pork amongst other-than-ST communities is also high; perhaps more than 50% of other-than-ST communities regularly consume pork. As a result, per capita consumption of pork is estimated at 1.9 kg/annum, double that estimated for Kamrup (0.92 kg/annum).
2. Consumption was exclusively of fresh pork, the demand for which was growing slowly in traditional and non-traditional pork-consuming households in both urban and rural areas. Some smoked pork was also eaten but there was no supply of or apparent demand for frozen or processed pork.
3. Detailed consumption studies are required to validate the preliminary projections of the increased demand for pork (presented in section 3.1).
4. Unlike in other surveyed districts, a large section of producers slaughter and sell their own pigs in the weekly markets in order to generate more income per pig. Due to the presence and unpredictable number of these occasional pork sellers in weekly markets, demand and supply may not match well in price fluctuations. To avoid the risk of unsold meat, many of these producer-retailers cook any surplus meat and sell it as pork curry.
5. Retailers indicated that pork consumption per household has decreased over the last few years, possibly because of the poor economic status of the majority of households caused by years of socio-political disturbance in the district. Households that earlier consumed 0.5 to 1.5 kg pork twice or thrice a month now consume only 0.25 to 0.75 kg pork, a reflection of declining purchasing power amongst pork consumers.
6. Kokrajhar currently produces a small surplus of slaughter pigs (about 500 per annum) and pork (about 200 tonnes) which are marketed to Meghalaya and the

Kingdom of Bhutan. With increased pressure from within and outside the district on the existing stock of pigs, the surplus may turn into a deficit within the next two to three years. There is, therefore, potential to increase Kokrajhar's production and productivity of pigs to exploit the market opportunities supported by client-oriented extension and improved input services.

7. Retail sales of pork, both in urban and rural areas, are mainly through markets that lack infrastructure for hygienic slaughter of pigs and sale of pork.
8. There is concern among consumers and pork retailers about infestation of pork by the zoonotic tapeworm *Taenia solium* (measly pork). However, this does not pose a serious threat to public health because of traditional ways of cooking pork and the traders' and pork retailers' knowledge about the disease.
9. Currently, even in Kokrajhar town, there is no routine inspection of slaughterhouses, pork retail outlets or market facilities by veterinary officers. There is also no awareness of town committee regulations for the registration and inspection of pork outlets. Inadequate coordination amongst the AHVD, town committee and police administration exacerbates the lack of supervision of public health risks associated with slaughter of livestock and sale of pork.
10. These deficiencies in public health measures should be addressed through risk analysis along the production-to-consumption value chain. A structured evaluation of the practices of pig producers, traders and pork retailers is required, and the requirements for improved infrastructure and for training in meat hygiene and food safety should be based upon consumers' needs, perceptions and willingness to pay.
11. Similar to Dhemaji district, in 2006 Kokrajhar had an estimated 27,000 piglets surplus to local needs which were sold to Goalpara, Kamrup and Darrang districts of Assam and to the neighbouring state of Meghalaya. The surplus of piglets in Kokrajhar depressed prices relative to other districts and stimulated lucrative opportunities for traders.
12. The demand for pork and piglets was higher during winter than summer. This seasonal variation influences producers to synchronize their production cycle with the market demand, thereby generating more income in winter. Demand for male piglets was higher than for females.
13. Overall 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 increasing their cost and reducing the profits for

traders. An awareness program for pig/piglet/pork traders and police officials about the legal aspects of transporting and selling pig products should address this problem.

14. Major problems encountered by piglet traders are insufficient working capital to run their businesses, diseases of piglets and poor demand in the market. Distance from the place of procurement to the markets and high transport costs were reported as other constraints to the marketing of piglets. Pork retailers also expressed the need for short-term credit to run their businesses.
15. Despite these issues, it was clear that the market/supply chain for pigs and pork was a significant and growing source of income and employment and that the majority of the 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 Kokrajhar 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: Bengtol, Kachipara and Cerphanguri (Figure 1 and Table 11). Pig production in the Bengtol area is practised by the Bodo and Adibasi (Santhal) communities, while in Kachiapara area it is a growing activity amongst the non-traditional pig-rearing Rajbongshi community, although these are fewer than 5% of all households. Bodo and Rabha are the main communities that keep pigs in the Cerphanguri area.

Local key informants at the veterinary dispensaries mentioned that in all the areas, a small section of non-traditional pig-rearing households, especially of THE Scheduled Caste (SC) and Other Backward Class (OBC) communities – Sutradhar, Mandal, Rajbongshi, Jyogi and Das – have started producing pigs. They are looking into the growing market opportunity for increased profit but are fewer than 5% of all households. In contrast to this growth of piggery in the SC and OBC communities, pig rearing amongst the Adibasi community has decreased considerably over the years, from about 90% to 50%, especially after ethnic violence, possibly because of disruption to household economies and the loss of pigs and other assets during the violence. Some households have become too poor to procure feeds for pigs and their poverty has forced them to turn to day-wage employment.

