Golaghat'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 Golaghat; the other districts were Dhemaji, Kamrup, Kokrajhar and Karbi Anglong. 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

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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 Golaghat; the other districts were Dhemaji, Kamrup, Karbi Anglong and Kokrajhar. A sixth synthesis report brings together the results and conclusions of the district reports. The objectives of the appraisals were, first, to build a comprehensive understanding of the pig systems in Assam through a participatory process involving key stakeholders and, second, to identify entry points for effective public and private sector interventions in the pig sub-sector in order to improve livelihoods and generate employment.

The appraisal studies applied two complementary methods: a review of secondary information from or relevant to Assam and the collection of primary data through semi-structured interviews. The interviews were carried out at district, village and household levels with consumers, market agents and producer households and district- and village-level key informants. Through consultations with key resource persons, district veterinary officials and some district-level market agents, three cluster areas per district were identified in each of which interviews were carried out in three households in each of two villages. Generally one cluster was selected near the district headquarters/major town of the district and the other two some 30 to 70 km in different directions 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 Golaghat district, the three selected clusters were Golaghat town, Sarupathar and Kamargaon. The clusters were visited during the first week of December 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 Golaghat relative to the other surveyed districts were: topographically plain valleys on the southern bank of River Brahmaputra representing the upper Assam districts; pig production mostly dominated by Other Backward Classes (OBC) Ahom and Chutiya communities; lower concentration of

Scheduled Tribe (ST) population; and it is strategically located sharing its border with the Indian state of Nagaland, which is a major importer of pigs from other states.

Golaghat district lies east of Assam state. It is bounded to the north by the River Brahmaputra, to the south by the state of Nagaland, to the east by Jorhat district and to the west by Karbi Anglong and Nagaon districts. At the 2001 census, its population was 0.95 million (approximately 180,000 households), 90% of which was rural. The district capital, Golaghat, has a population of about 33,000. Each of the other five urban centres has a population of less than 15,000. The majority of Golaghat's people are Hindus of the general community. The Scheduled Caste (SC) and ST communities are only 5% and 10%, respectively, of the district population. While the *per capita* Gross District Domestic Product is close to the state average, other socio-economic indicators are above average. Golaghat ranks third out of Assam's 23 districts for both the Human Development Indicator and the Human Poverty Index. Although almost half of Golaghat is under forest, its net sown area of 33% is close to the average for districts in Assam. Tea is a major industry with large and small tea gardens. Small-scale tea growing has gained in popularity amongst educated youths as a source of employment and income. Apart from tea planting, cropping (paddy occupies half the total cropped area) with livestock as a subsidiary income source dominates the rural economy of Golaghat. Sixty percent of farming households have farms of less than 1 ha in size. In common with other districts in Assam, general community households in Golaghat rear cattle, goats and poultry, while tribal households prefer to rear pigs and poultry. These are raised in low external input production systems. Feeds for pigs are mainly the by-products of paddy and other crops or are collected from common property resources. The pigs, therefore, serve to convert existing resources of low value into a high-value animal-source food which can be sold. As with other livestock, keeping pigs serve as a source of cash and helps resource-poor households to diversify their risks and to improve livelihood security.

It was against this broad background that a detailed overview of Golaghat's pig sub-sector was compiled through consultations along the market chain from consumers of pork to retailers, pig traders and pig producers, and with the organizations that serve them. Consistent with expectations, pig production was mainly a small-scale market-oriented enterprise of tribal and OBC communities. About 70% of rural tribal and OBC households reared pigs, which invariably were crossbreeds. Most households (70%)

used tethering/penning to manage one to six pigs. Stall-feeding was used by another 20%, a much higher proportion that in other surveyed districts. The remainder used the traditional scavenging system. Except for the Mising community, the majority of households of other communities did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. These pigs were reported to reach 50 to 80 kg live weight at 10 months of age with the lower weights 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). However, because these and other local feed resources were of low or no opportunity cost and the labour for caring for the pigs was provided mainly by the women of the producer households, pig production was an attractive, profitable business. Furthermore, there has been, as yet, little or no private sector investment in more intensive systems of production beyond the introduction of stall-feeding with some purchased crop by-product feeds.

This competitive small-scale sector in Golaghat has been responding to the vibrant market for slaughter pigs and pork; traders and retailers said that demand for slaughter pigs increased by about 50% over the previous five years. Not only had local demand been satisfied, but an estimated 20% of piglets and 30% of slaughter pigs produced in the district were sold to traders for external markets. What is more, the live-animal traders and pork retailers were confident that sales of fresh pork and slaughter pigs would continue to grow as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there has been growing demand for slaughter pigs and piglets from the neighbouring district of Karbi Anglong and the neighbouring state of Nagaland, it is clear that small-scale production has expanded considerably during recent years to satisfy the increased demand for pork from outside the district. These changes have resulted not only in more pigs being produced from the estimated 53,000 small-scale units with benefits to the livelihoods of the tribal producer households, but there are also many more people earning their living from the marketing of pigs and pork.

These market-driven changes meant that pig producers in Golaghat were happy with the income they generated and were very keen to further increase herd sizes, provided they got additional sources of locally available feed or purchased feed at reasonable price with required technical and other input services. Hence the conundrum; the market is continuing to demand more pork but the input constraints now faced by the

majority of producers – mainly resource-poor tribal households – are limiting their capacity to respond. Pressure is also increasing on Golaghat's existing stock of pigs due to the demand from Nagaland and the shortage of supply from Uttar Pradesh (UP)/Bihar primarily because of the increased prices for pigs in that part of the country. Therefore, interventions to support the production of piglets and slaughter pigs in Golaghat have to be developed taking into account the competition from these other sources of supply.

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

Production constraints and opportunities

1. 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 ineffective 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.
2. 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 four complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forage 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; (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia*/taro and sweet potato and (iv) synchronizing the production cycle of fatteners with the availability of feed. Each of these interventions conforms to the principle of providing current and potential pig producers with information and technological options that will 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.

3. The participatory action-research 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 research and development (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 giving credit, the provision of which is likely to have a key role in supporting the adoption of technical innovations.
4. The same participatory action-research 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 schemes within which locally-based veterinary assistants are paid by the community to supply a variety of services. Local skilled persons in the villages may be trained to castrate and vaccinate pigs and provide first aid treatment. A priority should be community-based training in the early clinical diagnosis of swine fever and putting in place the collective actions required to prevent the spread of infection.
5. Although the district produces surplus piglets, it suffers from scarcity of quality piglets especially of the Large Black breed. Support to innovative community-based systems and encouragement of private-sector investment are required 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 R&D agencies and a needs-based training program designed for smallholders on the care and management of breeding stock.
6. Lack of operating capital and limited access to credit were reported as constraints to piggery development in Golaghat especially amongst the Mising and ex-tea tribe communities. It is recommended that micro-credit through non-governmental organizations (NGOs) may be a way forward to availing credit to smallholders. Capacity building of existing NGOs to serve as intermediate money-lending

agencies can be a first step. Since resource poor households are risk-averse, group insurance schemes may also be made available along with the credit.

Marketing and consumption issues

1. Whereas households were faced by 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 the transport of piglets, slaughter pigs and pork, increasing the price of meat to consumers and reducing profits for producers. It is recommended that there should be an awareness program to overcome this problem, which would involve all participants in the market chain: producers, traders, police and other officials.
2. In need of improvement was the food safety of pork. With pork consumption rising and the number of market participants between producer and consumer increasing, the risks to public health from unhygienic practices are growing. Currently in Golaghat town there is no routine pre- and post-mortem inspection of slaughter pigs because of inadequate manpower and physical resources and the absence of a slaughterhouse and regulation under the town committee. Absence of a concrete shed along with water and electricity supplies and drainage facilities is regarded as one of the major constraints for selling of hygienic pork. These deficiencies in public health measures should be addressed through a risk analysis along the production-to-consumption value chain to systematically evaluate 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.
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 Manila-based Animal Products

Development Centre of the Bureau of Animal Industry, the Government of the Philippines. See http://www.aphca.org/reference/apdc_ph/apdc_index.html for more information.

4. Retailers and consumers reported that pork consumption was exclusively of fresh meat, the demand for which was growing quickly in urban and in rural areas. In contrast to fresh pork, there was no supply of or any apparent demand for processed pork products and frozen pork. 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.

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. Yet it was clear that market-oriented pig production is integral to the livelihoods of many thousands of resource-poor rural households in Golaghat. Moreover, the continuing increase in the demand for pork represents a major opportunity for improving livelihood security and increasing incomes, particularly amongst marginalized groups like the tribals and OBC, and educated unemployed youths.
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 self-help groups (SHGs). To achieve this, it is recommended that a planning and coordination group be established as a platform to catalyze this process and to prepare a policy on pig sub-sector development.
3. To be effective, the group will have to overcome the current inadequate coordination among the varied R&D stakeholders like the College of Veterinary Science (CVSc), AHVD, ALPCo, commercial banks and insurance companies, an issue that can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.

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

By having a better understanding of the current constraints to and opportunities for the productivity and profitability of Golaghat'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 increasing demand for pork, particularly from Nagaland, and with Dimapur's potential for expanding peri-urban pig production using purchased feeds. Monitoring and evaluating these changes in the structure of piggery in Golaghat and Dimapur 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 region state governments (Planning Commission, 2006). The NE region 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 of India's pigs are in the NE region. The increasing demand for animal-source foods in the NE region and in India generally, matched with the current low productivity of the NE region 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 the NE region, ILRI committed to work with its partners to appraise the pig sub-sector (pig production and marketing) beginning in Assam, the NE state with the largest human population and biggest pig herd.

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

1.2. Objectives

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

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

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

1.3. Approach and methods

The approach taken 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, market agents and pig producers.

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

- the 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: Dhemaji, Golaghat, Kamrup, Karbi Anglong and Kokrajhar. Each district was selected based on the diversity in respect of ethnic groups, geographical location, agro-

climatic zone, production system, pig population and market opportunities. Relevant secondary information and knowledge of the key resource persons about the major supply- and demand-side factors influencing the variability of pig systems in the state was the guiding force in the process of selection.

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

- Topographically plain valleys on the southern bank of River Brahmaputra, representing the upper Assam districts
- Pig production is mostly dominated by Ahom and Chutiya communities that belong to the OBC
- Lower concentration of ST population
- Strategic location sharing its border with the Indian state of Nagaland, a major importer of pigs from other states

Within each of the sample districts – Golaghat in this case – and in consultation with the key resource persons and district veterinary official, three cluster areas were identified. The three selected areas in Golaghat were Golaghat town, Sarupathar and Kamargaon (Figure 1) where the semi-structured interviews were carried out at village and household levels. For each cluster, the interviews were carried out in two villages and in three households in each village. A common process was adopted to select the clusters in all the surveyed districts. One cluster was selected near the district headquarters/major town of the district (5 to 10 km) and another two clusters in two different directions 30 to 70 km away from the district headquarters. Efforts were also made to accommodate the areas thought to have the most potential for increasing pig production and having different ethnic groups, production systems and market opportunities. Likewise, two villages were identified within each cluster (Table 1) from a list of about 10 villages after detailed discussion with the veterinary assistant surgeon (VAS) and staff of concerned local veterinary dispensaries about the demographic and livelihood pattern, role of agriculture and livestock in farming system, concentration of pig population, variation in ethnic groups and proximity to the market. The clusters and villages were visited during the first week of December 2006 to collect primary information from producer and consumer households, market agents, input suppliers and other key players and stakeholders in pig production and marketing. These,

therefore, included district officials working on pig systems. The local daily and weekly markets that were visited are listed in Table 1.

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

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

Table 1: Areas and markets surveyed in Golaghat district

Clusters	Villages	Daily markets	Weekly markets
Golaghat town	Horizon colony-Chandmari	Golaghat	
	Bagarizang		
Sarupathar	Naojan		Sarupathar
	Betani pathar		Naojan
Kamargaon	Bortika	Bokakhat	Bihara
	Parghat		Subjuri

1.4. Expected outputs

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

- A better understanding of current pig production and marketing systems in Golaghat 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 the AHVD and ALPCo for interventions in support of improved livelihoods through pig production and marketing and
- A basis for others to develop needs-based projects and/or commercial ventures.

These outputs are derived in the context of Golaghat'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 report and the equivalent ones for Kamrup, Dhemaji, Kokrajhar and Karbi Anglong districts (Deka *et al.*, 2007).

2. Historical and demographic overview

2.1. Golaghat and its people

In 1987 Golaghat came into being as a new district of Assam after carving out the Golaghat sub-division of erstwhile Sibsagar district covering the Doyang-Dhansiri valley. The district is bounded by the River Brahmaputra to the north; the state of Nagaland to the south; Jorhat district to the east and Karbi Anglong and Nagaon districts to the west (Figure 1). The district is situated between 26.0° and 27.1° latitude and 93.0° and 94.18° longitude and lies 100 metres above sea level. Table 2 presents descriptive statistics of the district's social structure and its infrastructure and some indicators of its development relative to other districts in Assam.

As per the 2001 decadal population census, Golaghat's population is about 0.95 million[2] of which about 91% lives in rural areas. There are six urban centres in the district: Golaghat, Dergaon, Bokakhat, Numaligarh, Sarupathar and Borpathar (Figure 1). Urbanization is slow; Golaghat has the population of about 33,000 and each of the other districts less than 15,000. The population density of the district is 236 persons per square km, lower than the state average of 340.

In respect of religion groupings, the majority of Golaghat's people are Hindus (86%) followed by Muslims (8%) and Christians (6%). The SC and ST communities are 5% and 10%, respectively, of the district population in contrast to the state average of 7% and 12%. The ST community of Golaghat comprises Mising, Sonowal Kachari, Shyam and Lalung while the SC community is constituted of fishermen. The district also holds a significant percentage of people from the Ahom, Chutiya and Tea Tribe communities that belong to the OBC. The remainder of the population belongs to general community that includes the Brahmin, Kalita, Nepali, Bihari, Bengali and Marowari communities.

