

Dhemaji'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 Dhemaji; the other districts were Kamrup, Karbi Anglong, Kokrajhar and Golaghat. A sixth report synthesizes the results of the district reports, draws conclusions and makes recommendations at the state level, and summarizes the district-level and site-specific conclusions and recommendations. Given that a common approach and the same methodology were used in each of the district appraisals and that the same authors wrote the reports, the series of reports have the same structure and some common text. While designed to be part of a series, each district report can be read in its own right.

Acknowledgements

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

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

Executive summary

The present study is one of a series of five that appraises the pig sub-sectors of selected districts in Assam state, NE India. The five districts were chosen to reflect the variation observed in Assam for pig production and marketing. This report covers the district of Dhemaji; the other districts were Golaghat, Kamrup, Karbi Anglong and Kokrajhar. A sixth synthesis report brings together the results and the 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 to 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. 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 Dhemaji district the three selected clusters were Batgharia, Gogamukh and Silapathar. The clusters were visited during the first week of November 2006 to collect primary information from producer and consumer households, market agents, input suppliers and other key players and stakeholders in pig production and marketing. Drawing upon their experience and knowledge, the key resource persons considered that the distinctive features of Dhemaji relative to the other surveyed districts, were: a major piglet-producing area supplying other districts in Assam and the neighbouring state of Arunachal Pradesh; a large majority of people rearing breeding pigs; the presence of diverse communities that

include Mising, Deori, Sonowal Kachari, Moran, Motok and ex-tea labourers; the Mising community has a distinctive system of pig rearing; and a major flood-prone area.

Dhemaji district is situated on northern bank of the River Brahmaputra. It emerges from the foothills of the Himalayas of Arunachal Pradesh on the northeast and stretches down to the River Brahmaputra towards the southwest. It is composed mainly of plain valleys with less than 20% net sown area, half of the state average. The district is one of the heaviest rainfall areas in Assam. During the southeast monsoon (May to September) there are floods that cause heavy erosion and excessive siltation in cultivable riverine areas, damage to household and public assets and loss of human and animal lives. The district's composite Human Development Indicator is one of the lowest in Assam; its income component is the lowest. In the 2001 census, Dhemaji's population was 0.57 million (approximately 100,000 households) of which over 90% were rural. The largest urban centre, Silapathar, had only 22,000 inhabitants. Over 90% of Dhemaji's people are Hindus; the others are Christians and Muslims. Nearly half the population belongs to the Scheduled Tribes (ST) and 5% to the Scheduled Castes (SC). The tribes include Misings (the largest group), Sonowal Kacharis, Bodos, Deoris, Lalungs, Hazongs and ex-tea garden labourers. There are also a large number of Other Backward Class (OBC) people, the Ahom and Chutiyas.

Dhemaji's economy is rice-based agriculture with livestock. Smallholder households form the large majority of the rural population. Forestry, fishing and non-agricultural enterprises serve as supplementary sources of income. Farms are small and fragmented; 60% are less than 1 ha. Rice occupies 70% of the total cropped area. Crops and livestock are produced in low external input systems such that many households are not self-sufficient in paddy. Livestock (including poultry) are integral to household livelihoods. Pigs are traditionally kept by tribal households who also rear cattle for draught power. Unlike in Kamrup district, the large majority of livestock were said to be indigenous breeds. The 2003 livestock census reported that there were 114,000 pigs in the district. For the tribal, Ahom and Chutiya communities, piggery is a source of additional income and diversifies household risks. As well as these financial benefits, socio-religious aspects are very strong amongst the Mising and Deori communities.

It was against this broad background that a detailed overview of Dhemaji's pig sub-sector was compiled through consultations along the market chain from consumers of pork to retailers, pig traders and pig producers and through discussions with the organizations that serve them. Consistent with expectations, pig production was a small-scale market-oriented enterprise of the tribal, Ahom and Chutiya communities. About 90% of rural tribal households reared pigs, mostly crossbreeds, as an important source of income. Production varied by community. Most Mising and Deori households kept one or more sows, retained some progeny for fattening and sold the rest. Scavenging provided an important part of the feed for these pigs. In contrast, Bodo, Rabha and Sonowal Kachari households mostly purchased piglets for fattening under tethered/penned management (the management type that comprised about 30% of all pig enterprises). Because of the large number of smallholders with sows (breeding units), Dhemaji is the major source of piglets in Assam and to neighbouring states. It also supplies some slaughter pigs to other districts and states. However, traditional feeding practices limited pig performance. Slaughter pigs were reported to reach 60 to 70 kg live weight at 10 months of age with the lower weights more prevalent. A major contributing factor to the slow growth 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, pig production was an attractive, profitable business 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. What is more, even close to Dhemaji town there has been, as yet, little or no private sector investment in more intensive systems of production. Annual flooding (a result of the monsoon and the riverine geography) and poor road connectivity also have important impacts on pig production and marketing in the district because households reduce their pig holdings to minimize losses during the floods and because of feed scarcity.

It was clear from the field surveys that these small-scale pig producers have successfully responded to a vibrant market for fresh pork and piglets; traders and retailers said that demand for pork and piglets in Dhemaji is ever-increasing. About 60% of piglets produced in the district are procured by traders from the piglet-deficit districts of Assam (Kamrup, Darrang, Morigaon, Nagaon, Karbi Anglong, Dibrugarh and Sivsagar) and from the neighbouring states of Arunachal Pradesh and Nagaland. A few slaughter pigs are also marketed to Dibrugarh and Arunachal Pradesh. Moreover, the local traders were confident

that sales of fresh pork, slaughter pig and piglets would continue to grow as a result of the continuing rise in demand from within and outside the district. Given the increase in demand for slaughter pigs and quality piglets, it is clear that small-scale production must have expanded considerably during recent years to satisfy the increased demand for piglets and pork. These changes have resulted not only in more pigs being produced from the estimated 56,000 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 slaughter pigs, piglets and pork.

These market-driven changes meant that pig producers in Dhemaji were happy with the income they generated, but, at the same time, they said that they were keen to further increase the size of their herds because of the lack of other income-generating opportunities. However, the lack of household feed resources and the damage caused by flooding are major constraints. Hence the conundrum: the market is continuing to demand more pork and piglets, but the input constraints now faced by the thousands of resource-poor, tribal households are limiting their capacity to respond.

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

Production constraints and opportunities

1. It was clear that inadequate knowledge about feeding, health care and breeding management was a major constraint to improving the traditional system of production. Similarly, poor knowledge about the storage and handling of feed resources and the preventive and curative measures against diseases that need to be adopted before, during and after the floods were major handicaps for the farming communities living in riverine areas. Current extension programs were said to be ineffective and limited in their reach and not targeted to the specific needs of the communities or the geography of Dhemaji. Tailor-made needs-based, client-oriented programs, delivered using participatory methods, are required to improve the capacity of pig producers to make

more effective use of available feed resources, to maintain their pigs in good health, to breed productive crosses and to withstand the threats of the flooding.

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 three complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forages including soybean; (ii) testing the profitability for pig producers and feed suppliers of a protein-rich feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units elsewhere in the state; and (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia/taro* and, if appropriate, sweet potato. Each of these interventions conforms to the principle of providing farmers with information and technological options that allow them to combine feeds optimally in relation to the cost of production (including family labour) and the contribution of each feed to meeting the nutrient requirements of their pigs for profitable performance.
3. The participatory action-research process may 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, foot and mouth disease (FMD), haemorrhagic septicaemia (HS) and internal worms. 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. Skilled local people should be trained to castrate, vaccinate and provide first aid treatment to the smallholder pig population. 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.
4. The lack of operating capital and inadequate access to credit were reported as major constraints to maintaining pigs during the flood and post-flood periods. To address the issue, it is recommended that micro-credit schemes managed by non-governmental organizations (NGOs) should be popularized. Capacity building of existing NGOs for playing the role of intermediate money lending agencies may be the first step. Since

resource-poor producers are risk-averse, a group insurance scheme may also be combined with the credit component.