Table 11: Socio-economic and production characteristics of the pig systems of Kokrajhar district

Ethnic groups and their areas	% House-holds with pigs	Pig Pop. (%)	Livelihood Importance	Herd type	Surplus + or deficit -	Source
Bodo/Rabha : Bengtol, Cerphanguri, Kachugaon, Patgaon, Hatugaon, Basugaon, Gossaigaon Naigaon, Magur Mari,	90	80	Important	Breeding: 20% Fattening : 70% Breeding/ fattening: 10%	Fattener + Piglet +	Visiting traders/ weekly market
Adibasi (Santhal): Cerphanguri, Bengtol, Gossaigaon, Kachugaon	50	15	Important	Breeding: 10% Fattening : 80% Breeding/ fattening: 10%	Fattener + Piglet -	-do-
Rajbongshi/Jyogi/ Nepali/ Mandal Kachiapara, Gossaigaon, Shakti Ashram, Gendra Bill	5	5	Important	Breeding: 10% Fattening : 80% Breeding/ fattening: 10%	Fattener + Piglet -	-do-

Source: key informants during market and field surveys

4.2. Classification of production systems

Table 11 shows the characteristics of the pig production systems in the three clusters by ethnic group. Amongst the Bodo and Santhal communities, pig production plays an important socio-economic role. As well as pork being considered by tribal households an essential commodity for every religious and social festival, pig production is an important income-generating activity. Fattening (the purchase and feeding of pigs for slaughter) was much more common, practised by approximately 70% of pig-keeping households, than breeding or breeding and fattening (Table 11). Women are mainly responsible for the care and management of the pigs (Table 12) and the income generated was used mostly for subsistence needs. Rearing of pigs exclusively for household consumption was not reported. The interviewed families were happy with the current demand for and price of pigs. All ethnic groups in all areas considered rearing a few pigs an important livelihood source. On the other hand, only a small number of households and SHGs with so-called stall-feeding units with or without any hired labour to look after the pigs considered pig rearing as a primary source of livelihood. In the individual units, it was the man who managed the pigs, while in SHGs it was the president and secretary who had the key role in all decision making (Table 12). Amongst the poorest households, some rear pigs under a system locally called *adhiary*[8], a type of share-cropping. The majority of the interviewed households reported lack of finance as the major problem limiting pig rearing. It was reported that micro-credit systems were weak and that insurance companies were not keen to insure small-scale piggery units in the district. In summary, therefore, pig production in Kokrajhar, which was almost limited to tribal communities, can be termed a small-scale market-oriented enterprise.

As elsewhere in Assam and the NE, the pig management systems in Kokrajhar district can be classified broadly into two groups: tethered/penned and stall-fed (Table 12). The herding system of pig management, which is practised in some parts of South and Southeast Asia, was seen in the district until a few years back but its existence was not reported by key informants at the time of survey. Although the scavenging system of pig rearing is observed sporadically in the district, there are less than 1% of pig-keeping households with scavenging pigs.

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

Table 12: Pig production systems by management type in Kokrajhar district

Management type	Units %	Breed type	Housing	Main manager	Manure use
Tethered/ penned	98	Crossbred	Tethering 60% Enclosure 40%	Mostly female	Not used
Stall-fed	2	Crossbred	Semi-permanent shed	Mostly male	Fish feed or manure

Source: key informants during field survey

Tethered/penned: In the survey clusters, about 98% of pig-rearing households managed a herd of one to three pigs under this system; most keep two to three pigs. About 70% of pig-rearing households (other than Adibasi) kept fattening pigs (pigs reared for slaughter), about 20% kept pigs for breeding (production of weaner piglets) and about 10% practised both breeding and fattening. Both tethering and penning were observed in each of the surveyed areas irrespective of ethnic group or geographical location. Housing pigs in a formal roofed shed under this system was not observed in the surveyed areas, but some households constructed a temporary roof over the pig enclosure especially during the rainy season. 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 three times a day. The pigs were mostly crossbreeds and herd sizes usually did not exceed three. The herd size is limited by scarcity of feed resources and family labour. Labour was not hired to manage pigs in these systems. The feed constraints meant that the households were not keen to expand their existing units unless they could get some financial assistance from the government or non-governmental organizations to procure feed or for the household to produce additional feeds for their pigs. Instead, the households preferred

to achieve higher growth rates (more throughput) in a fixed time and avoid pig mortalities.

Stall-fed: Only about 2% of households in the surveyed areas managed their pigs in a semi-permanent pigsty (Table 12). The system is primarily for breeding. However, there was some mixing with fattening pigs although the system appears never to be used exclusively for fattening. The number of parent stock managed in most stall-fed units was 4 to 13. The type of pigsty construction may affect pig performance. Research in India has shown that intensively fed pigs on a concrete floor with asbestos roof performed better than those on an earthen floor with a tile roof (Kumar *et al.*, 2004).