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

Table 2: Some key statistics of Golaghat district

	Golaghat	Assam
No. of villages	1066	26312
No. of towns	6	125
Total households	181,692	4,914,823
Population density (per square km)	270	340
Sex ratio (female per 1000 males)	930	935
Decadal population growth from 1991-2001(%)	14.3	18.9
Literacy rate (%)	69.4	63.3
Road length per '00 square km of geog. area	45.9	47.8
Percentage of village electrified	64	77
Population per hospital, dispensary orPHC	22,006	30,359
Heads of cattle per veterinary hospital, dispensary or mobile dispensary	20,655	17,614
Per capita Gross District Domestic Product at current price (2000-2001), Rs.	12,792	11,937
Human Development Indicator[3](state)	0.540 (Rank 3 among all districts of Assam)	0.407
Income Index	0.409 (Rank 5)	0.286
Education Index	0.650 (Rank 6)	0.595
Health Index	0.564 (Rank 3)	0.343
Human Poverty Index	14.52 (3rd lowest in the state)	23.24

Source: Government of Assam websites

The Ahom and Chutiya communities are widely distributed throughout the district, while the Mising community is mostly concentrated in the Kamargaon (riverine areas of the River Brahmaputra) and Gomari areas. The Assamese-speaking general community is reported to be concentrated in Golaghat, Dergaon, Numaligarh and Bokakhat towns and adjoining places. There are also areas where Shyam, Nepali and Bihari people

[3] Assam Human Development Report (2003)

reside together with the Ahom, Chutiya and Assamese-speaking general communities. These areas include Sarupathar, Borpathar, Merapani and Naojan. Lalung people generally reside in Kohora, Kakodonga and Sarupathar areas. In all the urban centres there is a mixture of the different communities.

The district is mostly characterized by plain valleys. Dhansiri is the main river; it originates from the 'Laisang peak' of Nagaland and flows throughout the district. Doyang, Nambor, Doigrung and Kalioni are the four rivulets of Dhansiri. The river Kakodonga marks the border of Golaghat and Jorhat districts of Assam.

The district of plain valleys covers 3500 square km. About 47% of land is under forest and miscellaneous trees (Table 3) in contrast to the state average of 28%. The district's net sown area is about 33% while more than 13% of the land is unavailable for cultivation. Land under permanent pasture and grazing is negligible (less than 1%).

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

District	Total area	Total cropped area*	Net sown area	Fallow	Forest & misc. trees	Others
Golaghat	354	156	116	7	166	66
(%)			33	2	47	18
Dhemaji	324	108	55	24	82	165
(%)			17	7	25	51
Kamrup	446	247	175	6	142	123
(%)			39	1	32	28
Karbi Anglong	1033	181	123	**	314	596
(%)			12		30	58
Kokrajhar	313	145	87	2	168	56
(%)			28	1	54	17
Assam	7850	4087	273	176	2166	277
(%)			34	2	28	36

* Total cropped area is constituted of net sown area and area sown more than once out of net sown area. So total cropped area is not calculated under the total area

** Separate classification of areas for hill districts are not available, all included under barren & uncultivable land.

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

The Nambor Reserve Forest and a part of Kaziranga National Park are the two best known forest areas with tropical evergreen and semi evergreen forest that fall within the district (http://golaghat.gov.in). Kaziranga's wildlife includes the great Indian one-horned rhinoceros, tiger, leopard, elephant, wild pig, hog deer, swamp deer, buffalo and many migratory birds, while Nambor Reserve Forest is rich in plant diversity.

The district's climate is tropical; hot and humid in summer and cold in winter. The average temperature varies from 10°C in winter to 38°C in summer. From December 2003 to November 2004 the average monthly rainfall was 92 mm; the highest rainfall was in July (439 mm) and lowest in November (10 mm).

In respect of road, power and communication, the district has relatively better infrastructure than the other districts surveyed for these appraisal reports. The Assam Human Development Report (2003) shows Golaghat having the third lowest Human Poverty Index (HPI), i.e. it has a lower proportion of human poverty in Assam (Table 2).

2.2. Rural economics and the role of pigs

Rural economy of Golaghat is agro-based and paddy is the main crop. Apart from paddy, tea and sugarcane are the most notable crops in the district. The operational holdings of farming families are small: about 61% have marginal holdings (less than 1 ha) followed by small (21%) and large (18%) holdings (Table 4).

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

District	Marginal	Small	Large	Total
Golaghat	82.6	28.6	24.7	135.9
(%)	61	21	18	
Dhemaji	45.4	16.9	14.2	76.5
(%)	59	22	19	
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	
Kokrajhar	59.5	19.7	14.6	93.8
(%)	63	21	16	
Assam	1669.3	561.0	452.7	2683.0
(%)	62	21	17	

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

Paddy cultivation occupies approximately 53% of the total cropped area. There are three types of paddy: *sali* (winter rice), *ahu* (autumn rice) and *boro* (summer rice). *Sali* is the major type (90%) followed by *ahu* (6%) and *boro* (4%). Of the total net cropped area about 35% is sown more than once; this is less than the state average (50%). The remainder lies barren for the most part of the year. Although the area under multiple cropping is less than the state average, the average paddy yield (2036 kg/ha) is reported to be higher than the state average of 1476 kg/ha, possibly because of more area under high-yielding variety (HYV) seed (67% of land under paddy) and irrigation (about 10% of total cropped area).

Apart from paddy, other significant crops are sugarcane, wheat and black gram. After Nagaon and Karbi Anglong, Golaghat is the third highest sugarcane producing district in the state with about 15% of total sugarcane production. Amongst fruits and vegetables, banana, papaya, pineapple, potato, cabbage and tomato are usually grown in the backyards of the majority of households. These homestead crops and vegetables not only meet household consumption needs but also generate cash income from sales.

Tea is the largest agro-based industry of the district. There are 63 large tea gardens[4] producing about 20,000 metric tonnes of tea per year. Besides, there are another 304 small tea gardens in the district with a registered area of 987 ha. Over the last 10 to 15 years small-scale tea growing has gained in popularity amongst educated youths, possibly because of unemployment and under-employment.

For the large majority of rural families, crop agriculture and rearing of livestock and poultry are integral to their livelihoods. Although it is more common for general community farmers to rear cattle, goats and poultry, the tribal communities prefer to rear pigs and poultry. The majority of the livestock (including pigs) and poultry are indigenous breeds or their crosses managed using traditional practices. Common property resources like hillsides, forestland, roadsides, playgrounds, school fields and riverbanks are the major sources of feed and fodder for the livestock.

In common with the other livestock species, piggery serves as a way of bringing additional income to rural families, principally the tribal communities. Like poultry- and goat-keeping, piggery requires only a low level of investment. Nevertheless, there

[4] Official website of Golaghat district (http://golaghat.gov.in/economy.htm)

are many instances where tribal people consider pig rearing as a primary source of livelihood in the district. Feeds for the pigs are mainly the by-products of paddy and other crops or are collected from common property resources (CPR). Pigs, therefore, serve to convert existing resources of low value into a high-value animal-source food which can be sold. In Golaghat's Sarupathar and Borpathar, as in Kamrup district, piggery is integrated with fishery. As with other livestock, keeping pigs helps households – mostly rural (Table 5) – to diversify their risks and improve livelihood security. Pig keeping also serves as a source of cash at times of need, for example, when farm households need cash for repairing of houses, taking land on lease, paying school fees and meeting day-to-day household expenses. Apart from pig rearing, a small section of people are also engaged in trading pork, slaughter pigs and piglets to earn their livelihoods. As Table 5 shows, unlike in other surveyed districts, pig production is not shown in the official statistics as a source of income generation for Golaghat's urban households.

In addition to the farming households, some rural dwellers work full- or part-time as farm labourers[5]. There are also some people engaged in wage labour, carpentry, transport operation, mechanics and petty trading (selling of fire wood, betel nuts, rice, country liquor, vegetables and fruits etc.) in small temporary retail shops.

Numaligarh Refinery is the only heavy industry in the district. Amongst non-farm activities in rural areas, weaving of cane and bamboo and making of earthen handicrafts are notable. However, only about 6% of Golaghat's population engages in weaving, and for the large majority it is a part-time occupation. Six percent of rural households are involved in sericulture. Rearing and reeling of *muga* and *endi*, making of *japi* (headgear) and extraction of *agaru* oil are the major cottage industries that prevail in Golaghat district. *Muga* silk and *agaru* oil extracted in Golaghat district are considered as superior. Long-necked earthen pots made in Dhekial and *japi* of Naharani of Dergaon are unique to the district in their style. In the absence of significant manufacturing units, the contribution of the secondary sector to the total Gross District Domestic Product (GDDP)[6] is low, only about 10% for 2000-01 at current price. The remainder is contributed by the primary (44%) and tertiary (46%) sectors.

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

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

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

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

Source: 17th livestock census (2003)

In summary, Golaghat's rural economy is agro-based and for the 10% of the population that is tribal and for some OBC communities, piggery is an integral part of their household livelihood strategies. Yet from the secondary information it was not clear the what the importance of piggery was relative to the other non-crop components of tribal household livelihoods (e.g. weaving), nor was it 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.

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, while others consider factors that may change the structure of the pig sub-sector. These hypotheses included:

1. In Golaghat, piggery is invariably a small-scale backyard enterprise that is practised by tribal and OBC communities that include Ahom and Chutiya.
2. Pig production by tribals and OBC serves several livelihood objectives including generating income, accumulating capital and providing a low-cost source of meat.

3. While it is recognized that the contribution of piggery to the livelihood of a household may be small, it is likely to be critical to the well-being of the women of the household.
4. Current systems of pig production depend upon family labour (particularly women) and on other local inputs (particularly feed) that are of no or low cost relative to the value of the pig being reared.
5. Traditional management practices continue to dominate production systems with the exception that indigenous pigs have largely been replaced by crossbreeds.
6. Despite the pig enterprise being market-oriented, the scale of production is invariably small and the level of purchased inputs low such that its contribution to the livelihood of a household is not large.
7. Currently, local feed resources define the scale of production of backyard enterprises. Therefore, improved feed resources and feeding practices will be the key interventions to increase the productivity and profitability of small-scale backyard piggery.
8. The market for 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 the change of food habits, consumption of pork among non-tribal people has increased.
10. If the demand for pork increases, it is expected that production will shift from small-scale rural backyard enterprises to large-scale peri-urban units using purchased inputs (particularly feed), i.e. traditional rural production will not 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 exotic crossbreeds reared more intensively.
12. Public interventions related to better access to technical knowledge will be required to support improvements in the productivity and profitability of small-scale backyard piggery.

3. Marketing of pigs and consumption of pork

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

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; SC: Scheduled Caste; OBC: Other Backward Classes

(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 also consume pork, so, at least for Kokrajhar, the NSSO statistics given in Table 7 may not reflect field reality. And given the number of tribal people in Golaghat, it is probable that the estimates for that district are also questionable. On the other hand, higher consumption in Karbi Anglong relative to Kamrup is consistent with the district's higher ST population. It was against this background that the field surveys examined the current marketing of pigs and the consumption of pork.

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

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

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 surplus in slaughter pig production, that is to say the supply of slaughter pigs exceeded local demand. This was possibly the result of the relatively larger herd size and increased commercialization of pig keeping in Golaghat and lower local consumption of pork. Pork retailers, pork and live-pig wholesalers and pig producers consistently indicated that current local demand for pork was being met fully by supplies from within Golaghat. Unlike in Kamrup and Karbi Anglong districts, pork retailers did not have to travel long distances in search of slaughter pigs. Likewise, pork retailers did not have to 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 Golaghat. From this information, it is estimated that the total volume of pork traded in Golaghat district is about 19,800 kg weekly or 2700 kg per day. This is the lowest amongst the surveyed districts, reflecting smaller size of the population in Golaghat that traditionally eats pork.

Based on the current availability of pork in the daily and weekly markets and an estimated human population in 2006 of 1.04 million, the per capita consumption in Golaghat district is estimated at 0.95 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 570,000 kg, which gives a per capita consumption of about 0.54 kg per annum. This is higher than the estimate of 0.08 kg derived from the NSSO round of 1999 to 2000 but lower than the estimate from our study. A major contributing factor to the

difference is that the AHVD report assumes an average yield of pork per pig of 19 kg, whereas the information gathered from the various markets in this study gave the average yield as 40 kg per pig. The lower proportion of ST people (over 10% of the total) and lower preference for pork over other types of meat amongst the general community people results in a lower per capita consumption.

Table 8: Quantity of pork sold through markets in Golaghat district in December 2006

Markets surveyed	Daily markets (kg)	Weekly markets (kg)	Weekly total (kg)
Golaghat	250		1750
Bokakhat	150		1050
Bihara		750	750
Sewaguri		200	200
Subjuri		750	750
Sarupathar		500	500
Numaligarh		600	600
Lakhowajan		150	150
Another seven daily markets like Bokakhat	150		7350
Another five weekly market like Sarupathar		2500	2500
Another 10 weekly markets like Lakhowajan		1500	1500
10% of total pork of the above markets is sold by occasional pork retailers			1500
Total			18800

Source: Market agents

People classified as "other than ST" communities, i.e. the Ahom, Chutiya and Tea tribe communities, traditionally consume pork. On the other hand, pork retailers and pig traders said that more households within the general community had started eating pork and that the number was increasing, perhaps because of changing food habits especially amongst younger generation. In light of the above, it can be presumed that the percentage of pork-consuming "other than ST" households in Golaghat is about 30%. Therefore, it is estimated that the total requirement of pork by 2010 will be about 1.36 million kg with a per capita consumption of about 1.24 kg based on the following projections and estimates:

i. A total of 105,000 pork-consuming households (ST) in 2010 and a current consumption of 0.5 kg/household twice a month (market source),
ii. About 30% of the "other than ST" community (Ahom, Chutiya and Tea tribe) currently consume 0.5 kg of pork twice a month,

iii. About 40% of the "other than ST" community will begin to consume pork by 2010, and

iv. Pork consumption will increase by 10% amongst the existing consumers (based on increased trend of consumption as reported by market agents) between 2006 and 2010.