5. A technical production constraint reported by some producers was the lack of quality breeding boars. A re-assessment of current government breeding programs is required and innovative community-based systematic breeding programs, along with support for private-sector investments, should be encouraged to better meet the unsatisfied demand for improved breeding stock and quality weaners. It is recommended that key elements should be expanding the stock of the preferred Large Black breed and making available quality boars to all breeders in the villages for use in the prevailing fee-paying mating system. The possibility of introducing artificial insemination (AI) in pigs should be explored by research and development (R&D) agencies and a need-based and effective training program should be designed for the smallholder pig breeders on the care and management of breeding stock.

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 especially 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. The food safety of pork needed improvement. With pork consumption rising and the number of market participants between producer and consumer increasing, the public health risks from unhygienic practices are growing. Currently, even in Dhemaji town, there is no routine pre- and post-mortem inspection of slaughter pigs because of inadequate coordination by the AHVD, town committee and police administration, inadequate manpower and physical resources and the absence of physical infrastructure (buildings, water and electricity) for slaughtering and selling of pork. These deficiencies in public health measures should be addressed through a risk analysis along the production-to-consumption value chain to systematically evaluate the practices of pig producers, pork wholesalers and retailers (in Dhemaji, often the

same person). 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 measles 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. Encephalitis in humans (in which the pig is regarded as an intermediate host) is also a growing concern among consumers and producers, especially in the areas bordering Arunachal Pradesh. It and other zoonotic diseases should feature prominently in any future training program on 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. For more information see http://www.aphca.org/reference/apdc_ph/apdc_index.html.

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 thousands of resource-poor rural households in Dhemaji. And what is more, the continuing increase in the demand for piglets and pork represents a major opportunity for improving livelihood security and increasing incomes, particularly amongst marginalized groups like the tribal, OBC and unemployed youth.
2. What is lacking to exploit these opportunities is effective extension support driven by a policy that recognizes that improvements in productivity and profitability of current producers will come from incremental production changes developed by innovative, community-based programs using participatory methods implemented by staff oriented towards the needs of their clients. The approach requires a mindset change by government officials, an increased role by NGOs and building upon local social

infrastructure, e.g. successful self-help groups (SHGs). To achieve that, 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 provide effective, timely veterinary services to the livestock keepers, the government may look into the problems and constraints faced by the veterinarians in the field and necessary critical interventions may be taken up in a phased manner.
4. A review of the *Rastriya Sama Viaksh Yojana* (RSVY) scheme may be suggested to make it more target-group-friendly by incorporating the needs and addressing the interests of the pig producers.
5. It is recommended that the town committees come forward to frame a regulation for registration and inspection of pork. A coordination group shall be formed within the town committee with division of responsibilities amongst the partners, namely, the town committee, AHVD and police administration.
6. The District Rural Development Agency (DRDA) may come forward to construct a permanent shed for hygienic slaughtering and displaying of pork in all weekly and daily markets. Potable drinking water should also be provided in the market shed.
7. To be effective, the group will have to overcome the current inadequate coordination among the varied R&D stakeholders like the Assam Agricultural University (AAU) College of Veterinary Science (CVSc), Indian Council of Agricultural Research Northeastern Hill Region (ICAR-NEH), National Research Centre on Pig (NRCP), AHVD, DRDA, commercial banks and insurance companies. This issue can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.
8. It is recommended that integral to the strategy and its implementation through participatory approaches 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.
9. As well as these production-level interventions, public health issues related to current slaughter and meat-handling practices may need attention. The awareness and training programs that have been recommended to improve value-chain and institutional capacity for hygienic pork marketing have to be designed to take into account the limits to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices.

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

1. Introduction

1.1. Background to the study

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

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

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

1.2. Objectives

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

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

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

1.3. Approach and methods

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

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

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

- 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)
- approximate timeline of changes (i.e. the dynamics of the systems)
- interviewees' perspectives on constraints and opportunities, i.e. the scope for improving the productivity and profitability of pig systems

To ensure that the results of the field surveys reflected the variation observed in Assam for pig production and marketing, five contrasting yet complementary districts were selected from the state's 23 districts (as at 2004). The sample districts – Dhemaji, Golaghat, Kamrup, Karbi Anglong and Kokrajhar – were selected based on their diversity of ethnic groups, geographical locations, agro-climatic zones, production systems, pig populations and market opportunities, and how these factors were thought to influence the variability of pig systems in the state. The choice of sample districts was guided by the information available from secondary sources and the field knowledge of the key resource persons.

The resource persons considered that the distinctive features of Dhemaji were:

- Major piglet-producing area supplying other districts in Assam and the neighbouring state of Arunachal Pradesh and Nagaland
- Large majority of people rear breeding pigs
- Presence of diverse communities that include Mising, Deori, Sonowal Kachari, Moran, Motok and ex-tea labourers
- The Mising community has a distinctive system of pig rearing
- A major flood-prone area

Within each of the sample districts – Dhemaji in this case – and in consultation with the key resource persons, district veterinary officials and some district-level market agents, three cluster areas were identified where the semi-structured interviews would be carried out at village and household levels. For each cluster, the interviews were carried out in two villages and in three households in each of the villages. In each of the surveyed districts, one cluster was selected near (within 5 to 10 km) the district headquarters/major town of the district and the other two clusters in two different directions from the district headquarters (40 to 60 km). Efforts were made to include the principal areas of pig production and the expected variation for ethnic group, production system and market opportunities. Likewise, within each cluster two villages were identified from a list of about ten after detailed discussion with the staff and veterinary assistant surgeon (VAS) of the local veterinary dispensaries about the demographic and livelihood patterns, the roles of crop agriculture and livestock, the concentration of pigs, the variation in ethnic groups and the proximity to markets. For the pair of villages within a cluster, one was selected nearer to the market and the other away from the market considering the variation in ethnicity

and concentration of pigs. For the study of Dhemaji district, the three selected clusters were Batgharia, Gogamukh and Silapathar (Figure 1). The Jonai sub-division was not considered due to distance and poor road connectivity from Dhemaji town.