Table 13: Pig performance in the two management types, Kokrajhar district

Production traits	Stall-fed	Tethered/penned
Farrowing interval (months)	7-9	7-9
Number of litters in lifetime	4-5	4-6
Litter size at birth	8-12	6-12
Litter size at weaning	6-10	5-10
Age at weaning (days)	45-60	50-90
Weight of fatteners at 10 months (kg)	50-80	40-60

Source: key informants during field survey

The performance of pigs in the two management types is shown in Table 13. In the study areas, farrowing intervals for stall-fed and tethered/penned sows were reported as 7 to 9 months, similar to the 6.5 months recorded on the CVSc farm under the All India Coordinated Research Project on Pig (AICRPP). In the same project 50% Hampshire:50% indigenous crossbreeds attained about 90 kg in 10 months compared to the field performance reported in the current study of 50 to 80 kg, possibly reflecting the more intensive feeding and other management practices in the AICRPP. In the project, the average litter sizes at birth and at weaning, 6.91 and 5.91 respectively, were lower than those reported by our study informants (8 to 12 and 6 to 10, respectively). Breed differences may explain some of the variation; the majority of pigs kept by Kokrajhar producers are Large Black crosses and Ghungroo cross which are reported to have larger litter sizes at birth and at weaning. While AICRPP results indicated that piglets could be weaned at 28 days of age, the field practice was 50 days

or later (Table 13). 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 showed that weaning at 42 days of age did not adversely effect piglet survival.

4.3. Breeding and reproductive management

Kokrajhar is well known among farming communities as one of the major pig producing districts. Piglets produced in the district are supplied to Kamrup, Goalpara and Darrang districts of Assam and the neighbouring state of Meghalaya. The piglets are mostly the Ghungroo variety (black-coloured pig with a short snout, locally known as Nepali) with some Large Black crosses. It was said that the Ghungroo breed was imported from Nepal and West Bengal until a few years back, but the importations have stopped following the increase in price of piglets in Nepal and West Bengal, higher hidden costs at the inter-state check gate and increased piglet production locally. A small percentage of indigenous pig was also reported in the district.

Amongst the crossbreds, there were pigs with characteristics of two to three breeds, a result of the apparently haphazard crossbreeding practised by pig producers. Consequently, it was not possible to ascertain the degree of exotic blood in the different crosses and it is assumed that there is large variation. Just as there was a lack of systematic crossbreeding, there were few purebred pigs. The government supply of breeding pigs was said to be negligible; in 2006 the government farm at Kokrajhar sold only 12 piglets of the Large White Yorkshire breed which is not preferred by pig producers.

It was said that pig producers in Kokrajhar bought breeding stock either from small-scale breeding units or stall-fed units. It is estimated that of all the available breeding stock in the district, about 95% comes from small-scale breeding units and stall-fed units. Most 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. It was reported that producers with a stall-feeding unit always tried to purchase piglets from a well-managed pig unit.

Natural service is the only breeding method used by producers in the district; there was no reported use of AI. It was said that boars are used for breeding until three to four years of age, while sows are used for three to five years producing four to six litters (Table 13). Thereafter, the parent stock is usually replaced by its own progeny. Of the households using the tethered/penned system (98% of all producers), around 20% were reported to keep one to three sows, some with a breeding boar. There was another group of breeders (10% of all producers) who also kept fattening pigs. It was said that about 10% of breeding households kept a boar. There were no reports of any community breeding boar in the villages. Rather, those households without a boar used the boar from other households in the village and paid Rs. 200 to 300 for each service. If the sow did not conceive at the first service, subsequent services were obtained free of charge from the same breeding boar. Informants estimated that a boar gives 5 to 10 services in a month. The intensity of services is almost the same throughout the year, although producers prefer to have the pigs mate during June to September so that litters are born during October to January and piglets are ready for sale during December to 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)

Whereas rural pig producers try to take advantage of seasonal price variation, there appeared to be less awareness of performance variation amongst crossbreds, beyond a general preference for Ghungroo or Large Black crosses. There was no evidence of systematic crossbreeding, organized selection of breeding boars or 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 programs by government or NGO agencies on crossbreeding or within-breed selection, yet the adoption of crossbreeds to replace indigenous breeds has been the major management change in pig production systems in Kokrajhar district in recent times. Other new management practices are the adoption by some producers of stall-fed units by individual or SHGs and use of deworming drugs and mineral and vitamin mixture by a small section of producers.

There were about 2% of pig units that used stall-feeding to breed pigs, maintaining 3 to 10 sows with one to three boars with or without a few fatteners. The breeding boars were generally the Large Black and/or Nepali (black-coloured with short snout) types.

Feeding, medication and vaccination of these stall-fed pigs are relatively better than that of tethered/penned pigs.

Interviewed producers said that they weaned piglets at 50 to 90 days of age. Unlike in Kamrup or Karbi Anglong districts, early weaning by smallholder pig producers was not reported in Kokrajhar, possibly because of a lower demand for piglets in the market. Some of the stall-feeding units weaned piglets at 45 days of age. It was understood that breeders did not know the scientifically recommended age of weaning; they weaned only when the piglets start to eat solid feed. Some research in Assam (Nath *et al.*, 2003) reported higher mortality with shorter farrowing intervals of 200 days because of early weaning practices.