To meet this increased demand for pork will require 34,000 slaughter pigs per annum (assuming a carcass yield of 40 kg per pig) compared to the current estimates of 25,000 pigs, an increment of 36%. Table 9 presents these calculations.

Table 9: Projection of demand for and supply of pork in Golaghat District, 2006 to 2010

Particulars	2006		2010	
Projected population	1,039,000		1,103,000	
ST Population (9.93%)	103,172		109,528	
ST households (av. size 5.21)	19,803		21,023	
Pork requirement @ 0.50 kg twice in a month/household		237,636		252,276
Increment among existing consumers (2006-10) 10%			10%	23,763
Other than ST households eating pork including OBC(30%)	59,827		84683	
Pork requirement @ 0.5 kg twice a month		717,924		1,016,196
Increment (2006-10)			10%	71,792
Total pork requirement (kg)		955,560		1,364,027
Current availability as per market survey (kg)		985,500		
Difference in estimation		29,940		
Pig requirement (40 kg av. yield/pig)		24,600		34,000
Projected pig population (based on growth trend from 1997 to 2003 @ 14%)		155,562		262,738
Slaughter pig (45% of total pig pop.)		70,002		118,232
Surplus of slaughter pig		45,402		84,232
Say total surplus pig		45,000		84,000

3.2. Current supply chain of pigs and pig meat

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

The output market of the pig sub-sector in Golaghat district has three principal products: weaner piglets, slaughter pigs and fresh pork. Weaner piglets are the first product in the production supply chain.

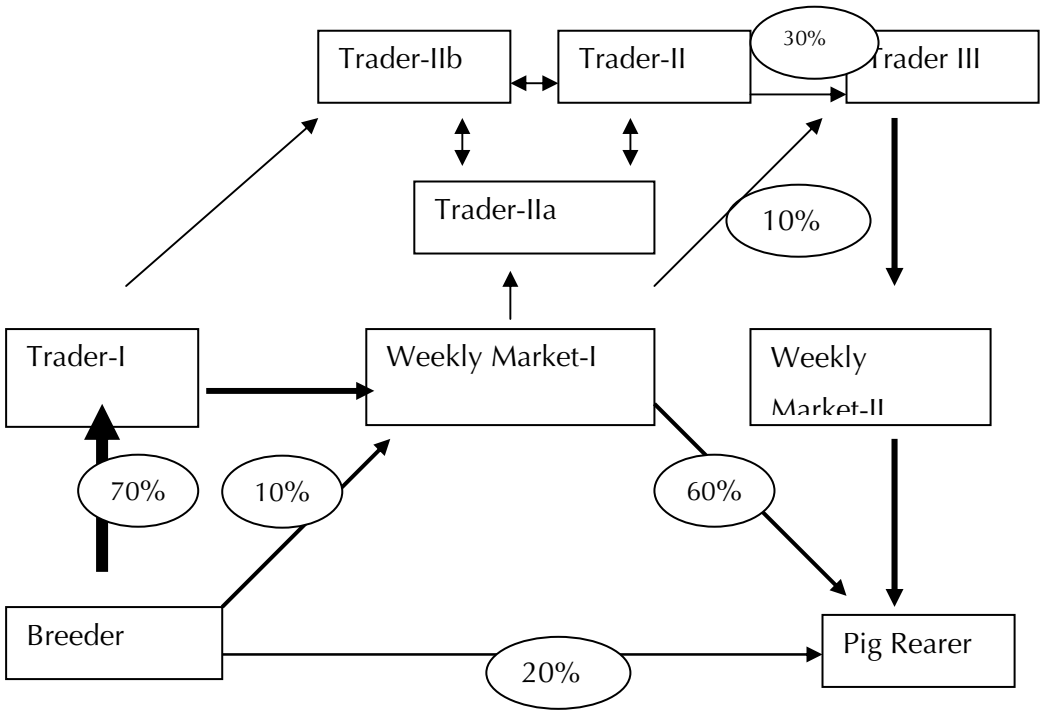
Piglets are produced in pig units which keep breeding sows. In Golaghat, the large majority of these units are small-scale backyard enterprises while about 20% are stall-feeding units. Piglets that are sold may be marketed in one of several ways (Figure 2), the simplest of which is direct sale by breeders to pig rearers. Piglets of known quality from reputed breeding units[7] are generally procured by producers, some even from far away places. On some occasions (an estimated 10% of sales), breeders visit the markets to sell their own piglets.

While 30% of marketed piglets move directly from breeders to rearers, the remainder are sold to traders (Figure 2: Traders-I, both men and women) who visit villages looking for piglets to procure. Unlike in Kokrajhar district, tribal women (Bodo) acting as Traders-I are not generally observed in Golaghat. Traders start searching and procuring piglets two or three days before the weekly market day (cases reported in Bihara). Sometimes breeders inform the traders about the availability of their piglets. The purchased piglets are transported by bicycle or public bus to the traders' homes. There they are kept in a stocking yard until the following weekly market.

Out of all the available piglets in the market, about 90% are brought by traders and only about 10% are brought by breeders. In Bihara market, there are about 30 to 50 traders (Traders-I) who collect and sell piglets. There is another group of 30 to 50 intermediate traders (Traders IIa/IIb) who procure piglets from Traders-I/breeders and sell them to Traders-II. On many occasions, piglets are procured and sold two to four times by intermediate traders in the market. In the process, the price increases from Rs. 20 to Rs. 100 per piglet. Finally, piglets are procured by local pig rearers or visiting traders from Nagaon, Karbi Anglong or Nagaland. Two to five traders from these areas

[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.

procure 10 to 20 piglets each. Transportation of piglets is done collectively by all traders in auto-van or by bus to their respective places. The cost of transportation comes to about Rs. 1220 per piglet. Visiting traders from other districts reported that during the time of transportation they have to bear some hidden expenses. There are also some groups of traders from Golaghat who procure piglets in local weekly markets (i.e. Sarupathar, Borpathar and Naojan market) for sale in Karbi Anglong (confirming information from traders in Karbi Anglong). The group keeps the procured piglets in its stocking yard (rearing costs are Rs. 2 to 3 per piglet per day) and visit weekly markets to sell them.



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

Trader-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/ breeder and sell them in their respective markets of the district/state

Market-I: Weekly markets of Golaghat district

Market-II: Weekly markets of other districts

Figure 2: Supply chain for piglet marketing.

Table 10: Estimated number of piglets sold in each weekly market

Weekly markets for piglets	Approx. number of piglets	Major destination outside the district
Bihara market	300-400	Nagaon, Karbi Anglong, Nagaland
Subjuri Sombariya market	50-60	Nagaon
Barpathar market	150-200	Karbi Anglong
Sarupathar market	50-60	Karbi Anglong
Naojan market	100-150	Nagaland, Karbi Anglong
Total	650-820	

Source: Market agents

In smaller weekly markets, the presence of visiting traders (Trader-II) from outside the district is not very common (cases reported in Subjuri market), resulting in a lower demand for piglets. On many occasions, traders cannot sell all the piglets. Therefore, they move from one market to another to sell the piglets until their stock is exhausted. In Bihara market, out of the total available piglets, about 10 to 15% are returned while in Subjuri market 70 to 80% are returned. It was reported that the supply of piglets to the Bihara market has declined. Five years ago, about 800 to 1000 piglets were sold in the market, two years ago 500 to 600 and in 2006 only 300 to 400. The market agents said that possible reasons for the change are the increase in number of weekly markets (e.g. Subjuri) in the area from one to four; more direct selling by breeders to pig rearers and the increase in the number of units that keep breeding females. Nevertheless, smaller weekly markets like Sarupathar, Barpathar and Naojan have an increasing number of piglets possibly because of procurement by neighbouring districts and states. In summary, the growth of piglet marketing in the district is not uniform. While some of the markets are showing an increasing trend, sales in others are declining. An estimated of number of piglets brought for sale in each weekly market is given in Table 10.

Figure 3 presents a summary of the costs that were reported in Golaghat for the supply chain for piglets. For comparative purposes, the figure includes the results from the other four surveyed districts. In Golaghat, as in Dhemaji and Kokrajhar, middlemen played a key role in the supply chain. Transport was the other important cost. An estimated 165 piglet traders served Golaghat and the net daily profit per individual trader was approximately Rs. 105. Given that in Golaghat 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 pig fatteners in the district.

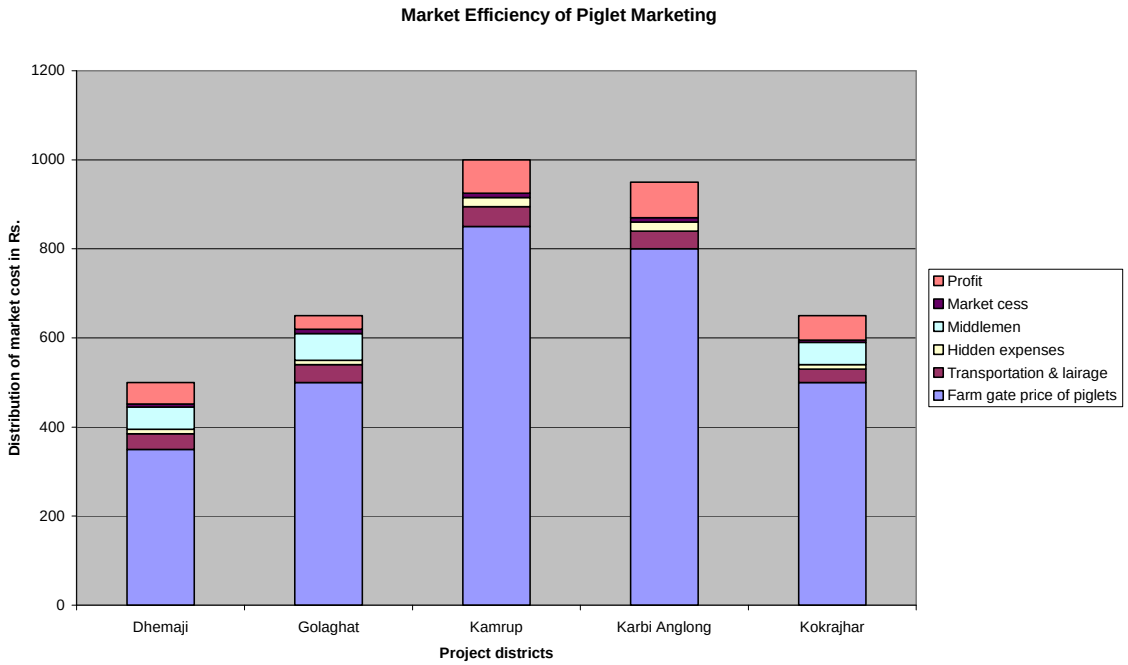


Figure 3: Marketing costs for piglets in Golaghat and the other four surveyed districts.

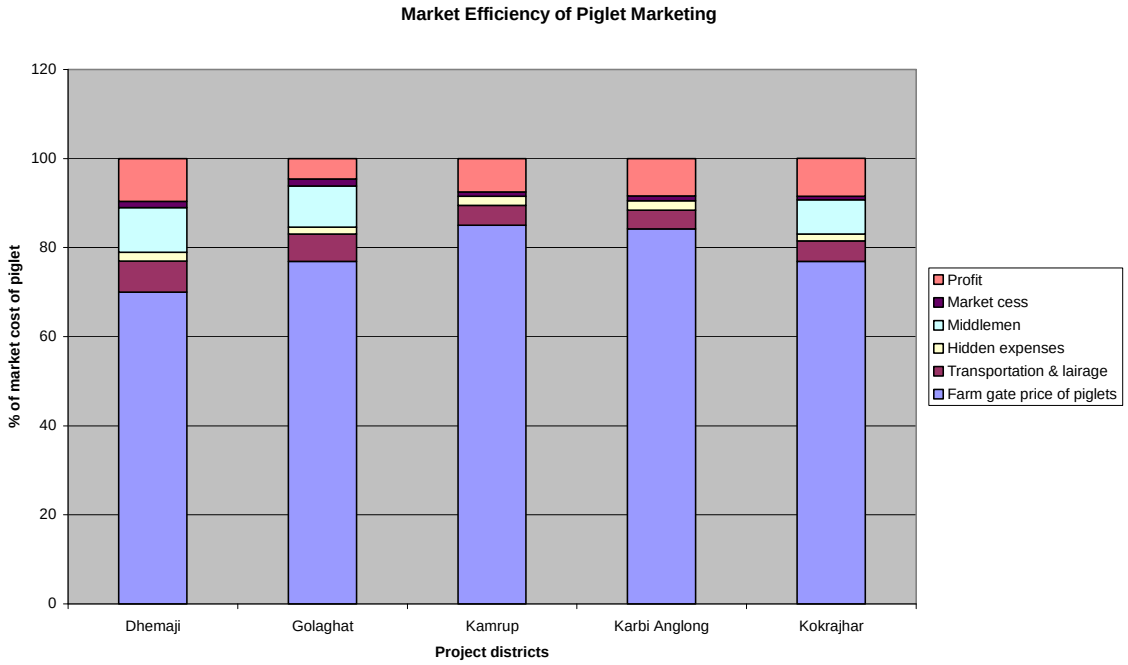


Figure 4: Relative marketing costs for piglets in Golaghat and the other four surveyed districts.

Supply chain for slaughter pig and pork marketing

The supply chain for slaughter pigs in Golaghat district is presented in Figure 5. As expected, some producers slaughter their own pigs and sell the pork in their villages or by the roadside. In Golaghat, this route is not large (about 10%) possibly because of a lower concentration of the ST community who generally retail pork. Another contributing factor may be the higher demand for slaughter pigs at the farm gate.