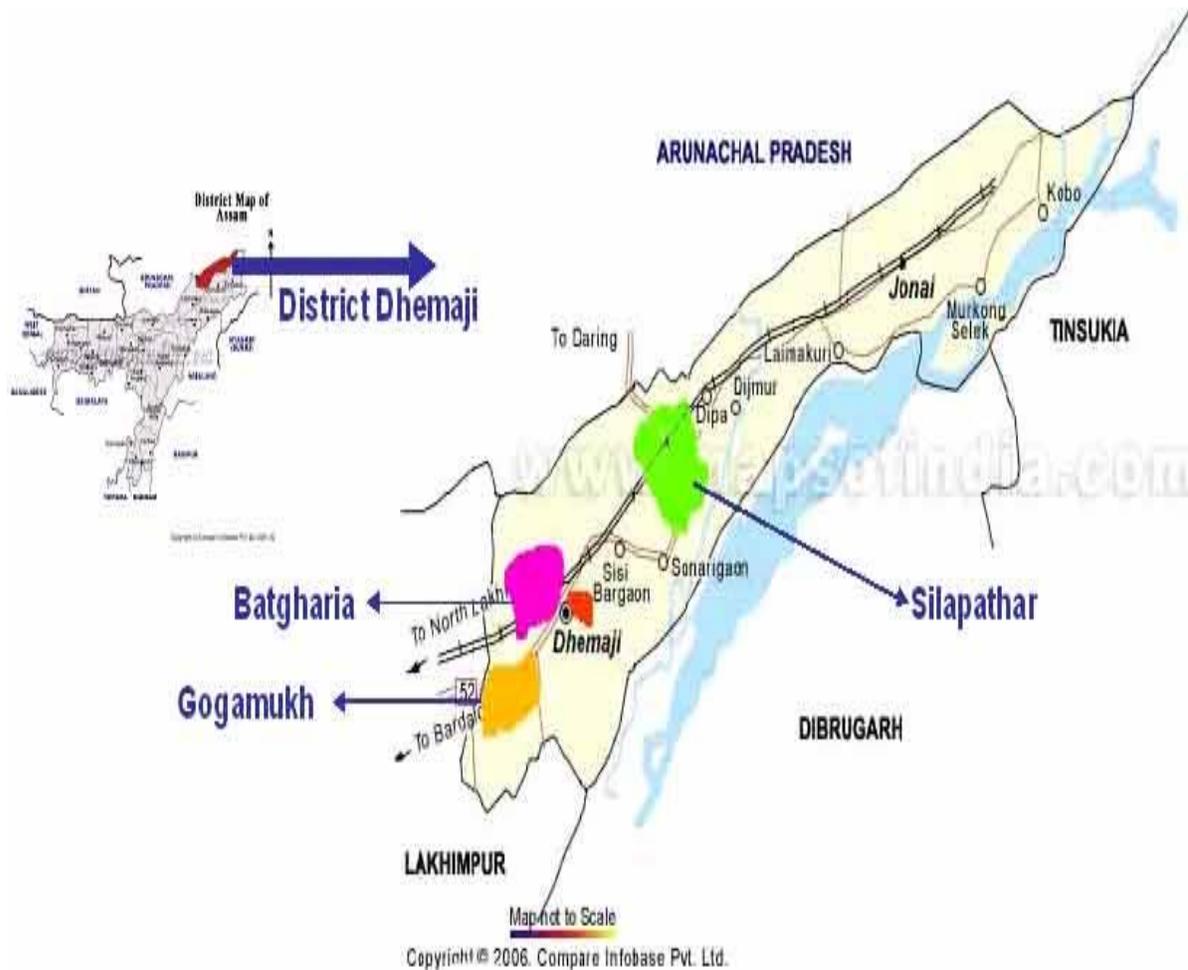


Figure 1: Map of Dhemaji district showing the pig clusters.

Table 1 lists the villages and markets which were surveyed. They were visited during the first week of November 2006 to collect primary information from producer and consumer households, market agents, input suppliers and the other key players and stakeholders in pig production and marketing.

This report draws on the field data collected in Dhemaji and the secondary information gathered through visits to the major R&D organizations and during the literature review. The report provides a description of the pig systems in Dhemaji 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 Dhemaji District

Clusters	Villages	Daily markets	Weekly markets
Bathgharia	Bathghari	Dhemaji town	Dhemaji town
	Kochoriting		
Gogamukh	Pub Baligaon	Gogamukh	Gogamukh
	Mazgaon		
Silapathar	Barmuria	Silapathar	Silapathar
	Arnay 1 No. Gaon		

1.4. *Expected outputs*

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

- A better understanding of current pig production and marketing systems in Dhemaji, and the constraints to and opportunities for improving systems productivity and profitability especially amongst the tribal communities;

- Specific recommendations to overcome technical, institutional and policy constraints and to exploit the opportunities for improving productivity and profitability;
- A sound basis for the development of a new program or project by ALPCo, AHVD, DRDA and the Department of Welfare for Plain Tribes and Backward Classes 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 Dhemaji'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 reports for Kamrup, Golaghat, Karbi Anglong and Kokrajhar districts (Deka *et al.*, 2007).

2. Historical and demographic overview

2.1. *Dhemaji and its people*

Dhemaji district came into being in 1989 with its headquarters in Dhemaji town. It comprises the erstwhile Dhemaji and Jonai sub-divisions and parts of the Machkhowa mouza and Bordoloni areas of North Lakhimpur district. The district is situated on northern bank of the Brahmaputra River between 27°05' N to 27°57' N latitude and 94°12' to 95°41' E longitude (Figure 1). The district emerges from the foothills of the Himalayas of Arunachal Pradesh on the northeastern side and stretches down to the River Brahmaputra towards the southwest. Table 2 presents descriptive statistics of the district's social structure, its infrastructure and some indicators of its development relative to other districts in Assam.

As per the 2001 decadal population census, Dhemaji's population was about 0.57 million², about half the population of Guwahati, the state capital. About 93% of the population lives in rural areas. There are only three urban centres: Dhemaji, Silapathar and Jonai (Figure 1) and urbanization is quite slow. Silapathar's population is only about 22,000 and that of each of the other centres less than 15,000. The district is thinly populated with a density of 177 people per square km (lowest amongst the plain districts) compared to the state average of 340.

In respect of religious groupings, most of Dhemaji's people are Hindus (96%) with a small percentage of Muslims (2%), Christians (1%) and other religious groups (Sikh, Jain and Buddhist). The percentage of Muslims is the lowest of all the districts of Assam. The ST and SC comprise 47% and 5% of the population, respectively, with ST dominating amongst the plain districts). Dhemaji is home to many tribes including Misings, Sonowal Kacharis Bodos, Deoris, Lalungs, Hazongs and ex-tea garden labourers. Apart from the tribes, there are large numbers of OBC people, the Ahom and Chutiyas. There are also people from Nepali, Bihari, Bengali and Assamese-speaking communities. Mising is the largest tribe followed by Ahom, Bodo, Deori and Sonowal Kachari. The Mising people reside

² Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Govt. of Assam

throughout the district. Bodo people predominantly reside in the Gogamukh, Cement Sapori and Nalbari areas. The Ahom, Deori and Sonowal people are mostly concentrated in and around Dhemaji town and in the Akajan area. All the urban centres have mixed communities which include Bengali, Bihari, Nepali and Marowari as well as the tribal communities.

Table 2: Some key statistics for Dhemaji district and the state of Assam

Particulars	Dhemaji	Assam
No. of villages	1236	26312
No. of towns	3	125
Total households	96,949	4,914,823
Population density (per sq. km)	177	340
Sex ratio (female per 1000 males)	941	935
Decadal population growth (1991-2001)(%)	19.45	18.92
Literacy rate (%)	64.48	63.25
Road length per '00 sq. km of geographical area	37.80	47.80
Percentage of village electrified	32	77
Population per hospital, dispensary or PHC	35,746	30,359
Heads of cattle per veterinary hospital, dispensary or mobile dispensary	12,561	17,614
Per capita Gross District Domestic Product at 2000-2001 prices (Rs.)	7602	11,937
Human Development Indicator ³ (Rank out of 23 districts in Assam)	0.277 (Rank 20)	0.407
Income Index	0.026 (Rank 23)	0.286
Education Index	0.622 (Rank 10)	0.595
Health Index	0.186 (Rank 21)	0.343
Human poverty Index	19.60	23.24

Sources: Statistical Hand Book, 2005, Dept. of Economics & Statistics and Human Development Report, 2003

³ Assam Human Development Report, 2003

The district covers 3237 square kilometres and is basically composed of plain valleys at an altitude of 104 m above sea level. About 20% of land is under forest (Table 3); the state average is 24%. The district's net sown area is about 17%, while more than 40% of the land is not available for cultivation. Land under permanent pasture and grazing is only about 5%. The rest is uncultivable and fallow land.