4.4. Feeding management

As reported in section 3.2.2, in Kokrajhar (as elsewhere in Assam), the large majority of households feed their pigs using family labour and feeds procured or produced by the household on the smallholder farms, in their backyards and from common properties. The major feed sources are rice polish and *juguli*. Some of the producers also fed pigs on broken rice. The ubiquitous nature of these feeds reflects the rice-based agriculture of rural Kokrajhar, hence the ready availability of rice by-products in the majority of households and their cost-effectiveness as pig feeds. Unlike other surveyed districts in Assam, *Colocasia* (*Colocasia esculenta*) or taro is not very popular as a pig feed in Kokrajhar. Producers were of the view that feeding of *Colocasia* resulted in less fat deposition and poor growth performance of pigs. This would reflect the lower energy content of *Colocasia* compared to *juguli* or rice polish. It was also reported that *Colocasia* caused diarrhoea in pigs.

Table 14 presents the feed resources reported by the various ethnic groups. Along with rice by-products, many of the households use papaya, banana and other fruits and vegetables as pig feeds. Although Kokrajhar is Assam's highest producer of tapioca (4201 tonnes), the use of tapioca as pig feed is not very popular in the district and some of the interviewed households were even not aware that it could be used as a pig feed. Purchased feeds, apart from some crop and milling by-products, are not frequent and, except for a few small-scale commercial units and government pig farms, the use of commercial concentrate feed is negligible (much less than 1% of total feed).

Table 14: Feed resources used by different ethnic groups in Kokrajhar district

Ethnic groups	First major component	Second major component	Third major component	Occasional feed resources
Bodo	*Juguli*	Rice polish	Vegetables, kitchen waste	*Colocasia*
Rabha	*Juguli*	Rice polish	Vegetables, kitchen waste	*Colocasia*
Adibasi	*Juguli*	Rice polish	Vegetables, kitchen waste	Tapioca
Rajbongshi/Jyogi	Rice polish	Vegetables, Kitchen waste	-	*Colocasia*
Stall-fed units	Rice polish	Wheat bran, kitchen waste	Maize, fishmeal, mineral and vitamin mix	*Colocasia*, vegetables, banana, water-hyacinth

Table 15: Calendar showing the seasonal availability of feeds in Kokrajhar district

Main feeds	Jan-Feb	Mar-Apr	May-June	July-Aug	Sep-Oct	Nov-Dec	Fresh or cooked
Juguli	A	A	A	A	A	A	Fresh
Rice bran/polish	A	A	A	Sc	Sc	A	Fresh/cooked
Broken rice	A	A	A	A	A	A	
Colocasia	NA	NA	A	A	Sc	NA	Cooked
Banana/vegetables	A	A	A	A	A	A	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

Table 15 presents the reported seasonal availability of the feed resources used in the surveyed areas. Throughout the year most tribal households, irrespective of ethnic group, prepare country liquor for their own consumption and for sale. As mentioned in section 3.2.2, rice polish tends to be scarce and costly between July and October.

During this period, pig keepers reduce the volume of rice polish and substitute more *juguli*, banana plant or broken rice.

As noted in Tables 14 and 15, kitchen and hotel wastes (the latter especially in peri-urban areas) are also fed to pigs. The availability of hotel waste may explain the significantly higher body weights of piglets maintained in peri-urban compared to rural areas of India reported by Kumar *et al*. (2005). As mentioned earlier, the use of commercial concentrate feed was not reported in the surveyed areas except in the AHVD breeding farms which have own source of feed from the department.

If any feed was purchased, some producers (especially breeders) provided wheat bran, oil cakes and fishmeal to their pigs, while many reported that they gave eggs to breeding boars before and after natural service. The large majority of backyard producers were not aware of the existence of such feeds or their nutritional qualities. However, it was reported that a small number of producers, especially in stall-feeding and breeding units, used mineral and vitamin mixtures.

It is clear, therefore, that the reported feeding practices are almost invariably dependent on locally available feed sources which, when fed to young crossbreds at traditional levels, result in only moderate growth rates (Table 13). 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 minor nutrients. 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; Gupta, 2006; Kumarsean *et al.*, 2006). Research has shown that, if supplemented, crossbreeds fed on local feed rations respond well in terms of growth rate (Pal *et al.*, 2001). Options that have been explored in NE India include buckwheat and various legumes (Gupta and Bujarbaruah, 2005), up to 80%maize grain and up to 50%rice polish 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 throughputs 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. At the same time, it must be remembered that in small-scale units using 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

The diseases cited as most important by the veterinary staff and pig producers in the surveyed areas were internal worms, pneumonia, piglet diarrhoea, piglet anaemia, swine fever, haemorrhagic septicaemia (HS), mange, foot and mouth disease (FMD), anthrax and some non-specific problems like hernia and closed anus/eyelids among piglets. It was confirmed that parasitic infestation was more common when pigs scavenged or were tethered, as reported by Bandyopadhyay (2002). Veterinary informants said that incidence of swine fever was lower than in neighbouring districts, although there were more reported cases of HS, because such diseases were not considered a major threat to the pig sub-sector in the district.

Except for mortalities from piglet diarrhoea, trampling death, pneumonia and swine fever, losses from other causes were few. 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. Loss of young pigs to predators was not reported in the surveyed areas. The practice by producers of slaughtering and selling diseased adult animals reduced the financial losses resulting from disease but represented risks to public health.