By contrast, about 60% of all slaughter pigs are sold by producers to pork retailers (Figure 5). Local retailers visit the villages to procure fatteners (slaughter pigs). Alternatively, producers go to the market to inform the pork retailers about the availability of slaughter pigs. Procured pigs are transported by bus, auto van or pulling cart to the retailer's stocking yard (generally near a market) where they receive feed and water which costs about Rs. 20 to 50 per pig depending on the number of days the pigs are kept in the stocking yard. Generally, one to three days elapse between procurement of stock and sale. Pigs are generally slaughtered near the market place and the offal is usually cleaned in a nearby stream or pond or well. Pork retailers work in groups of three to five; one or two roam around the villages to procure the pigs while the rest slaughter the pigs and sell the pork. As in Kamrup and Karbi Anglong, pork retailers reported that during winter (October to April) good quality hair is obtained from the pigs, which has good demand in the market. The hair is sold at Rs. 250 to 350 per kg to traders from outside the state.

Apart from local traders, traders from Nagaland and Karbi Anglong also procure slaughter pigs (about 30% of the total) from bordering areas of the district like Naojan, Sarupathar and Borpathar (Figure 5). They either approach the farmers directly or use local commission agents. Pig traders from Nagaland pay better prices than local Assam traders. Therefore, farmers prefer to sell slaughter pigs to traders from Nagaland. As a result, incomes and employment have grown as a result of opportunities for pig rearing and most producers in the bordering areas either increased their herd size or intensified their production practices. This has brought vibrancy in the entire pig production and marketing system in the bordering areas.

Pork retailers pay a fee to the market committee/lessee to sell pork in urban centres. The fee varies from market to market. In Golaghat town, for example, market retailers pay Rs. 15 per day while in Subjuri Sombariya market they pay Rs. 40 per pig.

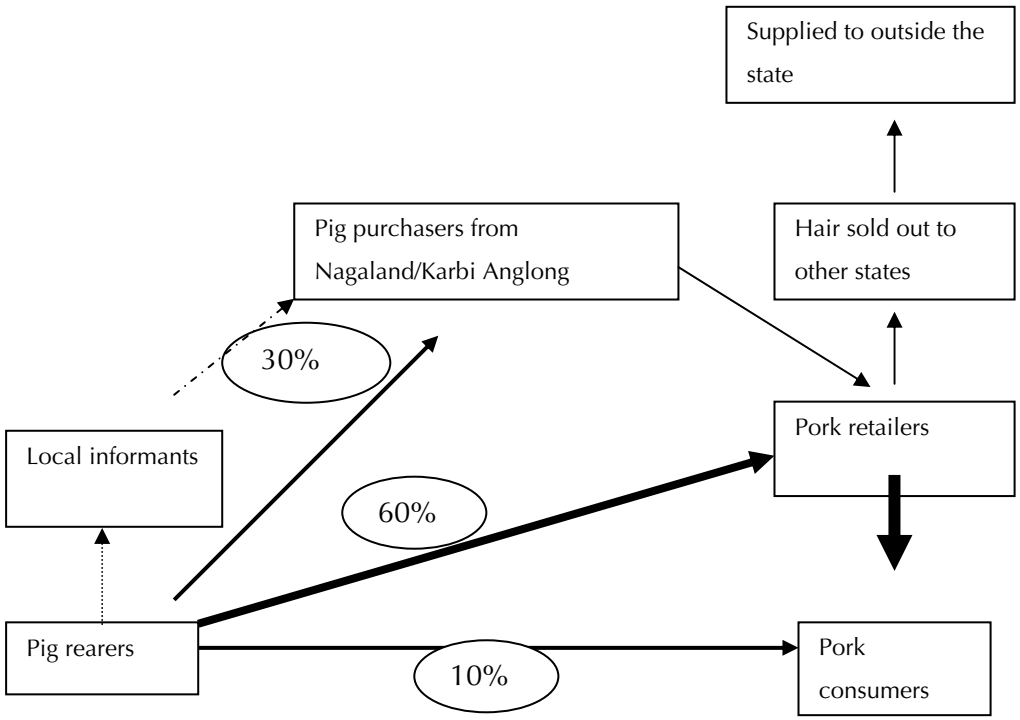


Figure 5: Supply chain for slaughter pig and pork marketing

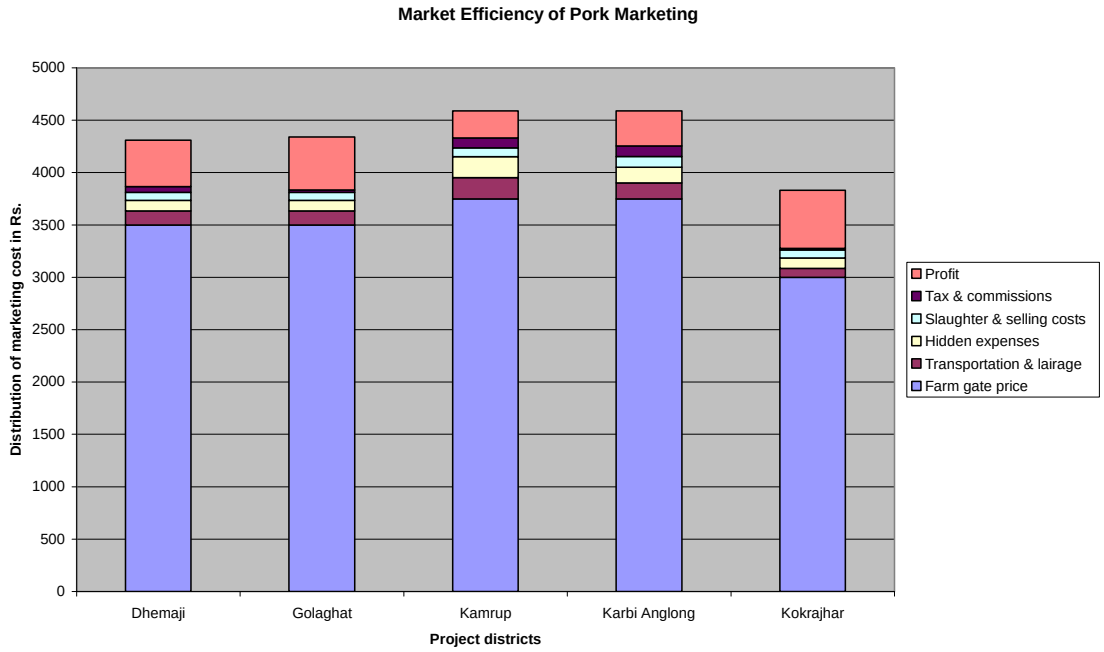


Figure 6: Marketing costs for pork in Golaghat and the other four surveyed districts.

Figure 6 presents a summary of the costs that were reported in Golaghat 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 individual trader was Rs. 145 and that that there were approximately 265 pork traders in Golaghat. That estimate, together with the 81% 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.

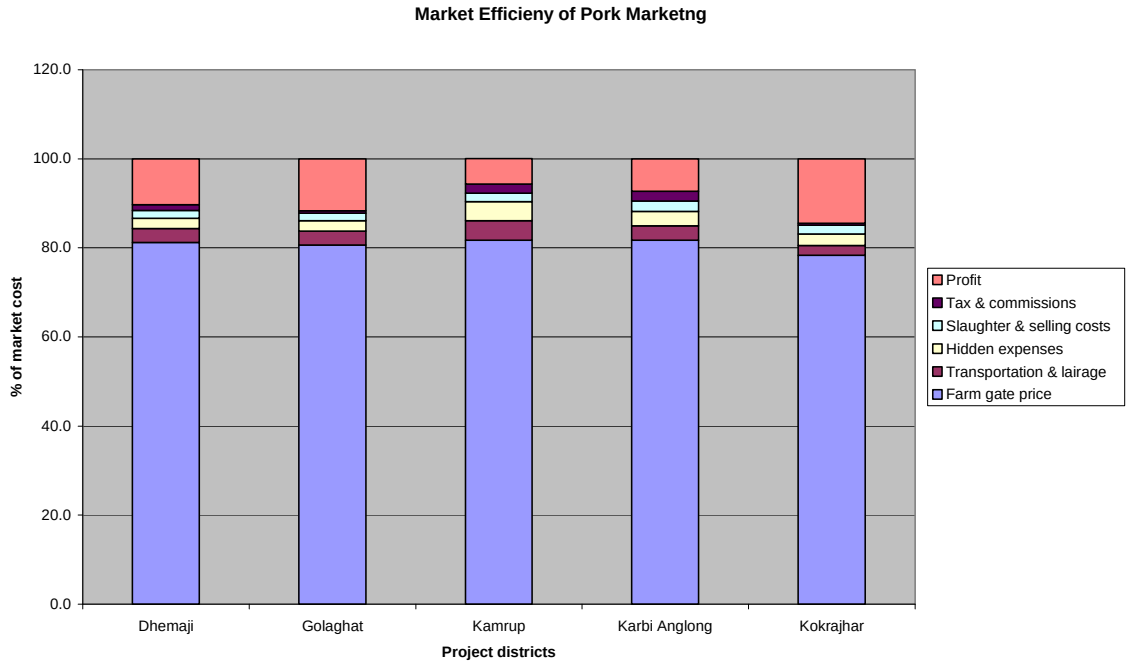


Figure 7: Relative marketing costs for pork in Golaghat and the other four surveyed districts.

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

The major inputs for pig production are piglets, labour, feed and veterinary supplies. In Golaghat, while about 20% of piglets are bought directly from breeders, the remainder are bought through the weekly village markets (see Section 3.2.1). Relative to these large numbers of piglets, the supply from public sector sources is negligible because there is no government pig breeding farm in the district. 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 piglets. Golaghat pig keepers mostly prefer black-coloured piglets with drooping ears and an elongated body and specifically the "Australian" types which are crosses between Large Black and indigenous pigs. They

are preferred because of their black colour, fast growth and larger litter size. Nevertheless, some Large White/Yorkshire pigs were also observed in Sarupathar area.

Piglets sold by stall-feeding units claim a higher price (Rs. 1000 to 1300 for a two-month-old piglet) than those from backyard units mainly because of better quality and higher cost of production. 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, the season when prices are higher. In surveyed markets, the prices of piglets varied from Rs. 300 to 800 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 Golaghat, 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. The use of commercial concentrate feed was not reported, although most stall-feeding units procure small quantities of feed ingredients like fish meal, maize and mineral and vitamin mixture. Major feed sources used by smallholder pig producers are rice polish, vegetables and kitchen waste. Use of the residue of rice-based country liquor (locally known as *juguli*) is not very common amongst the Ahom, Chutiya and tea tribe communities. Generally, only the Mising and Sonwal Kachari communities provide *juguli* as an important item of feed. Rice polish is 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. Similar to Kamrup and Karbi Anglong districts, two qualities of rice polish are obtained in the market: no. I and II. No. I quality is obtained from sheller mills and no. II quality from huller mills. Due to the differences in milling, no. I rice polish is reported to be smoother in texture and more palatable than no. II. Producers are of the view that pigs can grow faster when fed no. I rice polish. This is reflected in their prices: Rs. 7 to 8 per kg of no. I and Rs. 5 to 6 for no. II. Tribal households with surplus *juguli*, sell it to nearby villagers at Rs. 5 to 10 per 5 kg tin of rice. Other feed ingredients like maize, wheat bran and fishmeal cost Rs. 8.50, Rs. 9.00 and Rs. 12.00 per kg, respectively. The women in pig-keeping farming families are generally responsible for procuring piglets and feed.

In respect of veterinary supplies, no private veterinary clinics were reported in the surveyed areas. Veterinary medicines are generally sold in human medical clinics. Pig keepers travel long distances from remote rural areas to procure medicine from these private veterinary clinics or dispensaries. When interviewed, the human clinician in Kamargaon reported that producers' awareness about various diseases of pigs and their preventive measures has increased significantly. This is reflected in the volume of sales of veterinary medicines. Of the available medicines, sales of deworming drugs are the highest followed by mineral and vitamin mixture and antibiotics.

3.3. Pig meat consumption and preferences

Marketed non-vegetarian food in Golaghat mainly comprises chevon, chicken, pork, fish and eggs (milk and dairy products are classed as vegetarian food). Since more than half of the population living in Golaghat is from the general community, the demand for chevon, chicken (especially duck amongst the Ahom community), fish and eggs is presumed to be relatively higher than pork. Demand for beef is only recorded in Muslim-dominated areas. Information from our interviews suggested that all tribal, Ahom and Chutiya people irrespective of age, sex or educational qualification, consume pork. Similarly in rural areas, the demand for pork was found to be significant only in traditionally tribal- and OBC-dominated areas. 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 generally in the district and particularly in urban centres like Golaghat and Bokakhat.

Consumers prefer fresh, warm, newly-slaughtered, bright-coloured pork rather than frozen or leftover pork. Pork from fattener pigs of 40 to 80 kg body weight is more preferred than pork from boars or sows. 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) but it was reported that equal quantities of fat and lean meat were sold. Unlike Kokrajhar district, there is no price difference between pork from indigenous and cross-bred pigs. Some poor people consumed the feet, head and offal, which were sold at Rs. 30 to 50 per kilogram.

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 whole Assamese Community) and *Holi* (the festival of colour of the Hindu society). Demand for pork was higher on Sundays in urban areas and on weekly market days in rural areas. In rural areas, pork is usually sold in the weekly markets. People mostly consume pork on the market day. Market agents reported that there were about 20 weekly markets in the district and that the total number of pigs slaughtered in the weekly markets was about 200 per week. The price of pork in weekly market varies from Rs. 80 to 90 per kg. The price of pork usually did not vary by season because market committees controlled it. However, once the price increased, often during the festival season, it did not come down and generally remained unchanged for at least another year. Over the last five years, pork prices rose by 30% or more in both daily and weekly markets. Once inflation is discounted, this relates to a price rise of approximately 15%.