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

District	Total area	Total cropped area*	Net sown area	Fallow	Forest and misc. trees	Others
Dhemaji	324	108	55	214	64	165
(%)			17	7	20	51
Golaghat	354	156	116	7	166	66
(%)			33	2	47	18
Kamrup	446	247	175	6	142	123
(%)			39	1	32	28
Karbi Anglong	1033	181	123	**	314	596
(%)			12		30	58
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 Brahmaputra along with its tributaries (mainly the Subansiri, Gainadi, Jiadhah and Moridhal) forms the main river system of the district, which is one of the heaviest rainfall areas in Assam. During the southeast monsoon (May to September), the district experiences regular and devastating floods, resulting in heavy erosion and excessive siltation in riverine

areas. This makes the fertile cultivable land unsuitable for crop production. The flooding damages cultivable land, household assets, buildings, public utilities and it claims human and animal lives. Many of the farmers living in riverine areas become landless because of flooding. The district has many ditches (areas of swampy and waterlogged land) and their extensive nature is indicative of the flood problem.

As the district is located at the foothills of Arunachal Pradesh, its climate is considerably different from that of the rest of the state of Assam. It is in the per-humid thermic-agro ecological sub-zone characterized by high rainfall, mild summer and winter. From December 2003 to November 2004, the average monthly rainfall was 434 mm and was highest in May (1310 mm) and lowest in November (0 mm).

2.2. Rural economy and the role of pigs

In the absence of any major urban centre in Dhemaji, the district's economy is dominated by rice-based agriculture practised by smallholder households who form the majority of the rural population. As well as their main staple crop, paddy/rice, smallholders cultivate other cereals, pulses, oilseeds, fibre crops and vegetables. Livestock, fishing and non-agricultural enterprises – especially weaving, petty trading and day-wage labour – serve as supplementary sources of income for these farming families.

Operational holdings are small and fragmented with about 59% of farm families in the marginal group⁴ (less than 1 ha), 22% on small holdings (1 to 2 ha) and 19% on large holdings (over 2 ha) (Table 4). Paddy cultivation occupies approximately 69% of total cropped area. There are three types of paddy: *sali* (winter rice), *ahu* (autumn rice) and *boro* (summer rice). *Sali* is the major type (76%), followed by *ahu* (15%) and *boro* (9%). In Dhemaji, the average paddy yield is 1074 kg/ha, much lower than in most districts of the state and about two thirds of the state average (1476 kg/ha). The low paddy yields are as a result of limited use of high-yielding variety (HYV) seed, irrigation and fertilizer. Only 18% of land under paddy is sown to HYV seed and only about 12% of the net cropped area is irrigated, mainly by shallow tube wells.

⁴ Handbook of Agricultural Statistics 2005-2006, Directorate of Agriculture, Government of Assam.

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

District	Marginal	Small	Large	Total
Dhemaji	45.4	16.9	14.2	76.5
(%)	59	22	19	
Golaghat	82.6	28.6	24.7	135.9
(%)	61	21	18	
Kamrup	140.0	46.1	42.2	228.3
(%)	61	20	19	
Karbi Anglong	16.0	20.8	16.4	53.2
(%)	30	39	31	
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

As well as paddy, other significant food crops are potato, banana, wheat, maize, black gram, sesame, lemon and jute. Some rural households have cash crops like betel nut, coconut and some vegetables in their homesteads. These homestead crops and vegetables not only satisfy household consumption needs but also help to generate cash.

Crop agriculture, livestock and poultry rearing are integral to the livelihoods of these farm families. Although livestock rearing is observed throughout the district, irrespective of geographical or ethnic variation, fishing is restricted to riverine areas (Figure 1). Here, fish drying is another important activity especially during the monsoon season on sunny days. Fish is also smoke-dried in the kitchen. There is little commercial fish farming in tanks or ponds. Whereas it is more common for general community farmers to rear cattle, goats and ducks, the tribal communities rear pigs and chicken. Cattle are reared by the tribal community, generally for draught power. Unlike in Kamrup district, majority of the livestock in Dhemaji, especially cattle and poultry, are indigenous breeds managed using

traditional practices. Dairy crossbred cattle are less than 0.2%⁵. Common property resources (CPR) like road sides, playgrounds, school fields, river banks and forest land are the major source of feed and fodder for the livestock, although these resources are decreasing mostly because of human habitation and increased siltation.

In common with the other livestock species, piggery serves as a way of bringing additional income to rural families, principally the tribal and some OBC communities (Ahom and Chutiya). Like poultry and goats, piggery requires only a low level of investment. Pig feed comes mainly from CPR and the by-products of paddy and other crops. Pigs therefore serve to convert existing low-value resources into high-value animal-source foods for home consumption or sale or both. Integration of piggery with fishery, in which pig excreta are used as fish feed, is not common because there are few stall-feeding piggery units. As with other livestock, keeping pigs helps rural and urban households to diversify their risks and improve livelihood security. Pig keeping also serves as a source of cash for various needs, e.g. marriage, illness, house repairs after flooding, school fees and purchase of feed, seed, fertilizer and other farm inputs. As well as the financial benefits, the socio-religious aspect of piggery is very strong amongst the Mising and Deori communities. A home-reared pig is invariably used in religious occasions like *Koushak*, *Uram* and *Daha-Kage*. In the Mising community, many households rear at least one pig for each girl-child and the income generated is utilized by the girl-child for her own needs.

Apart from pig rearing, some people also sell piglets, slaughter pigs and pork to earn their livelihoods. As the data in Table 5 show, these functions of income generation and diversifying risk are also relevant to significant numbers of urban households, who in Dhemaji, as in Kamrup and Karbi Anglong districts, keep a quarter of the district's pigs. Given the small proportion of urban households, this seems unrealistic.

As well as agriculture, sericulture is another major agro-based activity. About 20% of households are involved in sericulture, the highest amongst the districts in the state. Dhemaji occupies a unique place in the production of three different kinds of silk: *pat*, *muga* and *eri*. However, due to a lack of infrastructure and marketing facilities, the industry is yet to grow to the desired extent.

⁵ Livestock census (2003)

Table 5: Number of pigs ('000) and the percentage 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 addition to the farming households, some rural dwellers work either full- or part-time as farm labourers. In Dhemaji, about 35% of the district population (as per 2001 census) is involved in agriculture⁶ with about 32% working as cultivators and the rest as agricultural labourers. Although the percentage of cultivators is more than double the state average (about 14%), the percentage of agricultural labourers (3%) is lower than the state average (5%) indicating more dependence on family labour. Other sources of livelihood are fishing, wage labour, carpentry, transport operation, mechanics and petty trading (i.e. selling of fish, firewood, beetle nuts, rice, country liquor and vegetables in small temporary retail shops). In common with Karbi Anglong, Dhemaji is not industrially developed and therefore, unlike in Kamrup, the employment rate in the manufacturing and service sectors is low (about 9%).