It was reported that vaccination of pigs against swine fever is almost non-existent in the district, apparently because of 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. It was also learnt that the AHVD had, for a long time, had a shortage of medicines and vaccines, especially for swine fever, and that supply from the private veterinary clinics was irregular.

Producers were said to visit government veterinary dispensaries less frequently, especially because of poor accessibility and inadequate availability of medicines and vaccines in the hospital. If a pig was ill, they preferred to visit the human clinic with supplies of veterinary medicine or a private veterinary clinic to purchase medicine based on their description of the pig's symptoms. Richer producers, especially breeders, were said to call a veterinarian to treat their diseased pigs; a visit and some cheap medicine cost Rs. 30 to 70. Veterinary Field Assistants (VFA) were paid a lower fee than the VAS so most producers preferred to call the VFA. For some conditions like fever and diarrhoea, pig keepers reported using human medicine available within the household. Cases were also reported in Bangtol area, where a medicine vendor moved from one weekly market to another selling medicine to producers. Unlike in Dhemaji district, the use of herbal/traditional medicines was not very common except for *Chatiana pat* for deworming. Interviewed households reported that this tree leaf is very effective.

It was clear from the surveys that the level of awareness was very low among producers of the diseases that affect their pigs and possible preventive measures. 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, it was reported that government and NGO extension services were either very poor or absent in the district; there were no reports of NGO extension programs for pig producers in the survey 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 Kokrajhar district (here covering Kokrajhar and Chirrang districts). At the same time, there are some important issues that relate to the constraints to and the opportunities for improving pig production to generate income and increase livelihood security.

1. Consistent with the hypotheses presented in section 2.3, piggery in Kokrajhar is invariably a small-scale backyard enterprise practised mainly by tribal communities and a small section of OBC and SC communities 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. While pig rearing is gaining popularity amongst the traditional and non-traditional pig rearing communities, its popularity is decreasing amongst the Adibasi community particularly because of extreme poverty caused by socio-political disturbances and ethnic violence.
2. Despite being small-scale (generally one to three pigs), production is primarily market-oriented and contributes significantly to the livelihood of the majority of tribal households. The income from pig sales meets essential household and farming expenses, and provides some financial independence to the women in the family.
3. The quantity and quality of locally available feed resources – mainly from the household's crop by-products – is a major factor that limits the scale and efficiency of pig production. Therefore, improved feed resources and feeding practices (e.g. to overcome the feed deficit in August to October when rice polish is scarce) 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, land and other resources.
4. As locally available feed resources (with their strong dependence on rice by-products) lack protein, mineral and vitamins relative to energy, the deficit could be offset by feeding a low-cost supplement (e.g. incorporating fish meal and a mineral and vitamin mixture). Other possible interventions are promoting, through participatory research and awareness programs, some of the non-conventional feed resources (e.g. rice bean – *Vigna umbellata* – and legume forages) and improved varieties (e.g. tapioca, *Colocasia*/taro, sweet potato) well documented by various R&D organizations.
5. It was clear that in Kokrajhar's pig pockets, traditional management practices continue to dominate production systems with four exceptions: (a) the herding system of pig keeping has virtually disappeared from the district, (b) most indigenous pigs have been replaced by crossbreeds, with crosses of Ghungroo and Large Black breed preferred over other exotics, (c) a small group of producers and

SHGs practise stall-feeding and (d) a section of producers have changed their herds from fattening only to breeding.

6. Despite the preference for Large Black and Ghungroo breeds, government breeding programs promote the less popular Large White-Yorkshire breed. A re-assessment of the government breeding program 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. AI may have a role to play.
7. Closely related to these breeding and feeding issues were reports by the majority of interviewees that they had inadequate knowledge about breeding (especially the care of sows during pregnancy and lactation), feeding and health care management (medication and vaccination). There was no systematic government approach to address this lack of access to technical extension advice (see section 5), although there were reports of sporadic training courses on intensive pig management which were not popular amongst the small-scale pig producers who constitute about 98% of all producers. Therefore, it is clear that much work is required to ensure that extension programs are needs-based and client-oriented and that the programs address how to improve production through incremental steps achievable within the limits of current household resources, especially feed and female labour.
8. The veterinary service delivery system in the district was reported to be very poor because of inadequate infrastructure and manpower coupled with inadequate supply of medicines, vaccines and first aid treatment. Some hospitals (e.g. Cerphanguri Hospital) were either destroyed at the time of the Bodo movement or are occupied by the Indian Army (as part of the district headquarters). Government initiatives are required to repair or reconstruct the veterinary infrastructure.
9. Swine fever, HS and FMD were said to be prevalent in the district, but confirmatory diagnoses were not carried out and current delivery systems were not effective to supply vaccines or ensure their quality (e.g. it was not possible to maintain the cold chain due to frequent power failures). 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 to prevent the spread of infection.
10. Lack of working capital was a recurring constraint observed during the field surveys. High interest rates were commonplace and the poorest households

depended on the *adhiary* system for rearing pigs. Pork and piglet traders mostly depended on local money-lenders to run their business. SGSY programs were not very successful in addressing the need for credit because of poor responses from commercial banks. More effective schemes for availing credit are required; extension of micro-credit through NGOs may be a viable alternative. In the same way, insurance coverage for the pigs of small-scale producers may be possible by SHGs through the Group Insurance Schemes of insurance companies.