The price of pork was lower than that of chevon and chicken but higher than that of broilers. Consumers who were interviewed (especially non-traditional pork consumers) said that though the price of pork was relatively lower, taste not price was the prime criterion for its consumption. Among tribal people, pork was the first choice irrespective of its price. Customers were said to be good bargainers in rural markets where prices vary based upon the number of pork retailers available in the market and the demand-supply situation of pork. The variation of price was reported to be higher in winter than summer months, mainly because of more irregular/occasional pork sellers during this period who have more leisure time after harvesting paddy. In addition, for rural pork retailers, it was an occasional activity and they did not have storage facilities. Therefore, on many occasions retailers sold pork at a lower price later in the day to minimize losses. In urban areas, price varied much less because pork retailing was a regular business and there were alternative markets for unsold stocks, e.g. to hotels/restaurants. Unlike in the other surveyed districts, in Golaghat town pork retailing is mostly by the Sweeper community.

From the interviews with the wide range of informants, it was concluded that in addition to the tribal communities who are traditional consumers of pork, about 30% of non-tribal consumers including OBC are now eating pork. It was also concluded that the trend of increasing pork consumption is expected to continue at the rate of about

2.5% per annum within the non-traditional pork consuming households as a result of changing food habits and increased purchasing power arising from the growth of the economy. Current trends suggest that the quantity and frequency of pork consumption will also increase among current consumers within their households and in fast-food restaurant and hotels.

3.4. Food safety and human nutrition issues

One potential food safety risk associated with pork and pig production is the infestation of pigs by worms, particularly the zoonotic tapeworm *Taenia solium*, which can be transmitted among humans and between humans and pigs causing neurocysticercosis. Humans can acquire taeniosis (tapeworm infection) through eating pork. Consumers who were interviewed said that in order to reduce the risk of worm infestation, they always cooked pork by boiling it for a long time. Customers ascertain the quality of pig meat by visual inspection and previous experiences. Moreover, when buying pork, experienced consumers always looked for the presence of cottonseed-like follicles (measly pork) in the meat and did not buy the pork if these were present. Likewise, pork retailers also reported taking utmost care at the time of procuring slaughter pigs from producers. They look for cottonseed-like follicles in the eyelids and tongue of the pigs, an indication of infestation with worms, and do not buy infected pigs. Therefore, it appears that in Golaghat district, local knowledge of the disease and its manifestation and traditional cooking practices greatly reduce the risks to human health from cysticercosis.

In Golaghat, as elsewhere in Assam and throughout the NE region, there is little or no formal infrastructure for slaughtering of pigs or for the display of pork. The general practice is that pork is sold at the market place displayed on a wooden platform, gunny bag or polythene sheet without any measures for hygienic slaughtering or sale of the pork. Another unhygienic practice is that in some places pork retailers mostly use water from ponds, tanks or rivers to clean the offal, putting at risk the health of consumers. Other serious risks to human health can arise from the practice of slaughtering diseased pigs and selling the meat to consumers.

However, there is no specific regulation for registration and inspection of pork outlets under the Golaghat town committee. It was also stated that there is inadequate

coordination among the town committee, AHVD and police administration; this is the main reason for the lack of effective inspection of pork markets.

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 Golaghat district:

1. Consumption was exclusively of fresh pork, the demand for which was growing quickly in both urban and rural areas although the current per capita consumption is still lower than in the other surveyed districts.
2. Demand for pork was higher during winter than summer and at some festivals. In rural areas, consumption was mainly on the day of the local weekly market.
3. Price of pork generally did not vary by season, but it had increased about 30% during the last five years (by about 15% in real terms, i.e. after inflation is discounted). Nevertheless, preference for pork was based on taste rather than price. Fresh pork from young pigs of 40 to 80 kg live weight was more preferred than pork from pigs of more than 100 kg live weight including breeding boars and sows.
4. Although there were some clear consumer preferences based on taste, there was no price differential between lean and fat pork in Golaghat. Likewise, pork from indigenous pigs was not found to be more expensive than pork from crossbred pigs.
5. Detailed consumption studies are required to validate the preliminary projections of the increased demand for pork (presented in Section 3.1) and to define and quantify consumer perceptions of quality, including aspects of taste, appearance and composition.
6. Currently retail sales of pork, both in urban and rural areas, are mainly through informal markets of poor hygiene, which have inadequate infrastructure and are served by under-resourced institutions. There are no specific regulations or inspections to ensure consistent hygiene and food safety standards.
7. Although there is concern among consumers and pork retailers about measly pork (infestation of pork by the zoonotic tapeworm *Taenia solium*), traditional knowledge and food cooking practices reduce adverse impacts on human health and on the consumption of pork.

8. Currently, even in Golaghat, there is irregular pre- and post-mortem inspection of pork by the town committee because of absence of a slaughterhouse, government regulation and inadequate manpower and physical resources.
9. These deficiencies in public health measures should be addressed through risk analysis along the production-to-consumption value chain. Required is a structured evaluation of the practices of pig producers, traders and pork retailers. 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.
10. Similar to Dhemaji district, Golaghat produces slaughter pigs and piglets surplus to local requirements which are mainly sold to the neighbouring state of Nagaland and to Karbi Anglong district of Assam. Owing to the wide gap between demand and supply of slaughter pigs and piglets in Nagaland, traders procure more pigs from Assam, especially from bordering areas of Golaghat. Furthermore, the traders from Nagaland pay higher prices than local traders, such that producers are more inclined to sell their slaughter pigs to Nagaland traders. The excellent market opportunities at the farm gate coupled with remunerative prices have encouraged many pig producers to increase their pig production and its productivity by increasing their herd sizes and/or shifting to stall-feeding.
11. 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) by police added to marketing costs during the transport of piglet slaughter pigs and pork, increasing the cost of meat to consumers and reducing the profits for producers. An awareness program is required for all participants in the market chain: producers, traders, police and other officials.

4. Pig production systems

4.1. Ethnic and geographic distribution

Pig production is widely distributed in Golaghat because of the presence of pig rearing ST and OBC communities throughout the district. In our study, three areas were surveyed based on their ethnic and geographic diversity and accessibility: Golaghat town, Kamargaon and Sarupathar (Figure 1 and Table 11). Pig production in the Golaghat area is practised by the Sweeper and Ahom communities, while in Kamargaon area it is a popular activity amongst the Mising, Tea tribes and Sonowal Kachari communities. Ahom, Chutia, Shyam and Nepalis (especially Limbo, Rai, Thapa sub tribe) are the main communities that keep pigs in the Sarupathar area. Pig rearing amongst the Ahom and Chutiya communities is less prevalent (about 60%) than amongst other tribal communities. Our surveys found that in the Sarupathar areas, a few general community households have started to keep pigs, but these are less than 1% of all households.

4.2. Classification of production systems

Table 11 shows the characteristics of the pig production systems by ethnic group in the three clusters. Amongst the Mising, Sonowal Kachari, Ahom and Chutiya communities, pig production plays an important socio-economic role. As well as pork being considered by tribal households as an essential commodity for every religious and social festival, pig production is an important income-generating activity. Over 90% of Mising, Lalung and Sonowal Kachari households and about 60% of Ahom and Chutiya households rear pigs. Fattening (purchase and feeding of pigs for slaughter) is more common amongst the Ahom, Chutiya, Lalung, Kachari and Tea tribe communities, while breeding is more common amongst the Mising community (Table 11).

Table 11: Socio-economic and production characteristics of the pig systems of Golaghat District

Ethnic groups and their areas	% House-holds with pigs	Pig Pop. (%)	Livelihood Importance	Herd type	Surplus + or deficit -	Source
Ahom/Chutiya: Sarupathar, Borpathar, Merapani and other parts of the district	60	60	Important	Breeding: 10% Fattening: 80% Breeding cum fattening:10%	Fattener + Piglet +	Visiting traders/ weekly market
Mising: Kamargaon Gonmari, Merapani	90	10	Important	Breeding: 50% Fattening: 10% Breeding cum fattening:40%	Fattener + Piglet +++	-do-
Lalung/Kachari Sarupathar Kohara Kakodonga	90	10	Important	Breeding: 10% Fattening: 80% Breeding cum fattening:10%	Fattener + Piglet -	Visiting traders/ weekly market
Tea Tribes: Kamargaon, Borpathar, Bihara	70	10	Important	Breeding: 10% Fattening: 80% Breeding cum fattening:10%	Fattener + Piglet -	-do-
Sweeper/ Shyam/Nepali/ Golaghat Sarupathar Borpathar	20	10	Important	Breeding: 10% Fattening: 80% Breeding cum fattening:10%	Fattener + Piglet -	-do-

Source: key informants during field survey

Women are mainly responsible for the care and management of the pigs (Table 12) and the income generated is 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. For many years the Sweeper community living in Golaghat town used to rear scavenging pigs but have now shifted to stall-feeding mainly because of scarcity of land and gradual dissatisfaction among

their neighbours over the disturbance, noise and dirty habitat caused by the scavenging pigs. In the district, about 20% of pig-keeping households had stall-feeding units that were managed with or without any hired labour. In the recent past, many backyard units have changed to stall-feeding and/or increased their herd size from one to three pigs to as many as six especially in border areas of Golaghat district (Sarupathar, Barpathar and Naojan). This group of producers generally considers pig rearing a primary source of livelihood. In these units, it was the man rather than the woman who had the key role in all decision making (Table 12). In summary therefore, pig production in Golaghat, which was mostly limited to tribal and OBC communities, can be termed a small-scale market-oriented enterprise.

A section of the interviewed households, especially from Mising and Tea tribe communities, reported lack of finance as one of the major problems that limit pig rearing. It was reported that micro-credit systems were weak. Currently, credit for smallholders comes from local moneylenders or thrift societies, which were generally exploitative in nature. It was reported that insurance companies were not keen to insure smallholder piggery units in the district.

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

Management type	Units %	Breed type	Housing	Main manager	Manure use
Scavenging	10	Crossbred		Mostly female	Not used
Tethered/ penned	70	Crossbred	Tethering 40% Enclosure 60%	Mostly female	Not used
Stall-fed	20	Crossbred	Permanent shed	Mostly male	Fish feed or manure

(Source: key informants during field survey)

The pig management systems in Golaghat district can be classified broadly into three groups: scavenging, tethered/penned and stall-fed (Table 12). The herding system of pig management, which was earlier practised in some parts of Assam and other parts of South and Southeast Asia, is not seen in Golaghat district. The current systems of pig management in Golaghat are discussed below.

Scavenging: The scavenging system of pig management was the predominant system in Golaghat amongst the Mising community. Approximately 10% of the pigs owned by the Mising community, the major tribes in riverine areas of the district, are reared under this system. Of the total pig-rearing households, about 50% owned breeding herds, 10% owned fattening pigs and remainder breeding and fattening pigs. The Mising community traditionally rears pigs under the Chang Ghar[8]. During the day, the pigs move freely around the homestead in search of feed. In the night or hot hours of the day, they take shelter under the Chang Ghar. While scavenging, pigs consume shoots of grasses, roots, earthworm, insects, tubers of Colocasia etc. In the morning and evening they are provided with feed made of rice polish, juguli and/or Colocasia (depending on availability). As informed by the interviewed households, the system is advantageous because pigs are well protected under the platform from rain, heat and cold. Pigs also require less labour and less feed as they consume leftover food under the Chang Ghar and from the surrounding. Nevertheless, with the gradual shrinkage of grazing land, some people are restricting the movement of pigs to their own premises or on the roadside by tethering (with a long rope and frequently changing the position) in order to prevent damage to crops. In common with Dhemaji district, pig production by the Mising community in Golaghat (Kamargaon cluster) suffers greatly from annual flooding.

Tethered/penned: In the survey clusters, about 70% of households managed one to six pigs under this system, of which about 80% of households kept fattening pigs (pigs being reared for slaughter) while about 10% kept pigs for breeding, i.e. for the production of weaners. The remaining 10% of households kept breeding and fattening pigs. Both tethering and penning were observed in all the surveyed clusters, although occurrence of penning was much higher than tethering. Tethered pigs were shifted every two to three days from one place to another within the backyard to keep the place clean and dry. When pigs are penned, the pen is usually kept in the same place throughout the year without frequent cleaning; this results in an unusually dirty habitat. Some research carried out in Assam suggests that pigs reared on mud floors achieve higher weight gains than those on a concrete floor (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

[8] A house made over a platform made out of bamboo or timber. People live in the house over the platform and pigs are kept below the platform.

required feed and water within the enclosure two to three times a day. The pigs were mostly crossbreeds and herd sizes usually did not exceed six for fattening units or three for breeding units, although there were also reported cases of herd sizes of up to 26 pigs under this condition in the Sarupathar area. Herd sizes in the Sarupathar-Borpathar area were found to be relatively higher than in most other parts of project districts, possibly because of the ready availability of rice polish; lack of rice polish is generally considered the major factor that limits herd size in other surveyed areas. The more ready availability of rice polish may result from relatively large land holdings (1.5 to 3.0 ha) and high productivity of paddy (Section 2.1). Similar to Sarupathar-Borpathar area of Golaghat district, larger herd sizes were reported in the adjoining Silinajan area of Karbi Anglong district.

Stall-fed: About 20% 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. Some of the stall-fed units were integrated with fishery, especially in the Sarupathar area, in which pig manure was used as fish-feed. A few pig producers that use stall-feeding had been trained on scientific pig management by the AHVD, District Rural Development Agency (DRDA), or Assam Agricultural University (AAU). These trained producers (cases reported in Sarupathar) became the key motivators and role models for educated youths in the area to start stall-feeding units. In most stall-fed units the number of pigs managed was between 4 and 15, though there were some bigger units of up to 40 pigs in Sarupathar cluster. The type of pigsty construction may affect pig performance. Research in Assam has shown that intensively fed pigs on a concrete floor with an asbestos roof performed better than those on an earthen floor with a tile roof (Kumar *et al.*, 2004).