Amongst non-farm activities in rural areas, weaving and cane and bamboo handicrafts are most notable but the quality of the finished products cannot compete with the machine-made products from outside the district. Womenfolk are mostly involved in pig rearing and weaving, although pig rearing is preferred to weaving possibly because of the higher profit margins and ready market. The income generated from pigs is partly utilized to support the weaving through purchasing yarn and other inputs for weaving. Similarly, income

⁶ Statistical Handbook, Assam, 2005, Directorate of Economics and Statistics, Govt. of Assam

generated from weaving is partly utilized for purchasing feeds for pigs. With the growing demand for the traditional clothes of the Mising community amongst tribal and non-tribal people, commercialization of weaving is also taking place. Of Dhemaji's population, about 5% engage in weaving, mostly as a part-time occupation.

In the absence of significant manufacturing units and services, the primary sector contributes more than half (52%) of the total Gross District Domestic Product (GDDP)⁷ followed by tertiary (36%) and secondary (12%) sectors (for 2000 to 2001 at current prices).

In summary, Dhemaji's rural economy is agro-based. It seems that for the 47% of the population that is tribal along with some OBC communities, piggery is an integral part of household livelihood strategies. From the secondary information it was not clear what the importance of piggery is relative to the other non-crop components of tribal and OBC household livelihoods (e.g. weaving). It was also not obvious whether the importance of piggery for tribals is increasing or declining, nor was it apparent whether there was any tendency or trend for other communities to engage in piggery as an enterprise for improving their livelihoods.

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

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

1. In Assam, piggery is invariably a small-scale backyard enterprise that is practised by tribal and OBC communities (especially 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.

⁷ Statistical Handbook, Assam (2005), Directorate of Economics and Statistics, Govt. of Assam

3. Current systems of pig production depend upon family (mainly women's) labour and on other local inputs, particularly feed, of no or low opportunity cost relative the value of the pig being reared.
4. Traditional management practices continue to dominate production systems with the exception that indigenous pigs have largely been replaced by crossbreds.
5. 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.
6. While it is recognized that the contribution of piggery to the livelihood of a household may be small, it is likely to be critical to the well-being of the women and children of the household.
7. Currently local feed resources define the scale of production of backyard enterprises. Therefore, improved feed resources and feeding practices will be the key interventions to increase the productivity and profitability of small-scale backyard piggery.
8. The market for the slaughter pigs produced in Assam is invariably within the state and generally within the district of production, i.e. the local market is the primary consumer of production.
9. In Assam, the consumption of pork has traditionally been associated with tribal and OBC communities but with the change of food habits, consumption of pork is also picking up amongst other communities.
10. If the demand for pork increases, it is expected that production will shift from small-scale rural backyard enterprises to larger-scale peri-urban units using purchased inputs (particularly feed), i.e. traditional rural production will not be competitive with intensive peri-urban production.
11. The market for pork will increasingly differentiate between the meat from indigenous breeds and their high-grade crosses reared traditionally and the meat from high-grade exotic crossbreds reared more intensively.

12. Public interventions related to better access to technical knowledge will be required to support improvements in the productivity and profitability of small-scale backyard piggery.

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

3. Marketing of pigs and consumption of pork

It is known that, as elsewhere in the NE, pork consumption and pig production in Assam is strongly associated with tribal and OBC communities (ST in Table 6). Tribals and OBC have a high per capita consumption of pork whereas consumption is very low in the predominant general community (Others in Table 6). 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). Similarly, 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 northeastern states

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

* ST: scheduled tribe group; SC: scheduled caste group; OBC: other backward classes

Source: NSSO (2003)

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

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

Source: NSSO (2003)

The NSSO data also illustrate the wide variation for pork consumption amongst the sample districts surveyed in this study (Table 7). Dhemaji district, with its high proportion of tribal people living outside the district capital, has the highest consumption of pork. Kokrajhar also has many tribal people (over 30% of the population) who consume pork and non-tribals who also consume pork. Thus, at least for Kokrajhar, the NSSO statistics given in Table 7 may not reflect field reality. It was against this background that the field surveys examined the current marketing of pigs and the consumption of pork.

3.1. Projections of demand and supply of pork

Information from the field survey, supported by the data from secondary sources, showed that the district was self-sufficient in slaughter pig production. Indeed, it could supply about 1600 pigs per annum to Dibrugarh and/or Arunachal Pradesh, i.e. the supply of slaughter pigs exceeded local demand. 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 Dhemaji. This was the result of about 90% ST households and about 70% OBC (Ahom and Chutiya) households rearing pigs for breeding or fattening or both. 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 information gathered from the various markets and key informants for the markets in other areas of Dhemaji. From this information, it is estimated that the total volume of pork traded in Dhemaji district is about 38,900 kg weekly or 5500 kg per day. This is less than in Kamrup (7100 kg/day) and Karbi Anglong (7900 kg/day) districts, reflecting Dhemaji's smaller population.

Pork retailers who were interviewed in Dhemaji, Silapathar and Gogamukh, said that the demand for pork had increased quickly during previous five years and it was anticipated that it would increase further during the following five years. For example, five years back the Silapathar weekly market sold about 200 kg of pork whereas at the time of this survey,

the market sold about 450 kg (Table 8). One response to this rising demand has been an increase in the number of pork sellers (retailers) in the market, such that the average quantity of pork sold by each retailer has decreased. For instance, in Silapathar market, the number of pork retailers has increased from two to five over the last five years resulting in the decrease in pork sold by retailers from 100 to 90 kg per head per day.

Table 8: Quantities of pork sold through markets in Dhemaji district in November 2006

Markets	Daily quantity (kg)	Weekly quantity (kg)	Weekly total (kg)
Dhemaji	700	200	5100
Silapathar	450	400	3550
Gogamukh	1000	1000	8000
Jonai (similar to Silapathar)	450	400	3550
Ten other weekly markets like Silapathar		400	4000
Twenty daily markets on road side selling about 80 kg pork/day	1600		11200
10% of total pork of the above markets is sold by occasional pork retailers			3540
Total			38940

Source: key informants during market survey

Based on the current availability of pork in daily and weekly markets and an estimated human population in 2006 of 0.62 million, the per capita consumption in Dhemaji district is estimated at 3.23 kg per annum. On the other hand, AHVD statistics for 2005 to 2006 report that the total annual production of pork in the district is about 0.82 million kg. This translates into a per capita consumption of about 1.32 kg per annum, which is lower than the estimate of 2.56 kg derived from the NSSO round of 1999 to 2000 and much lower than the estimate from our study. A major contributing factor to this 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 pork yield as 40 kg per pig.

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

Particulars	2006	2010
Projected population	627,000	666,000
ST Population (47.29%)	296,508	314,951
ST households (av. size 5.90)	50255	53381
Pork requirement @ 0.75 kg thrice in a month/household	1,356,885	1,441,287
Increment among existing consumers (2006-2010)		10% 135,688
Other than ST households eating pork including OBC (70%)	39,210	80% 47,600
Pork requirement @ 0.75 kg twice in a month	705,780	856,800
Increment (2006 to 2010)		10% 70,578
Total pork requirement (kg)	2,062,665	2,504,353
Current availability as per market survey (kg)	2,030,130	
Difference in estimation	32,535	
	kg/annum	
Pig requirement (40 kg av. yield/pig)	50,753	62,608
Projected pig population (based on growth trend during 1997-03 @ 4.66%)	130,903	157,063
Slaughter pig (40% of total pig population)	52,361	62,825
Surplus of slaughter pig	1,608	217
Total surplus pig	1600	217

Unlike Kamrup and Karbi Anglong districts, people classified as “other than ST” communities (the Ahom and Chutiya communities) traditionally consume pork. On the other hand, the pork retailers and pig traders said that increasingly some households within the general community were now regularly consuming pork and that the number was increasing, perhaps because of the prevailing food habits in the district and the easy access to pork. Only the Bihari, Bengali, Marowari and Muslim communities generally do not consume pork, and they do not exceed 5% of the total population. In light of the above, it can be presumed that the percentage of pork-consuming households in Dhemaji is above 70%.