11. As was described in section 3, Kokrajhar had some small surplus of pig production relative to local demand. Nevertheless, production continued to grow, stimulated by increasing local consumption and purchases to supply Meghalaya and Bhutan. While rising demand has stimulated some changes in local production systems, there was a marked lack of investment in intensive production systems, suggesting that production that relies on purchased inputs may not compete well with backyard units that mainly use home-produced feeds, at least while the market does not differentiate between the pork from the two systems.

5. Policy and institutional issues

Conducive policies and supportive institutions are essential if the pig sub-sector is to serve as a strategic pro-poor entry point to improve livelihoods and generate employment in Assam. Therefore, secondary sources were reviewed and information gathered through key informant interviews and field surveys to identify any policy and institutional issues that might constrain improvements to the pig sub-sector or that might represent opportunities to improve the policy and institutional environment in Kokrajhar district (Kokrajhar and Chirrang).

5.1. Regulatory environment

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

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

1. Veterinary informants were not aware of specific regulations for the registration and inspection of pig and pork outlets in Kokrajhar town or regulations concerning pig rearing. Therefore, the official supervision of pork marketing was almost non-existent. It was also reported that there was poor coordination 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. On many occasions, they are transferred much earlier. Interviewed VAS in all the surveyed districts reported that during early and later parts of their transfers, they are more involved in their personal affairs rather than official duties. 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, they suggested that their stay in one dispensary should be extended to at least five years. In Kokrajhar, the dilapidated condition of buildings and utensils of veterinary dispensaries/hospitals and quarters, coupled

with use of veterinary buildings by military forces, discouraged many veterinary officers/staff from attending and delivering services effectively.

3. Although there are three 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 etc.) and financial resources. This has contributed to the poor level of awareness and knowledge about pig management amongst small-scale pig producers. What is more, there has been no systematic effort by the government or 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. But some of the interviewed pig/pork sellers reported that they are 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 or levy either to the local market management committee or to the local *mahaldar* (lessee); the cess varies from Rs. 5 to 10 per day depending on the market.

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

The programs and projects being implemented by government and donor agencies in support of Kokrajhar's pig sub-sector supply information from research, improved breeding stock, production training, extension and credit.

1. AHVD has started a pig breeding farm at Kokrajhar town under the Integrated Piggery Development Program sponsored by the Government of India. In 2005, 20 sows and 5 boars of the Large White-Yorkshire breed were brought onto the farm under this program. In the absence of farm building, pigs were reared in the hospital building without proper facilities for feeding and water. At the time of the survey, only 12 pigs had survived and it was reported that the performance of the farm was very poor. Litter size at birth was reported to be between three and seven while litter size at weaning was one to four, significantly lower than that of pigs in smallholder breeding units. In 2006, only 12 piglets were sold. Veterinary key informants mentioned that there was little demand for Large White-Yorkshire pigs in the market and therefore the breed of the parent stock should be changed.

2. The government's planning commission has formulated the RSVY to develop 155 districts in 27 states of India in order to address the problems of low agriculture productivity, unemployment and to fill critical gaps in physical and social infrastructure. Kokrajhar and four other districts in Assam are included in the RSVY. Under this program, 124 SHGs have been formed, 63 of which are involved in pig rearing. The total project cost for each piggery unit (11 sows and 2 boars) is Rs. 87,500. Already 50% of the total project cost has been released to each SHG, some of which have started to construct pigsties. Since the project is yet to be fully implemented on the ground, it is too early to assess its impact. However, from observing the piggery units in Dhemaji district under the same project, it can be presumed that the project may be less likely to show the desired result.
3. Principal amongst other efforts to reach rural communities in Kokrajhar is the promotion of SHGs in each block by the DRDA under the SGSY scheme[9]. Of the thousands of SHGs that have been formed in Assam, the majority have taken up weaving, pig rearing, farm mechanization and sericulture. Key informants said that the success rate of SHGs is about 30% (i.e. the SHG is running the activity and repaying the bank loan). In tribal dominated areas, most SHGs are taking up pig rearing. Table 16 gives some details of the SGSY program in the districts of Assam surveyed for this study and it shows that 20 to 60% of SHGs are involved in pig production and that a high proportion of SHG members are women. In Kokrajhar, pig rearing was taken up by 40% SHGs. Of these, about 30% received a revolving fund and another 30% received project finance. DRDA key informants mentioned that commercial banks were reluctant to give a matching share of loan under the SGSY program and they merely released the government grant portion (Rs. 10,000 and Rs. 100,000 per SHG as revolving fund and project finance, respectively). It was reported that those SHGs that availed themselves of project finance for pig rearing utilized only a small part of the loan to purchase piglets and diverted the remainder to extending credit to others at higher interest rates (5 to 10% per month) or distributed the amount among themselves. From a discussion with a DRDA official, it was understood that SHGs were not showing desired results due to poor awareness and motivation, lack of technical guidance and monitoring, and lack of entrepreneurship amongst the group members. DRDA organizes the SHGs mainly to achieve the physical target, overlooking or under-estimating the need for a

[9] Organizing farmers into a group of 10 to 20 members, imparting training on organizational management, motivating to build habit of savings, assistance for taking up income-generating activities and providing a revolving fund of Rs. 10,000 and project finance of Rs. 200,000 or more to eligible groups in a phased manner to promote relevant activities.

systematic approach to forming and nourishing the SHGs. The role of *Gram Sewok/Sewika* (community workers) was also reported to be unsatisfactory because of the permanent nature of their jobs.