The performance of pigs in the three management types is shown in Table 13. In the study areas, farrowing intervals for stall-fed and tethered/penned sows were reported as six to eight 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 60 to 80kg, 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 (7 to 16 and 6 to 12, respectively). Breed differences may explain some of the variation; the majority of pigs kept by Golaghat producers are Large Black crosses 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, field practice was 30 days or later (Table 13). Research in Assam indicated that better post-weaning growth could be achieved when weaning is 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 affect piglet survival.

Table 13: Performance of the predominant pig breed type in the three management types, Golaghat district

Production criteria	Performance		
	Stall-feeding	Tethered/penned	Scavenging
Farrowing interval, months	6-8	7-8	7-9
Expected no. of litter in life time	4-8	4-8	4-8
Litter size at birth	7-16	5-12	5-12
Litter size at weaning	6-12	4-10	4-8
Age at weaning, days	30-60	40-60	45-75
Weight of fatteners at 10 months of age (kg)	60-80	50-60	40-60

Source: key informants during field survey

4.3. Breeding and reproductive management

As mentioned above, the field surveys revealed that the current stock of pigs in the clusters is mainly Large Black crosses (with indigenous pigs) along with some Hampshire and Large White/Yorkshire crosses.

Amongst the crossbreeds were pigs with characteristics of two to three breeds, a result of the apparently haphazard crossbreeding by pig producers. Consequently, it was not possible to ascertain the degree of exotic blood in the different crosses and it was assumed that there is large variation. Pig producers in Golaghat bought breeding stock from two sources: small-scale breeding units and stall-fed units. It is estimated that of all the available breeding stock in the district, about 80% comes from small-scale breeding units and the remaining 20% from 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 well-managed pig units.

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 they are 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 replaced by its own progeny or the producers procure piglets from others. Of the households using the tethered/penned system (70% of all producers, Table 12), around 20% were reported to keep one to three sows, some with a breeding boar. It was said that about 10% of breeding households kept a boar. Those without a boar use the boar from other households in the village and pay Rs. 50 to 300 for each service. The fee is reported to be higher in Sarupathar area while it is lower in Kamargaon area because of more breeding herds. Informants estimated that a boar gives five to six services a month. Intensity of service is almost the same throughout the year, although mating during June to September is preferred 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 weaning occur when sows farrowed during 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 crossbreeds, beyond a general preference for Large Black crosses. There was no evidence of systematic crossbreeding, of organized selection of breeding boars or of efforts to maintain specific male:female ratios of breeding stock in a village. Sows were reported to be usually served by the boar available with a neighbour. Producers were more concerned about the litter size and its growth performance than its genetic composition. 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 a major management change in pig production systems in Golaghat district in recent times. Other new management practices are the adoption of stall-fed units, deworming drugs and mineral and vitamin mixture by some producers.

Smallholder pig producers said that they practised weaning at 45 to 75 days of age based upon the market demand and price of piglets. Some of the stall-feeding in Sarupathar units even reported weaning at 30 to 40 days of age in order to reduce the farrowing interval to obtain two litters in a year, although the reported average field performances (Table 13) did not reach two litters annually. A section of stall-feeding units provided broiler starter rations to piglets to form a habit of taking feed from the age of 20 to 25 days. Breeders were of the view that early weaning did not have any adverse impact on the survivability or growth performance of piglets. Some research in Assam (Nath *et al.*, 2003) reported higher mortality with shorter farrowing intervals (200 days). During the surveys it was apparent that the breeders were not aware of any recommendations related to age at weaning.

4.4. Feeding management

As reported in Section 3.2.2, in Golaghat (as elsewhere in Assam), the large majority of households feed their pigs using family labour and feeds produced or procured by the household on the smallholder farms and in their backyards. The major feed source is rice polish. As mentioned in Section 4.2, rice polish is available in some parts of the district like Sarupathar and Borpathar areas, possibly because of larger land holding and better productivity of paddy. Thus, the producers were found to be more equipped to respond to the marked demand for pork by way of increasing the herd size. Unlike the other surveyed districts, *juguli* is not a common feed resource for the pig-rearing communities other than Mising and Sonwal Kachari communities. Ahom, Chutiya, Sweeper and Tea Tribes communities do not prepare country liquor regularly, resulting in occasional use of *juguli* as pig feed. Another common feed is *Colocasia* (*Colocasia esculenta*) or taro, the tuberous plant that grows naturally in low-lying areas of many household gardens in Golaghat and elsewhere in the region. Table 14 presents the feed resources reported by the various ethnic groups. As well as rice by-products and *Colocasia*, vegetable and fruit residues and kitchen waste are common feeds. On the other hand, purchased feeds, apart from some crop and milling by-products, are not frequent and, except for a few small-scale commercial units, 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 Golaghat district

Ethnic groups	First major component	Second major component	Third major component	Occasional feed resources
Ahom	Rice polish	Kitchen waste	Banana, *Colocasia*	*Juguli*
Chutia	Rice polish	Kitchen waste	Banana, *Colocasia*	*Juguli*
Mising	*Juguli*	Rice polish	Kitchen waste	*Colocasia*, banana
Sonowal Kachari	*Juguli*	Rice polish	Kitchen waste	*Colocasia*
Tea labourers	Rice polish	Kitchen waste	-	*Colocasia*
Sweeper	Hotel waste	Rice polish	-	*Colocasia*
Stall fed units	Rice polish	Wheat bran, kitchen waste	Maize, Fish meal	*Colocasia*, vegetables, banana, water hyacinth

(Source: key informants during field survey)

While some producers (especially breeders) provided wheat bran, oil cakes and fish meal to their pigs, many others reported that they gave eggs to breeding boars before and after natural service. But the large majority of backyard producers were not aware of the existence of such feeds or of their nutritional qualities.

As noted in Tables 14 and 15, kitchen and hotel food waste (the latter especially in peri-urban areas) are also fed to pigs. The Sweeper community mostly depends on hotel waste to feed pigs. The availability of hotel waste may explain the significantly higher body weights of piglets maintained in peri-urban areas compared to rural areas in India reported by Kumar *et al.* (2005). Other feeds that were mentioned during the surveys included: water-hyacinth, banana leaves and discarded potato and cabbage from vegetable markets.

Table 15 presents the reported seasonal availability of the feed resources used in the surveyed areas. Rice polish tends to be scarce and costly during July to October when the old stock of paddy is exhausted and the new crop has not been harvested. As

explained in Section 3.2.2, there are two qualities of rice polish of which no. I is reported to give faster growth and costs more.

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

Main Feeds	Jan-Feb	Mar-Apr	May-June	July-Aug	Sept-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
Kitchen waste	A	A	A	A	A	A	Fresh
Hotel waste	Sc	A	A	A	A	Sc	Fresh
Colocasia	NA	NA	A	A	Sc	NA	Cooked
Banana/vegetables	A	A	A	A	A	A	Fresh/cooked
Water hyacinth	NA	NA	A	A	Sc	Sc	Fresh/cooked

A: available NA: not available Sc: scarce

Source: key informants during field survey

Hotel waste was reported to be scarce during winter mainly because of re-use of leftover hotel produce the following day. *Colocasia* and water hyacinth grow naturally in the wetlands in and around the homestead during April to November while in other months, these were reported to be scare. *Colocasia*/taro is a common pig feed in other parts of the tropics and there are current research projects by the Australian Centre for International Agricultural Research (ACIAR) aiming to improve taro production (http://www.aciar.gov.au/web.nsf/doc/ACIA-6NE7TR). The results of these projects could be relevant to Assam and elsewhere in India.

It is clear, therefore, that the reported feeding practices are almost invariably dependent on locally available feed sources which, when fed at traditional levels to young crossbreeds, result 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 Assam include buckwheat

and various legumes (Gupta and Bujarbaruah, 2005), maize grain up to 80% and rice polish up to 50% along with good quality vegetable protein and mineral mixture (Gupta, 2006) and raw sweet potato tubers up to a maximum level of 40% dry matter (Yadav *et al*., 2003). Other studies in Assam have examined factory tea waste (Chetia *et al*., 1991), garbage (Bora, 1999) and cabbage (AICRPP, 2005). Presenting these options to pig producers using participatory methods to evaluate their fit relative to the availability of household labour, land and other resources, would be one way to move towards faster growth rates and increased throughput from existing units. Other options, such as ensiled sweet potato vines and tubers (Gupta, 2005; Peters *et al*., 2005; Beckmann, 2006; Ilangantileke, 2007), quality protein maize (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. It must also 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 and some non-specific problems like hernia, abscess and closed anus/eyelids among piglets. Veterinary informants said that incidence of swine fever was lower as it was not considered a major threat to the pig sub-sector in the district. It was confirmed that parasitic infestation was more common when pigs scavenged or were tethered, as reported by Bandyopadhyay (2002).

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 presented risks to public health.

It was reported that incidence of vaccination of pigs against swine fever is very low in the district. This is because of inadequate knowledge of this preventive measure, low availability of the vaccine and the fact that when available, the vaccine 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 lacked a supply of medicines and vaccines, especially for swine fever, and that the supply from private clinics was irregular.

Producers were said to visit government veterinary dispensaries quite frequently when they need any technical advice from the veterinarian, reflecting the importance of pigs in supporting livelihoods. Better road connectivity and higher concentration of veterinary dispensaries will lead to better accessibility of veterinary services in Golaghat and Sarupathar cluster. In Kamargaon cluster, as in Dhemaji district, access to veterinary services was poor because of poor road connectivity arising from floods that recur every year. Many of the producers were said to call a veterinarian to treat their diseased pigs; a visit and some cheap medicine cost Rs. 30 to 100. Veterinary Field Assistants (VFA) were paid lower fees than the VAS and therefore the majority of producers preferred to call the VFAs. Use of herbal or traditional medicine was not very popular, while some poor households used human medicine like paracetamol tablet or anti-diarrhoea drug. Feeding of fishmeal was also reported when pigs were found to be anorexic.

It was clear from the surveys that the level of awareness among producers of the diseases that affect their pigs and the possible preventive measures was very low, especially in Kamargaon cluster and amongst the Sweeper community. Research in India (as elsewhere) has shown that education level, size of the 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 also 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 Golaghat district. There are also some important issues that relate to the constraints to and opportunities for improving pig production to generate income and increase livelihood security:

1. Consistent with the hypotheses presented in Section 2.3, piggery in Golaghat is a small-scale backyard enterprise practised by tribal and OBC 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.
2. Despite being small-scale (generally one to six 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 – are major factors that limit the scale and efficiency of pig production. Therefore, improved feed resources and feeding practices (e.g. to overcome the feed deficit in July to October when rice polish are 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 mentioned in Section 4.4, pig production and marketing in the cluster is vibrant due to availability of rice polish coupled with excellent market opportunities attributed by Nagaland traders in Sarupathar area. To tap the excellent market opportunities, some producers have shifted from the tethered/penned system to stall-feeding and/or increased their herd sizes. To overcome the limitation induced by feed scarcity in this area, some producers synchronized the October to July production cycle with the availability of feed, kept more pigs when rice polish was readily available and reduced the herd size before the onset of scarcity. Some owners of rice mills started stall-feeding.
5. Locally-available feed resources (with their strong dependence on rice by-products) lacked protein, mineral and vitamins relative to energy. This deficiency could be offset by feed milling units and feed suppliers selling a low-cost feed supplement

(e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units. Other possible interventions to improve the feeding of pigs are some of the non-conventional feed resources (e.g. rice bean – *Vigna umbellata* – and legume forages) and improved varieties (e.g. tapioca, *Colocasia*/taro and sweet potato) documented by various R&D organizations.

6. It was clear that in Golaghat's pig pockets, traditional management practices continue to dominate production systems with a few exceptions; most indigenous pigs have been replaced by crossbreeds, herd sizes have increased amongst some of the households and the tethered/penned system of rearing has transformed into stall-feeding amongst a section of households, especially in the bordering areas of Nagaland.
7. There is scarcity of good breeding stock even in the private stall-feeding units. It was reported that some of the breeders visited the neighbouring states of Meghalaya, Arunachal Pradesh and Mizoram to procure quality breeding stock. The government may consider setting up a pig-breeding farm in the district for the preferred Large Black breed of pig, but more promising would be to support the development of innovative community-based systems to produce good crossbred boars and gilts and to encourage other private-sector investment to better meet the unsatisfied demand for improved breeding stock and quality weaners. AI may have a role to play.
8. Respondents during the field surveys repeatedly reported surplus production of piglets in Golaghat, a result of the existence of a large percentage of breeding units in Kamargaon area and presence of small stall-feeding units in Sarupathar areas. Surplus piglets are sold to traders from Karbi Anglong and Nagaon districts of Assam and the neighbouring state of Nagaland.
9. 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 (Section 5), although there were reports of sporadic training courses on intensive pig management. Therefore, it is clear that much work is required to ensure that extension programs are needs-based and client-oriented and that they address how to improve production through incremental steps achievable within the limits of current household resources, especially feed and family labour.

10. While swine fever was said to be a major disease constraint, it was reported that confirmatory diagnosis was not carried out and that current delivery systems were not effective for supplying the vaccine or for ensuring its quality (e.g. it was not possible to maintain a cold chain due to frequent power failures). Alternatives to vaccine control are required through community-based programs in which locally-based veterinary assistants are paid to supply a variety of services. An important component should be community-based training in the early clinical diagnosis of swine fever and the collective actions required to prevent the spread of infection.
11. Inadequate land for pig rearing in Golaghat town was reported as a major problem by the Sweeper community, which was central to pig production and pork retailing in the town. Allocation of land to the community for pig rearing would be a key intervention for supporting their livelihoods.
12. Lack of working capital was a recurring constraint observed during the field surveys, especially amongst the tea tribes and Mising communities. While the *Swarnajayanti Gram Swarojgar Yojana* (SGSY) program addresses these needs of a small section of producers organized through SHGs (Section 5), it would appear that the group approach of rearing of pigs by SHGs is not showing desired result. Therefore, more effective schemes for availing credit to individuals 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 through contracts by SHGs with the Group Insurance Scheme of the Oriental Insurance Company.
13. As was described in Section 3, pig production in Golaghat has been growing quickly in response to the market demand, especially from Nagaland. Yet, despite this favourable market environment, there was a marked lack of investment in industrial-type production systems. It was estimated that over 90% of pig units continued with traditional management practices.