Therefore, it is estimated that the total requirement of pork by 2010 will be 2.50 million kg with a per capita consumption of about 3.76 kg, based on the following projections and estimates:

- the projected 53,381 pork-consuming households (ST) in 2010 and a current consumption of 0.75 kg/household thrice in a month (market source),
- 70% of the “other than ST” community (Ahom and Chutiya) currently consume about 0.75 kg pork twice a month
- about 80% of the “other than ST” community will begin to consume pork by 2010, and
- a 10% increase in pork consumption amongst 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 62,600 slaughter pigs per annum (assuming a carcass yield of 40 kg per pig) compared to the current estimated 50,700 pigs. This is an increment of 23%. Table 9 presents these calculations.

The latest (2003) livestock census of Dhemaji district reported that the pig population was 0.11 million. This gives a pig:person ratio in the district of about 20:100 compared to the state average of 5:100, confirming that Dhemaji has a much higher concentration of pigs than other districts. Government statistics suggest that from 1997 to 2003, Assam’s pig population grew at an average of 4.66% per annum. This increased growth was probably because of improved productivity (mainly from cross breeding) and an increased number

of pig-rearing households due to growing market opportunities. If the same trend continues to 2010, Dhemaji's pig population will increase to 0.16 m. At that rate, by 2010 there will be virtually no surplus slaughter pigs in the district, unless the number of pig producers in Dhemaji increases and/or their herd sizes and productivity increase to meet the probable demand for slaughter pigs to the other districts of upper Assam. Further, a new processing plant built in Nazira, Sivsagar is also targeting Dhemaji to supply slaughter pigs. Without herd expansion and/or productivity gains, the district will face an acute shortage of slaughter pigs.

3.2. Current supply chain of pigs and pig meat

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

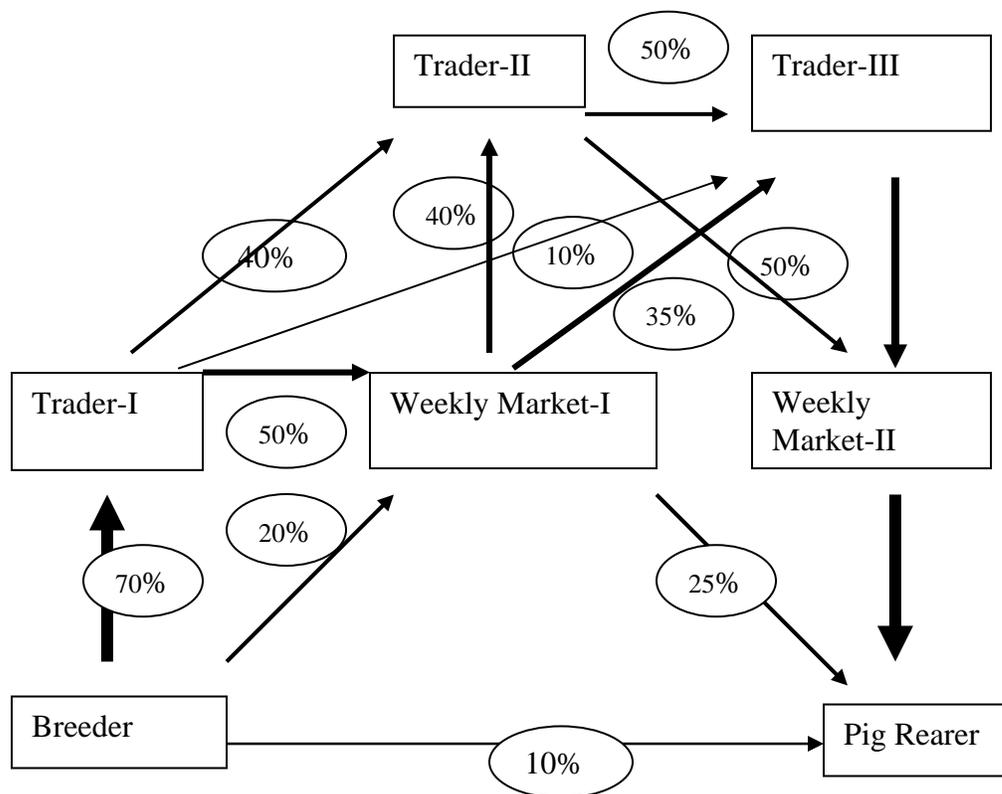
The output market of the pig sub-sector in Dhemaji district has three principal products: weaner piglets, slaughter pigs and fresh pork. In the production supply chain, weaner piglets are the first product. In Dhemaji, unlike in the other surveyed districts, the supply chain for piglets is more vibrant and complex than for slaughter pigs.

Piglets are produced in pig units which keep breeding sows. In Dhemaji, almost all these units are small-scale backyard enterprises, some of which also rear piglets for slaughter. Piglets may be marketed in one of several ways (Figure 2), the simplest of which is direct sale by breeders to pig rearers. These transactions are generally within a village or with a nearby village for piglets of known quality from reputed breeding units⁸. Unlike in Karbi Anglong district where 30% of piglets were sold via this direct route, in Dhemaji only approximately 10% are sold in this way, probably because most households produce their own piglets. It was reported that another 20% of piglets were sold by their breeders in local weekly markets. In contrast to some other districts (e.g. Karbi Anglong), pig breeders reported that paying in advance (reserving) piglets was not practised, again reflecting the greater supply than demand.

The balance of marketed piglets (70%) is directly sold to Traders-I who visit villages looking for piglets to procure (Figure 2). This is the preferred method amongst the breeders

⁸ 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.

because of the ease of access to market agents. The alternative method, travelling long distance on bad roads often affected by flooding, is neither convenient nor remunerative. The price of a piglet at the farm gate varies between Rs. 200 and 500. The price increases with the movement of piglets in the supply chain and reflects the size, health, age and breed. Traders-I sell piglets either in the village weekly market (about 50%) or to Traders-II/III (Figure 2). The majority of piglets available in the weekly markets (approximately 80%) are procured by traders (Traders II and III) for onward supply to other districts and states, while the balance (20%) are procured by local pig rearers, generally from Bodo, Rabha and Chutiya people who buy piglets for fattening. In contrast, the Mising and Deori people hardly procure piglets from markets as most have their own breeding sows.



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: Traders of Dhemaji district who procure piglets from Trader-I or weekly market to sell it to visiting traders from other districts/states (Trader-III).

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

Market-I: Weekly market of Dhemaji district

Market-II: Weekly market of other districts/states

Figure 2: Supply chain for piglet marketing.

In the piglet supply chain, Traders-II are the bulk purchasers/wholesalers who supply piglets to visiting traders (Trader-III) from other Assam districts (Kamrup, Darrang, Morigaon, Nagaon, Dibrugarh, Karbi Anglong etc.) or from other states (particularly Arunachal Pradesh and Nagaland). These traders are the key players in the local weekly markets. A variation is that Traders-II procure piglets from the breeders or Traders-I in the weekly markets and sell them immediately to another trader in the market, thereby earning a small profit. The operation of this group of traders is irregular in nature. Traders-III generally visit as a group all weekly markets in Dhemaji district (i.e. Gogamukh, Dhemaji, Silapathar, Cement Sapori, Jonai, Lai Mekuri). Each trader individually procures 20 to 50 piglets and then the piglets are transported collectively by bus (only some specific Night Super), train (especially to Dhekiajuli, Odalguri) or truck (especially those returning to the above districts after downloading the goods). Transport costs vary by mode of transport and distance. The Traders-II generally help Traders-III in making the transport arrangements as well as uploading the piglets to the vehicle. In some cases, Traders-III do not visit the Dhemaji markets (especially traders from Nagaland and Arunachal Pradesh); instead their piglets are supplied by Traders-II who generally care for the piglets in their stocking yard (locally called *Gadi*) for two to three days, until the required number of piglets is procured.