Table 16: District-wise progress of SGSY program in Assam

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

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

4. The BTC also extended Rs. 10,000 to each of 30 SHGs as a grant in aid of pig rearing. Another 120 individuals availed themselves of financial assistance of Rs. 2500 each for pig rearing. In addition, it provided Rs. 1,300,000 (50% of the total project cost) as a subsidy under the RSVY scheme for a feed-mixing unit.

5.3. Delivery of livestock services

5.3.1. Clinical and preventive veterinary services

The AHVD's dispensaries are the main veterinary service providers in the district. There are 22 veterinary dispensaries, each headed by a VAS with one to three VFAs and support staff. As mentioned earlier, some of the veterinary dispensary buildings (e.g. Cerphanguri dispensary) were destroyed during the Bodo agitation and a few others were occupied by military forces, including a part of the District Veterinary Office. As mentioned in sections 4.5 and 4.6, due to poor veterinary infrastructure and associated problems, veterinary service was reported to be poor in some of the dispensaries. The supply of medicines and vaccines is grossly inadequate and pig producers only get the advice of the VAS and some first aid treatment. Producers are not required to pay any fee to the veterinarian for his services in the dispensaries.

Apart from government veterinary dispensaries, there is one private veterinary clinic in Kokrajhar town run by qualified veterinary practitioners who sell medicines and serve producers at their doorstep. In all the surveyed areas, human pharmacies contain veterinary medicines. In the villages some retired veterinary personnel also treat animals, while castration is mostly done by a skilled local person. In return, they are paid Rs. 10 to 30 for each castration or a bottle of country liquor. The provision of veterinary services by NGOs or other similar organizations was not reported in the surveyed areas.

5.3.2. Breeding services

As described above, the breeding farm under the AHVD hardly extends any breeding services to the pig breeders; it sold only 12 piglets in 2006. As mentioned previously, the department has not introduced AI into Assam. Therefore, smallholder breeding units are the key service provider, delivering the services on their own initiative without any assistance from the government or any NGO.

5.3.3. Production and health extension

There appeared to be poor extension service in the surveyed areas. The AHVD was reported to have three veterinary extension officers but they were mostly involved in non-extension activities, perhaps because of lack of financial support and extension materials for activities in rural areas. When interviewed, farmers said government agencies had no major initiatives except some short-term training organized by the AHVD on management of stall-feeding units. However, it was reported that 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 system (tethered/penned) of pig rearing which dominates pig production in Kokrajhar (Table 12). The AHVD and DRDA organized some training programs on stall-feeding, a system which is not usually taken up by SHGs or individual farmers. Under the DRDA, there were *Gram Sewok/Sewika* (village extension workers) to provide extension services to the SHGs, but they were reported to provide organizational rather than technical support and appeared not to have the commitment required for an effective support program to resource-poor rural households.

Common to all these extension activities is that they were sporadic in nature and lacked any systematic approach or methods. AHVD staff pointed out that there had been no training needs analysis and, therefore, it was unlikely that the 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). Hence, 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 Kokrajhar demonstrated that coordination was poor among the different organizations promoting pig production, especially NGOs and AHVD. Nevertheless, in the recent past some joint efforts have been initiated. The major example is DRDA's program to organize farmers into SHGs in which AHVD and NGOs provide training and a commercial bank extends credit. However, cooperation from the commercial bank in respect of the SGSY program was very poor. Insurance companies were not well linked with other stakeholders in the pig sub-sector and they had little interest in insuring livestock and poultry.

5.6. Main policy and institutional issues

From the descriptions given in sections 5.2 to 5.5, it is clear that there are important policy and institutional issues that constrain pig production and marketing in Kokrajhar 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-oriented extension service delivery mechanism, inadequate incentives for staff and poor operational and physical resources. At the same time, it was clear that market-oriented pig production is integral to the livelihoods of many 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 focus 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 and Ghungroo pigs rather than the Large White Yorkshire breed supplied by the government farm) and will develop the improved feed resources that essential for increasing the scale and productivity of the backyard production units. At the same time, the development policy needs to incorporate institutional interventions to reduce the vulnerability of these resource-poor households through addressing the threats to their pigs from epidemic diseases like swine fever, HS and FMD. Improved veterinary services are required that deliver quality vaccines even to the rural areas where it is difficult to maintain a cold chain because of poor electricity supply. Community-based training is 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, training and monitoring. Some of these groups' 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 stakeholders like DRDA, AHVD, WPT&BC, 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 through community-based schemes should be an integral part of these programs.

Just as in the production phase, there was also a lack of coordination among public institutions involved 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.