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 for improving livelihoods and generating 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 for improving the policy and institutional environment in Golaghat district.

5.1. Regulatory environment

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

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

1. Veterinary staff reported that they were not aware of any specific regulations for the registration and inspection of pig and pork outlets in Golaghat town or concerning pig rearing. Therefore, the official supervision of pork marketing was limited to visual inspection by the veterinary officer. It was also reported that there was poor coordination amongst the town committee, AHVD and police administration, again limiting any action against malpractices.
2. The government regulation is that VAS need to 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 the early and later parts of their transfers, they get 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 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. Further, it was learnt that some dispensaries (e.g. Kamargaon veterinary dispensary) were running without VAS,

resulting delivery of veterinary services by the field staff who are actually meant to assist the VAS to treat animals.

3. Although there are veterinary extension officers under the AHVD, they are generally involved in other non-extension activities because of the 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 for carrying live pigs and pork, the Department of Transport Regulations permits vehicles to transport goods and livestock. But all 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/levy either to the local market management committee or to the local *mahaldar* (lessee). The daily cess varies from Rs. 5 to 40 per pig 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 Golaghat's pig sub-sector supply improved breeding stock, production training, extension and credit.

In Golaghat, the DRDA promotes SHGs in each block under the SGSY[9]. The number of SHGs formed in the project districts along with some of their details are presented in Table 16. It shows that about 20% of the SHGs are involved in pig keeping, indicating the importance and growing opportunities for piggery in supporting the livelihoods of the rural poor. DRDA informants mentioned that of the total pig-rearing SHGs, about 80% SHGs had borrowed money from a revolving fund and another 15% had received loans from the project. However, there were reported cases of diversion of a part of the loan to other income-generating activities or distribution of money among the group

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

members. Talking to the DRDA informants it was understood that inadequate motivation and orientation, absence of collective responsibility of group members, poor technical knowledge, a weak monitoring system and lack of technical guidance by the *Gram Sewok/Sewika* (village service providers) were the main reasons behind poor performance of many of the SHGs. However, due to lack of field information, we could not assess the success rate of SHGs.

Table 16: District-wise status of self-help groups (SHGs) in Assam

District	No. of SHG formed	Approx. % of SHGs rearing pig	% of women members	% of SHGs received revolving fund	% of SHGs received credit & subsidy	% of defunct SHGs
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
Kokrajhar	2640	40	67	12	3	0

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

5.3. Delivery of livestock services

5.3.1. Clinical and preventative veterinary services

The AHVD's dispensaries are the main veterinary service providers in the district. There are veterinary dispensaries in Golaghat, Borpathar and Kamargaon areas. The post of VAS was found vacant in Kamargaon dispensary while the irregular presence of VAS was reported in Borpathar dispensary. Consequently, treatment was mainly done by the VFA. The VFAs treated the animals brought to the dispensaries or visited the producer's house if called. The supply of medicines and vaccines in the dispensaries is grossly inadequate and pig producers only get the advice of the VAS and some first aid treatment. Producers do not pay any fee to the veterinarian for his services and they are supposed to procure medicines and vaccines from the market.

There were no private veterinary clinics in the surveyed areas. Veterinary medicines are generally kept in human clinics while in the villages, some retired veterinarians and/or experienced farmers treat and castrate the animals. 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, there is no government pig breeding farm in Golaghat. As mentioned previously, AHVD has not introduced AI into Assam.

5.3.3. Production and health extension

There appeared to be a poor extension service in the surveyed areas. As mentioned in Section 5.1, the AHVD had veterinary extension officers but they were mostly involved in non-extension activities. When interviewed, farmers, especially members of SHGs, said that government agencies had no major initiatives except some short-term training on management of stall-feeding units.

No program dealt with the backyard system (scavenging or tethered/penned), which dominates pig production in Golaghat. The DRDA organized some training programs for SHGs, mostly on stall-feeding, a system which is used by only a few SHGs and is very successful owing to conflict amongst the members regarding the sharing of labour and other resources. Under the SHG program, DRDA offers a group Rs. 5000 as a revolving fund with credit of Rs. 12,500 from a commercial bank six months after the group is formed. Thereafter, potential pig-rearing SHGs are trained on the scientific management of pigs and linked with the commercial bank for credit of up to Rs. 250,000 (of which about 50% is a grant up to a maximum of Rs. 125,000). As mentioned in Section 5.2, some SHGs diverted part of their loans to other income-generating activities, especially credit-lending to non-group members. This indicates that SHG members have other priorities than pig rearing when they receive credit. Learning about these decisions, the problems associated with rearing pigs as a group activity and the lack of interest in intensive systems of pig rearing will be an important source of information to consider in designing new public sector initiatives related to piggery development.

5.4. Producer organizations

Other than SHGs, there were no producer organizations like cooperatives or farm management committees (FMC) in the surveyed areas. Thus, the SHG programs were the only example of attempts to develop collective action amongst pig producers.

5.5. Institutional linkages

The information gathered from the various interviews in Golaghat demonstrated that coordination was poor among the different organizations that promote pig production, especially NGOs and AHVD. Nevertheless, some joint efforts have been initiated in the recent past. 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. On the other hand, it seemed that insurance companies were not well linked with other stakeholders in pig sub-sector and 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 Golaghat 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 performance of the publicly-funded production and veterinary extension services, which resulted from a variety of causes but particularly the lack of a needs-based client orientation and inadequate financial and physical resources including manpower. Yet, 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 groups of 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. The policy should also recognize that improvements in productivity and profitability will come from incremental production changes developed by innovative, community-based programs implemented by staff oriented towards the needs of their clients.

Central to these programs should be participatory approaches that address the shortage of cost-effective feeds and quality piglets and breeding stock. Programs based on

producer participation (with the involvement of women critical to success) will ensure that their preferences are recognized (e.g. for Large Black pigs) and develop the improved feed resources essential for increasing the productivity of the small-scale production units. At the same time, the development policy should incorporate institutional interventions to reduce the vulnerability of these resource-poor households through addressing the threats to their pigs from epidemic diseases, especially swine fever. Improved veterinary services are required that deliver quality swine fever vaccines even to the rural areas where poor electricity supply makes it difficult to maintain a cold chain. Community-based training is also required in the early clinical diagnosis of swine fever and putting in place 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. These programs lacked effective orientation and awareness among the members, some of whose needs for credit were being served but not, apparently, their needs for technical assistance. These and related programs illustrated what appeared to be inadequate coordination among the varied R&D stakeholders like CVSc, ICAR-North Eastern Hill (NEH), AHVD, the State Institute of Rural Development (SIRD), ALPCo, commercial banks and insurance companies. This issue can be addressed within an overall policy on pig sub-sector development and a pro-poor strategy for its implementation. Integral to the strategy and its participatory approach would 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 of the value-chain, there was also lack of coordination 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 should be sought in hygiene 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 large-scale breeding farms and feed mills in the district is worthy of note. This shows that current small-scale production systems are competitive in their use of local resources. Given Golaghat's strategic location and continuing growth in demand for pork, it will be important to design the policies and programs towards meeting the smallholders' needs and tapping the excellent market opportunity.

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 that serve them, we compiled a detailed overview of Golaghat's pig sub-sector. Consistent with expectations (Section 2.3: Hypotheses), pig production was mainly a small-scale market-oriented enterprise of tribal and OBC communities. About 70% of rural tribal and OBC households reared pigs, invariably crossbreeds. Except for the Mising community, the majority of households of other communities did not breed their own pigs but bought piglets to rear for sale as slaughter pigs. These pigs were reported to reach 50 to 80 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). Yet, 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 and profitable business. As yet there has been little or no private sector investment in more intensive systems of production.

This competitive small-scale sector in Golaghat has been responding to the vibrant market for slaughter pigs and pork; traders and retailers said that demand for slaughter pigs increased by about 50% over the last five years. What is more, they were confident that sales of fresh pork and slaughter pigs would continue to grow as a result of the continuing rise in demand from traditional and, increasingly, non-traditional consumers. Given that there has been growing demand for slaughter pigs and piglets from the neighbouring district of Karbi Anglong and the neighbouring state of Nagaland, it is clear that small-scale production has expanded considerably during recent years to satisfy the increased demand for pork from outside the district. These changes have resulted not only in more pigs being produced from the estimated 53,000 small-scale units with benefits to the livelihoods of the tribal producer households, but there are also many more people earning their living from the marketing of pigs and pork.

These market-driven changes meant that pig producers in Golaghat were happy with the income they generated and were very keen to further increase herd sizes, provided they got additional sources of locally available feed or purchased feed at reasonable

prices with required technical and other input services. 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 Golaghat's existing stock of pigs due to the demand from Nagaland and the shortage of supply from UP/Bihar primarily because of the increased prices for pigs in that part of the country. Therefore, interventions to support the production of piglets and slaughter pigs in Golaghat have to be developed taking into account the competition from these other sources of supply.

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

Production constraints and opportunities

1. 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 ineffective 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.
2. 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 four complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forage including soybean; (ii) testing the profitability for pig producers and feed suppliers of a protein-rich feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units; (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia*/taro and sweet potato and (iv) synchronizing the production cycle of fatteners with the availability of feed. 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.

3. 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 giving credit, the provision of which is likely to have a key role in supporting the adoption of technical innovations.
4. 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, probably through community-based schemes within which locally-based veterinary assistants are paid by the community to supply a variety of services. Local skilled persons in the villages may be trained to castrate and vaccinate pigs and provide first aid treatment. A priority should be community-based training in the early clinical diagnosis of swine fever and putting in place the collective actions required to prevent the spread of infection.
5. Although the district produces surplus piglets, it suffers from scarcity of quality piglets especially of the Large Black breed. Support to innovative community-based systems and encouragement for private-sector investment are required 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.
6. Lack of operating capital and limited access to credit were reported as constraints to piggery development in Golaghat, especially amongst the Mising and tea tribe communities. It is recommended that micro-credit through NGOs may be a way forward to availing credit to smallholders. Capacity building of existing NGOs to serve as intermediate money-lending agencies can be a first step. Since resource-

poor rural farmers are risk-averse, group insurance schemes may also be made available along with the credit.

Marketing and consumption issues

1. Whereas households were faced by constraints to their pig production, the market for their pigs (output marketing) generally worked efficiently with attractive prices for producers and reasonable margins for market agents. But rent-seeking ("hidden expenses", i.e. bribes) by police added to marketing costs during the transport of piglets, slaughter pigs and pork, increasing the price of meat to consumers and reducing profits for producers. It is recommended that there should be an awareness program to overcome this problem, which would involve all participants in the market chain: producers, traders, police and other officials.
2. In need of improvement was the food safety of pork. With pork consumption rising and the number of market participants between producer and consumer increasing, the risks to public health from unhygienic practices are growing. Currently, even in Golaghat, there is no routine pre- and post-mortem inspection of slaughter pigs because of inadequate manpower and physical resources and the absence of a slaughterhouse and regulation under the town committee. Absence of a concrete shed along with required water and electricity supplies and drainage facilities is regarded as one of the major constraints for selling of hygienic pork in both urban and rural areas. These deficiencies in public health measures should be addressed through a risk analysis along the production-to-consumption value chain to systematically evaluate 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.
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 Manila-based Animal Products

Development Centre of the Bureau of Animal Industry, the Government of the Philippines. See http://www.aphca.org/reference/apdc_ph/apdc_index.html for more information.

4. Retailers and consumers reported that pork consumption was exclusively of fresh meat, the demand for which was growing quickly in urban and in rural areas. In contrast to fresh pork, there was no supply of or any apparent demand for processed pork products and frozen pork. 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.

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 poor performance of the publicly-funded production and veterinary extension services. Yet it was clear that market-oriented pig production is integral to the livelihoods of many thousands of resource-poor rural households in Golaghat. Moreover, 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 OBC.
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. To achieve this, it is recommended that a planning and coordination group be established as a platform to catalyze this process and to prepare a policy on pig sub-sector development.
3. To be effective, the group will have to overcome the current inadequate coordination among the varied R&D stakeholders like CVSc, AHVD, ALPCo, commercial banks and insurance companies, an issue that can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.

4. As was detailed in Section 5.6, it is recommended that integral to the strategy and its implementation through participatory approaches should be the provision of financial resources to ensure the exposure of the research community to field problems and to support the extensive participatory field testing of promising research findings.
5. As well as these production-level interventions, and as was outlined in the "Marketing and consumption issues" section above, public health issues related to current slaughter and meat-handling practices merit attention. The awareness and training programs that have been recommended to improve value-chain and institutional capacity for hygienic pork marketing should 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 Golaghat'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 increasing demand for pork, particularly from Nagaland, and with Dimapur's potential for expanding peri-urban pig production using purchased feeds. Monitoring and evaluating these changes in the structure of piggery in Golaghat and Dimapur will be an important responsibility for the proposed planning and coordination group.

Bibliography

ACIAR (Australian Centre for International Agricultural Research). 2006. http://www.aciar.gov.au/web.nsf/doc/ACIA-6NE7TR

AAU (Assam Agricultural University). 2005. All India Coordinated Research Project on Pig (AICRP) 2005 Annual Report, AAU, Khanapara, Guwahati.

Baishya, G.K. 1997. Certain qualitative aspects of pork products marketed in Guwahati city. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Bandyopadhyay, S. 2002. Epidemiological studies on pig parasites. Annual Report, All India Network Program on Gastrointestinal Parasitism. ICAR-NEH, Pg.118.