From Silapathar, Jonai and Lekhabali markets, about 70% of piglets sold outside the state were reported to go to Arunachal Pradesh and the remainder to Nagaland. Within the state, about 90% were sold to Dibrugarh and the balance to Tinsukia. From Gogamukh, Dhemaji and Cementsapori markets, the majority of piglets are supplied to other districts of Assam that include Kamrup, Darrang, Nagaon, Morigaon and Karbi Anglong.

In riverine areas, waterways play a key role in transportation and marketing of piglets due to poor road connectivity. Traders-I transport the procured piglets to the other bank of the River Brahmaputra (where Dibrugarh district is situated) by boat instead of selling in local weekly markets. Transport by boat costs about Rs. 30 per piglet. On the other bank, another group of traders (Traders-III) procure the piglets (Rs. 500 to 600 per piglet) for sale in the weekly markets of Dibrugarh and Sivsagar districts (Rs. 700 to 800). We were informed that some piglets are also transported to adjoining areas of Nagaland through this route. However, during the monsoon, traders find it difficult to use the waterways for

supplying piglets to Dibrugarh and Sivsagar districts on the other side of the Brahmaputra, and these circumstances force distress-selling of pigs/piglets.

In each market three pricing mechanisms were observed. The better quality piglets were procured by local pig rearers at higher prices, while Traders-II/III considered both the cost and the quality of piglets as short-term profit was their main motive. Finally, there was another group of traders (wholesalers) who generally procured unsold piglets in the market at low prices for sale in bulk to neighbouring states. Of the existing weekly markets, the major one is Gogamukh followed by Jonai, Silapathar, Dhemaji, Cement Sapor and Lai Mekuri. The estimated number of piglets traded in the weekly markets is shown in Table 10.

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

Weekly markets for piglets	Volume (% total)	Numbers (per week)
Gogamukh (Friday)	40	1000
Dhemaji (Thursday)	10	250
Silapathar (Tuesday)	10	250
Cement sapor (Sunday)	10	250
Jonai (Sunday)	20	500
Laimekuri (Monday)	10	250
Total	100	2500

Figure 3 presents a summary of the costs that were reported in Dhemaji for the supply chain for piglets. For comparative purposes, the figure includes the results from the other four surveyed districts. In Dhemaji, as in Golaghat and Kokarajhar districts, middlemen were key parts of the supply chain. Their role and transport represented the major costs. It was estimated that there were approximately 270 piglet traders serving Dhemaji (of which approximately 40% were middlemen) and that the net daily profit per trader was approximately Rs. 205. Given that in Dhemaji on average 70% of the retail value of piglets is paid to the producer (Figure 4), the market chain for piglets could be said to be functioning reasonably efficiently for pig breeders, traders and pig fatteners in the district.

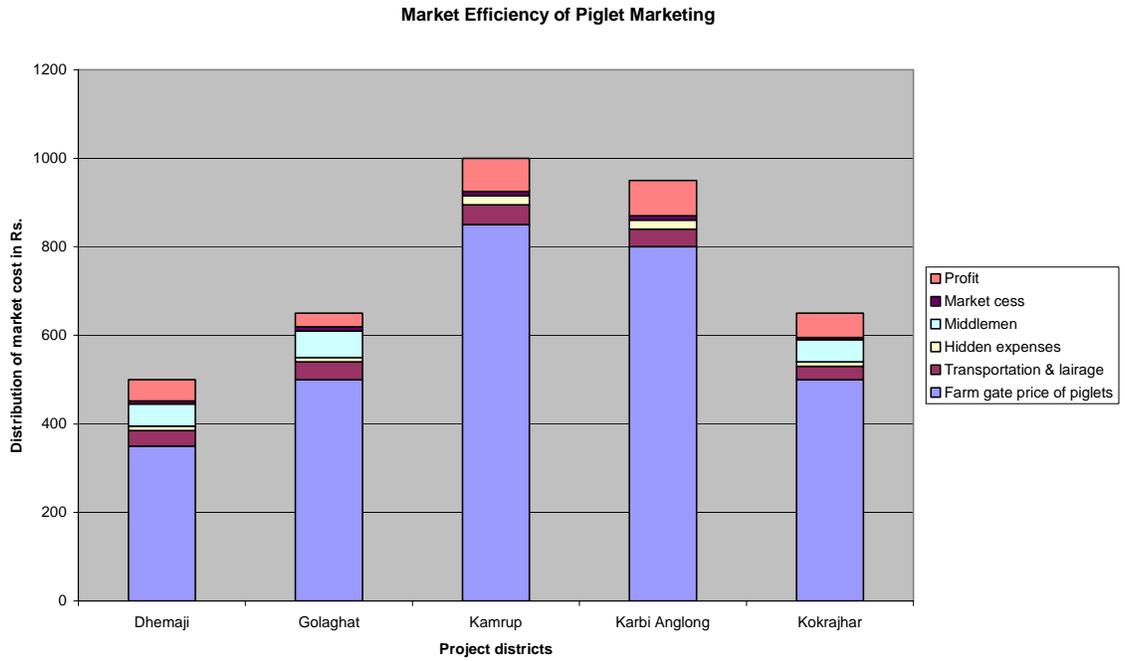


Figure 3: Marketing costs for piglets in Dhemaji and the other surveyed districts.

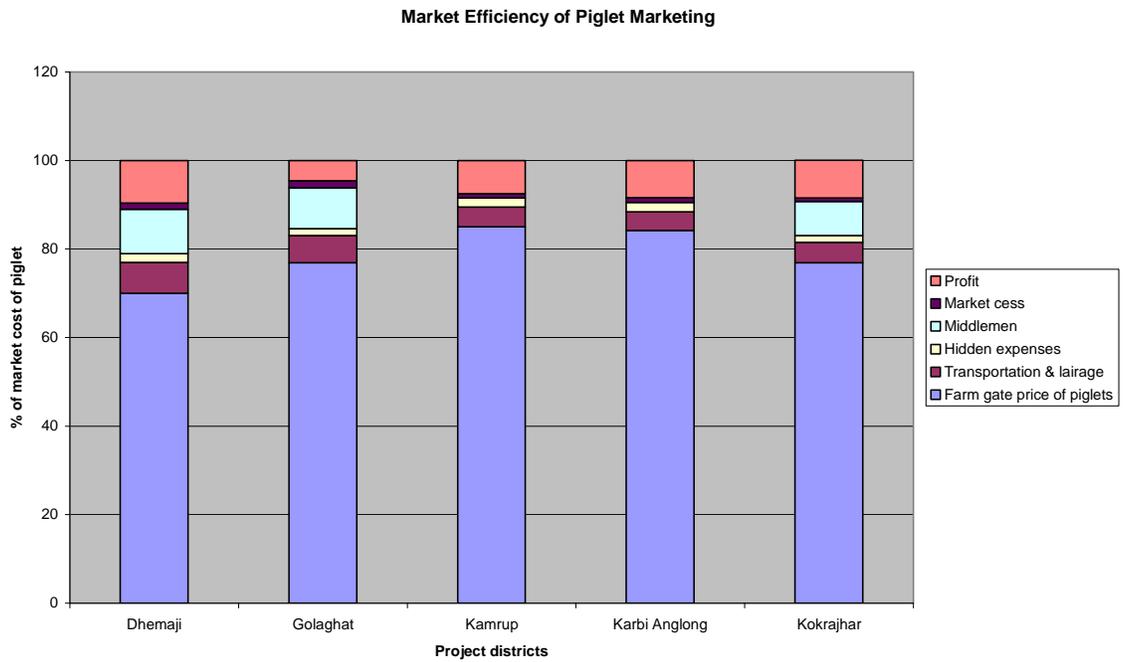


Figure 4: Relative marketing costs for piglets in Dhemaji and the other surveyed districts.