Finally, the absence of any significant private-sector investment in medium- or large-scale breeding farms and feed mills in the district is worthy of note, suggesting that current small-scale production systems are competitive in their use of local resources. Given Kokrajhar's continuing growth in demand for slaughter pigs from both within and outside the district, it will be important that policies are even-handed in support for small- and large-scale production, while ensuring that meeting consumer needs, as expressed through the market, is the primary aim of development policy.

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 Kokrajhar'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 90% of rural tribal households (especially Bodo community) reared pigs, mostly crossbreeds. About 70% did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. However, traditional feeding practices limited pig performance. Slaughter pigs were reported to reach 40 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 the by-products of the rice crop: bran and *juguli* (the residue of country liquor). *Colocasia* and tapioca were used less frequently. 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 Kokrajhar town there has been, as yet, little or no private-sector investment in more intensive systems of production.

This competitive small-scale sector in Kokrajhar district has been responding to growing market for fresh pork and slaughter pigs; traders and retailers said that demand had increased – although slowly – over the last five years. They were also confident that sales of fresh pork would continue to grow steadily as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there has been increased demand for slaughter pigs from within and 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 Kokrajhar. These changes have resulted not only in more pigs being produced from the estimated 59,000 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, piglets and pork.

These market-driven changes meant that pig producers in Kokrajhar were happy with the income they generated but, at the same time, they said that they were unable to

further increase the sizes of their herds, especially because of the lack of household feed and financial resources. 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 Kokrajhar's existing stock of pigs and piglets due to the demand from other districts of Assam, the neighbouring state of Meghalaya and the Kingdom of Bhutan. Therefore, interventions to support the production of piglets and slaughter pigs in Kokrajhar have to be developed taking into account these demand factors, which suggest that the district will no longer be a surplus pig producer by 2010 unless local pig keepers increase production by intensifying their systems.

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 Kokrajhar 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 Kokrajhar. Both pig producers and traders suffer from lack of credit. While pig producers require long-term credit, traders of slaughter pigs, pork and piglets require short-term credit. The government-sponsored SGSY and RSVY schemes extend credit to SHGs but not to individual members. It is recommended that credit should be made available so that individuals can achieve incremental changes in their production system; micro-credit schemes managed by NGOs may be a viable way forward. Capacity building of existing NGOs in project appraisal and financial management would be a first step towards their playing the intermediate role in money lending. Since resource-poor rural farmers are risk-averse, group insurance schemes should also made available with the credit. Integrated with these financial aspects should be technical extension to achieve increased scale and productivity of backyard pig production.
2. Inadequate knowledge about feeding, health care and breeding management was given by producers as their 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. 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 and *juguli*, 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, maize and sweet potato. 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. These feed interventions should be complemented by technical support to improve the housing conditions of pigs, particularly those in the tethered/penned system.
4. A technical constraint reported repeatedly by producers was the lack of quality 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 breeders in the villages for use in the prevailing fee-paying mating system. The possibility of introducing AI should be explored by R&D agencies and a needs-based training program designed for smallholders on the care and management of breeding stock.
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 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 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 should include veterinary assistants paid by the community to supply a variety of services and train local skilled persons 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 the transport of piglets, slaughter pigs and pork, thereby increasing the price of outputs 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 Kokrajhar, there is no routine pre- or post-mortem inspection of slaughter pigs because of inadequate manpower and physical resources and the absence of physical infrastructure (buildings, water and electricity) for slaughtering and selling of pork. 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. Integral to the evaluation should be the needs of the export trade to Bhutan.

3. 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 Animal Products Development Centre, the Philippines.

   See http://www.aphca.org/reference/apdc_ph/apdc_index.html for details.
4. Retailers and consumers reported that pork consumption was exclusively of fresh meat, the demand for which was growing in urban and rural areas. Therefore, there is no justification for any public investment to support the processing of pig meat beyond the recommendation in the two previous points for making available training in meat hygiene and food safety.
5. Notable results from the key informant interviews and the 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 many thousands of resource-poor rural households in Kokrajhar. Furthermore, the continuing increase in demand for pork represents a major opportunity to improve

livelihood security and increase incomes, particularly amongst marginalized groups like the tribals and 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.
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 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.
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 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 may need 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 the productivity and profitability of Kokrajhar'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 Kokrajhar will be an important responsibility for the proposed planning and coordination group.

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List of abbreviations

AAU	Assam Agricultural University
AHVD	Animal Husbandry and Veterinary Department
AICRPP	All India Coordinated Research Project on Pig
AI	artificial insemination
ALPCo	Assam Livestock and Poultry Corporation Limited
BTC	Bodoland Territorial Council
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
GDDP	Gross District Domestic Product
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
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	*Rastriya Sama Viaksh Yojana*
SC	scheduled caste
SGSY	*Swarnajayanti Gram Sawrozgar Yojana*
SHG	self-help group
ST	scheduled tribe
VAS	veterinary assistant surgeon
VFA	veterinary field assistant
WPT&BC	Welfare for Plain Tribes & Backward Classes

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

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Appendix 2: Agro-climatic zones

Based on climate, soil characteristics and land use pattern, Assam state has been divided into six agro-climatic zones[10]:

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

[10] Agriculture Department, official website