Beckmann, R. 2006. Sweet potato/pigs system – the best recipe for pigs. ACIAR Partners in Research for Development Winter: 12-14.

Bora, S.C. 1984. Studies on the effect of frequency of feeding on the growth rate of Hampshire piglets. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Bora, J.R. 1999. Growth and carcass characteristic of crossbred pigs under unconventional feeding regime. *PhD thesis*, Assam Agricultural University, Khanapara, Guwahati.

Centre for Humanistic Development. 2006. *Understanding of Assam's Agricultural Policies and Programs*. Draft Report, Centre for Humanistic Development, Guwahati.

CGIAR (Consultative Group for International Agricultural Research). 2005. *Quality Protein Maize in Northwestern India: Full of Protein and Potential*. CGIAR News, July 2005.

Chanphone, K. and Choke, M. 2003. Growth performance of indigenous pigs fed with *Stylosanthes guianensis* CIAT 184 as replacement for rice bran. Livestock Research for Rural Development 15 (9). Available online at http://www.cipav.org.co/lrrd/lrrd15/9/cont159.htm.

Chutia, S., Saikia, A., Konwar, B.K., and Baruah, K.K. 1991. Utilization of treated factory tea waste (*Camellia assamica*) in growing pigs. *Indian Veterinary Journal* 68: 378-380.

Das, A., Naskar, S., Baishya, S.K. Kadirvel, G. and Khargharia. 2005. Performance of different breeds of pigs under village condition of Meghalaya. *Indian Veterinary Medicine Journal* 29: 27-29.

Das, A., Saikia, A., Baruah, K.K. and Das, P.C. 1980. Protein requirement of growing indigenous pigs of Assam. J. Res. Assam agric. University. 1: 110-115.

Deka, K. and Bordoloi, T. 2004. Factors influencing body weight at different stages of growth and heritability estimates in Hampshire x indigenous pigs in Assam. *Indian Veterinary Journal* 81: 527-531.

Deka, K., Bordoloi, T., and Kalita, D. 2006. Genetic and phenotypic correlations among pre- and post-weaning growth traits in pigs of Assam. *Indian Veterinary Journal* 83: 171-174.

Deka, R., Thorpe, W., Lapar, M.L. and Kumar, A. 2007a. *Assam's pig sub-sector: current status, constraints and opportunities*. Project report, Markets theme, ILRI (International Livestock Research Institute), Nairobi, Kenya.

Deka, R., Thorpe, W., Lapar, M.L. and Kumar, A. 2007b. *Dhemaji's pig sub-sector: current status, constraints and opportunities*. Project report, Markets theme, ILRI (International Livestock Research Institute), Nairobi, Kenya.

Deka, R., Thorpe, W., Lapar, M.L. and Kumar, A. 2007c. *Golaghat's pig sub-sector: current status, constraints and opportunities*. Project report, Markets theme, ILRI (International Livestock Research Institute), Nairobi, Kenya.

Deka, R., Thorpe, W., Lapar, M.L. and Kumar, A. 2007d. *Karbi Anglong's pig sub-sector: current status, constraints and opportunities*. Project report, Markets theme, ILRI (International Livestock Research Institute), Nairobi, Kenya.

Deka, R., Thorpe, W., Lapar, M.L. and Kumar, A. 2007e. *Kokrajhar's pig sub-sector: current status, constraints and opportunities*. Project report, Markets theme, ILRI (International Livestock Research Institute), Nairobi, Kenya.

Department of Agriculture, Assam. [no date]. (Available from http://www.agriassam.org/)

Department of Industry and Commerce, Assam. [no date]. (Available from http://www.industriesassam.nic.in)

Gogoi, R.R. 2006. Effect of early weaning on performance of piglet and sow. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Government of Assam. [no date]. (Available from http://www.assamGovernment.nic.in)

Government of Assam. 2003. *Assam Human Development Report*. (Available from http://www.planassam.org/reports/hdr_2003/HRD.htm)

Government of Assam. 2003. *Seventeenth Livestock Census*. Department of Animal Husbandry and Veterinary, Guwahati.

Government of Assam. 2006. *Assam Handbook of Agricultural Statistics, 2005-06*. Directorate of Agriculture, Guwahati.

Government of Assam. 2005. *Statistical handbook, Assam*. Directorate of Economics and Statistics, Guwahati.

Government of India (GOI). 2003. *National sample survey dataset*. National Sample Survey Organization, Central Statistical Organization, Ministry of Statistics and Program Implementation, New Delhi, India.

Gupta, J.J., Bardoloi, R.K., Reddy, P.B., Bujarbaruah, K.M. and Das, A. 2006. Performance of crossbred pigs fed on raw and boiled sweet potato tuber at various levels at different stages of growth. *Indian Journal of Animal Science*

Gupta, J.J. and Bujarbaruah, K.M. 2005. *Promising non-conventional feed and forage resources of NEH region for livestock and poultry feeding*. ICAR research complex for NEH Region Technical Bulletin No. 16.

Gupta, J.J. and Reddy, P.B. 2006. *On farm feed resources management for feeding livestock in integrated farming system*. Winter School on "Complementary role of livestock and fisheries in sustainable hill farming", ICAR-NEH, Umiam, Meghalaya.

Ilangantileke, S. (ed). 2007. Prioritizing potato and sweetpotato research needs for north eastern states of India. Proceedings of a workshop held at Kohima, Nagaland, October 6-7, 2005. CIP (International Potato Centre), New Delhi, India.

Jain, P.K., Bajpai, V.K. and Jain, A. 2003. Effect of different flooring on post-weaning growth of crossbred piglets, *Indian Journal of Animal Science* 73: 1085-1087.

Kalita, D. 1995. Genetic studies on some of the economic traits of indigenous pigs and their crosses with Hampshire. *Thesis*, Assam Agricultural University, Khanapara, Guwahati.

Kalita, G. 1996. Performance of Hampshire pigs in respect of important reproductive and litter traits under farm condition of Assam. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Kalita, D., Das, D. and Goswami, R.N. 2001. Body weight of indigenous pigs of Assam and their crosses with Hampshire as affected by various factors. *Indian Veterinary Journal* 78: 1024-1027.

Kamrup and other surveyed districts, Assam. http://www.dhemaji.nic.in/

Kumar, R., Pal, P.P., Prasad, K. and Prakash, N. 2002. *Modernizing tribal piggery: a delineated approach*. Research Bulletin No.47. ICAR Research Complex for NEH Region, Umiam, Meghalaya. 39 pp.

Kumar, R., Prasad, C.M., Singh, S.K. and Prasad, S. 2004. Economics of pig farming in Jharkhand. *Indian Journal of Animal Science* 74: 450-451.

Kumar, R., Prasad, C.M, Singh, S.K., Prasad, S., Singh, R.N. and Turi, D.N. 2004. Effect of grazing on growth rate of pigs under different feeding regimen at farmers' door, *Indian Veterinary Medicine Journal* 28: 231-233.

Kumar, R., Singh, S.K. and Mehta, S. 2004. Effect of different types of flooring and roofing materials on body weight of crossbred pigs. *Indian Journal of Animal Science* 74: 1241-1242.

Kumar, R., Singh, S.K. and Prasad, C.M. 2005. Performance of pigs maintained under different systems of management at farmer's door. *Indian Veterinary Medicine Journal* 29: 109-112.

Kumar, R., Singh, S.K., Prasad, C.M. and Turi, D.N. 2004. Effect of feeding regimen on post-weaning growth rate of pigs maintained at farmers' door. *Indian Journal of Animal Science* 74: 444-446.

Kumarsean, A., Hussain, J., Ahmed, S.K., Pathak, K.A., Das, A. and Bujarbaruah, K.M. 2006. Growth performance of Hampshire, Large White Yorkshire and Mizo local pigs under field conditions in Mizoram. *Indian Journal of Animal Science* 76: 148-150.

Murugkar, H.V. 1998. *Diagnosis and Control of Piglet Mortality*. Annual Report, 1998-99, ICAR-NEH: 30.

Naskar, S., Das A., Bujarbaruah, K.M. and Khargharia, G. 2006. Comparison of reproductive traits of different genetic groups of pigs. *Indian Veterinary Journal* 85: 104-106.

Nath, D.R. and Deka, D. 2003. Litter trait and pre-weaning growth performance of Large Black pig in Assam. *Indian Veterinary Journal* 80: 287-289.

Neog, B.N. and Baruah, K.K. 1999. Influence of protein concentration in the diet on the carcass characteristics and body composition of indigenous pigs. *Bulletin of Life Science* 9: 63-66.

Pal, P.P., Naskar, N. and Kumar, R. 2000. *Performance assessment of introduced technology in livestock productivity*. Annual Report, 2000-01, ICAR-NEH: 41.

Panchayat and Rural Development Department, Assam. [no date]. (Available from http://www.pnrdassam.org/)

Panday, A.K. and Kumar, R. 1999. Factors affecting adoption of improved pig rearing practices in tribal areas. *Indian Journal of Animal Science* 69: 350-351.

Peters, D., Nguyen Thi Tinh, Mai Thach Hoanh, Nguyen The Yen, Pham Ngoc Thach and Fuglie, K. 2005. Rural income generation through improving crop-based pig production systems in Vietnam: Diagnostics, interventions and dissemination. *Agriculture and Human Values* 22:73-85.

Phookan, A. 2002. Studies on certain growth, reproduction and bio-chemical traits in indigenous pigs of Assam. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Planning Commission. 2006. *Towards faster and more inclusive growth: An approach to the 11th five year plan*. Government of India.

Rohilla, P.P., Bujarbaruah, K.M., Kumar, M. and Singh, G. 2000. Carcass traits of Large White Yorkshire, Hampshire and Naga local pigs. *Indian Journal of Animal Science* 70: 307-308.

Roychoudhury, R. 1978. Studies on pre-weaning growth and its effect on subsequent body weight gain in Landrace pig. *Thesis*, Assam Agricultural University, Khanapara, Guwahati.

Roychaudhury, R., Goswami, R.N., Bardoloi, J.P., Deka, D. and Laskar, S. 2005. Litter performance of indigenous pigs of Assam under field condition. *Indian Veterinary Medicine Journal* 29: 133-135.

Saha, D.N. 2002. Studies on some economic traits of Large White Yorkshire Pigs. *Indian Veterinary Medicine Journal* 26: 339-340.

Saikia, A. K., Baruah, K. K., Neog, B. N., and Sarmah, S. 2004. Effect of energy levels with or without enzyme supplementation on growth of crossbred pigs. *Indian Journal of Animal Nutrition* 21: 1-4.

Sailo, R.N. 2005. Effect of body cooling and dietary energy lunch on growth performance and carcass characteristic. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Sangma, B.D., Nath, D.R., Sarkar, A.B. and Bora, J. B. 1995. Comparative studies on wholesale cuts and meat composition of Hampshire, crossbred (Hamp x local) and local pigs of Assam. *Indian Journal of Animal Production and Management*11: 212-216.

Sasidhar, R.V.K. 2001. Correlates of livestock owners' attitude towards vaccination program. *Indian Veterinary Journal* 78: 817-819.

Sharma, P.K., Saikia, S. and Baruah, K.K. 2004. Effect of stocking density on growth performance and feed efficiency of Hampshire grower pigs reared under identical feeding and management. *Indian Veterinary Journal* 81: 299-301.

Shylla, B. 1988. Genetic studies on some of the economic traits of indigenous pigs in Assam. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Singh, C.A. 1986. A study on the effect of partial substitution of concentrate ration by garbage on the growth performance of Hampshire pigs. *MVSc thesis*, Assam Agricultural University, Khanapara, Guwahati.

Sudhakar, K. and Gaur, G.K. 2003. Preweaning growth in indigenous pigs of eastern region. *Indian Journal of Animal Science* 73: 1182-1183.

Yadav, B.P.S., Gupta, H.K. and Gupta J.J 1990. *Evaluation of sweet potato (Ipomoea batatas L.) based feeding system*. Annual Report, 1990-91, ICAR-NEH: 131

Yadav, B.P.S. and Gupta J.J. 1994. Studies on cheap ration with resource based feeding. Annual Report, 1994-95, ICAR-NEH: 94

Yadav, B.P.S. and Gupta, J.J. 1995. Nutritional value of rice polish in fattening pigs. *Indian Journal of Animal Nutrition* 12: 119-120.

Yadav, B.P.S., Gupta, H.K. and Gupta, K.K. 1995. Sweet potato as a component of swine ration. *Indian Journal of Animal Science* 65: 455-459.

Yadav, B.P.S., Gupta, H.K., Sahoo, S.K. and Gupta, J.J. 2001. Growth performance and caecal fermentation pattern in pigs fed on rice polish based ration. *Indian Journal of Animal Science* 71: 493-496.

Yadav, D.S., Rai, N., Sarma, P. and Yadav, R.K. 2003. Effect of storage of vine cuttings with and without leaves on tuber yield of sweet potato under Meghalaya condition. *Journal of Root Crops* 29: 65-67.

List of abbreviations

AACP	Assam Agricultural Competitiveness Project
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
ATMA	Agricultural Technology Management Agency
BPBF	Base Pig Breeding Farm
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
GMC	Guwahati Municipal Corporation
HYV	high-yielding variety
ICAR-NEH	Indian Council of Agricultural Research-North Eastern Hill region
ILRI	International Livestock Research Institute
NABARD	National Bank for Agriculture and Rural Development
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
SBI	State Bank of India
SC	scheduled caste
SGSY	*Swarnajayanti Gram Sawrozgar Yojana*
SHG	self-help group
SIRD	State Institute of Rural Development
ST	scheduled tribe
UP	Uttar Pradesh
VAS	veterinary assistant surgeon
VFA	veterinary field assistant

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

Name	Designation & Address
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Mr Dilip Sarma, Director, Centre for Humanistic Development

Dr M.K. Tamuli, Principal Scientist, NRCP

Appendix 2: Agro-climatic zones

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