Supply chain for slaughter pig and pork marketing

The supply chain for slaughter pigs in Dhemaji district is presented in Figure 5. As would be expected, some producers (estimated at 10%) slaughter their own pigs and sell the pork in their village or at the crossing of two or three roads (locally called *chowk*) or at the weekly market, especially during festive occasions. By contrast, about 90% of all slaughter pigs are sold by the producers to pork retailers (Figure 3). Due to difficulties in transportation of slaughter pigs to the market, producers prefer to sell them at the farm gate to pork retailers. Therefore in the weekly markets, in contrast to the selling of piglets which is common, sales of slaughter pigs are not generally observed. The market link between pig producers and pork retailers and their efficient marketing network – either directly or through local informants (who are paid Rs. 20 to 30 per pig for their services) – was reported and observed to be running successfully in the district.

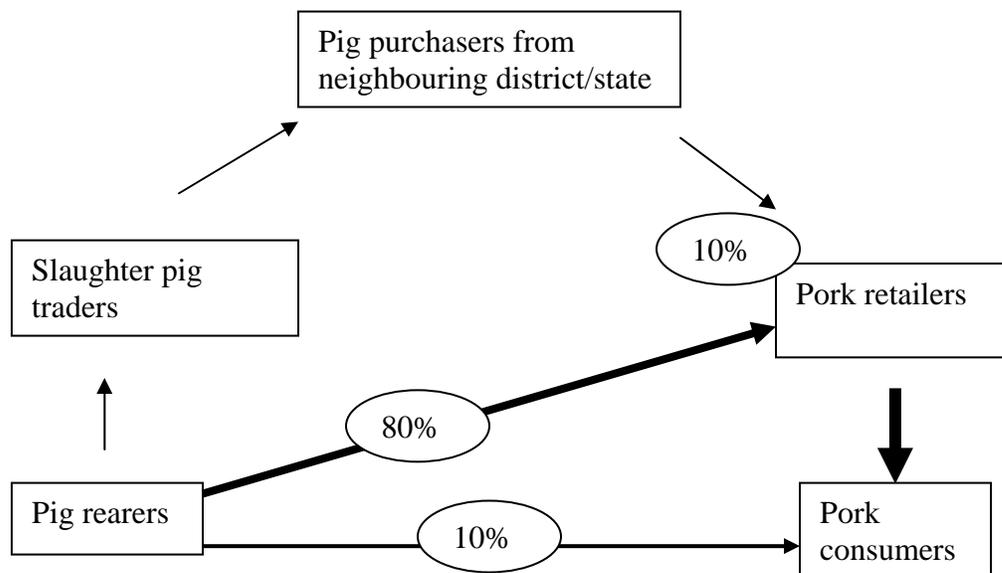


Figure 5: Supply chain for slaughter pig and pork marketing.

Once procured, pigs are transported to the stocking yard of the retailer (generally near a market) by bus, auto van or pulling cart where they receive feed and water which costs 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 the procurement of stock and their sale. Pigs are generally slaughtered near the market place; the offal is usually cleaned in a nearby

stream or pond or well. Pork retailers work in groups of three to five persons. One or two persons roam around the villages for procurement of the pigs while two or three slaughter the pigs and sell the pork. During the process of slaughtering, the hair is burnt from the skin with a blowtorch or paddy straw. One liquid petroleum gas cylinder suffices to burn off the hair of seven to eight pig carcasses (costing about Rs. 50 per pig). Unlike Karbi Anglong and Kamrup districts, the sale of hair was not reported by pork retailers.

As mentioned in Section 3.1, the small surplus of slaughter pigs produced in Dhemaji was sold to traders from the neighbouring district of Dibrugarh and to the neighbouring state of Arunachal Pradesh. Visiting traders from these areas procured pigs from the villages with the help of local informants or commission agents.

Pork retailers pay a fee to the market committee or lessee; the fee varies from market to market. For example, in Gogamukh market retailers pay Rs.10 per day while in Silapathar market they pay Rs. 50 per day.

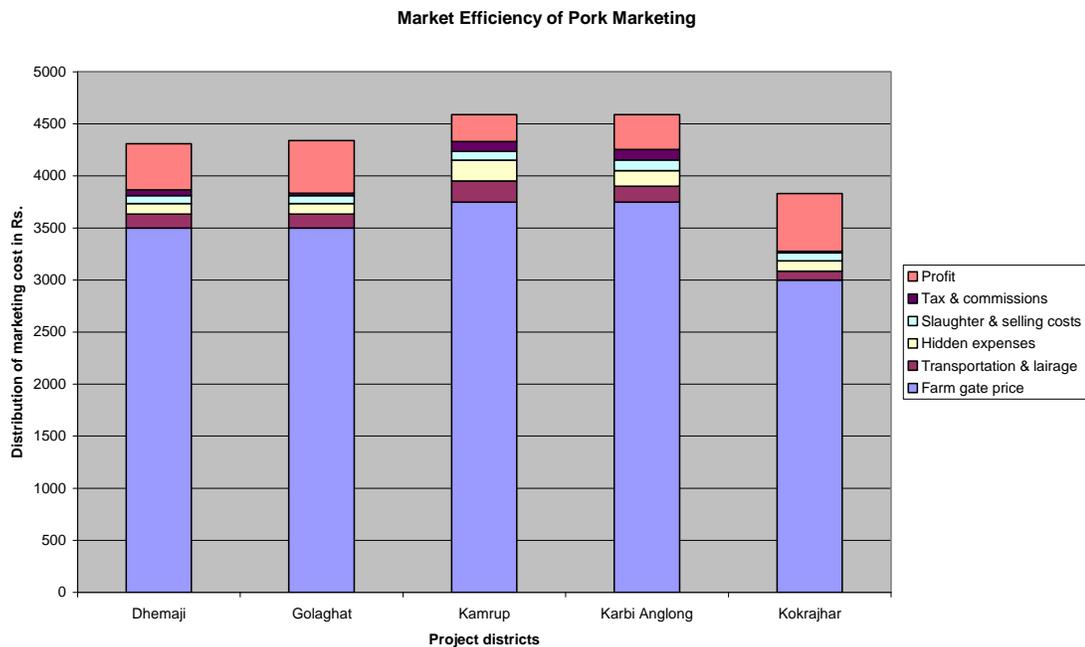


Figure 6: Marketing costs for pork in Dhemaji and the other surveyed districts.

Figure 6 presents a summary of the costs that were reported in Dhemaji for the supply chain of pork, i.e. the purchase of a pig, its slaughter and its sale as pork. The results for the other four surveyed districts are presented for comparative purposes. It can be seen that the costs related to taxes, commissions and “hidden” expenses were similar to those incurred for transport and slaughter. It was estimated that the net daily profit per trader was Rs. 100 and that there were approximately 200 pork traders in Dhemaji. That estimate, together with the 80% 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 Dhemaji.

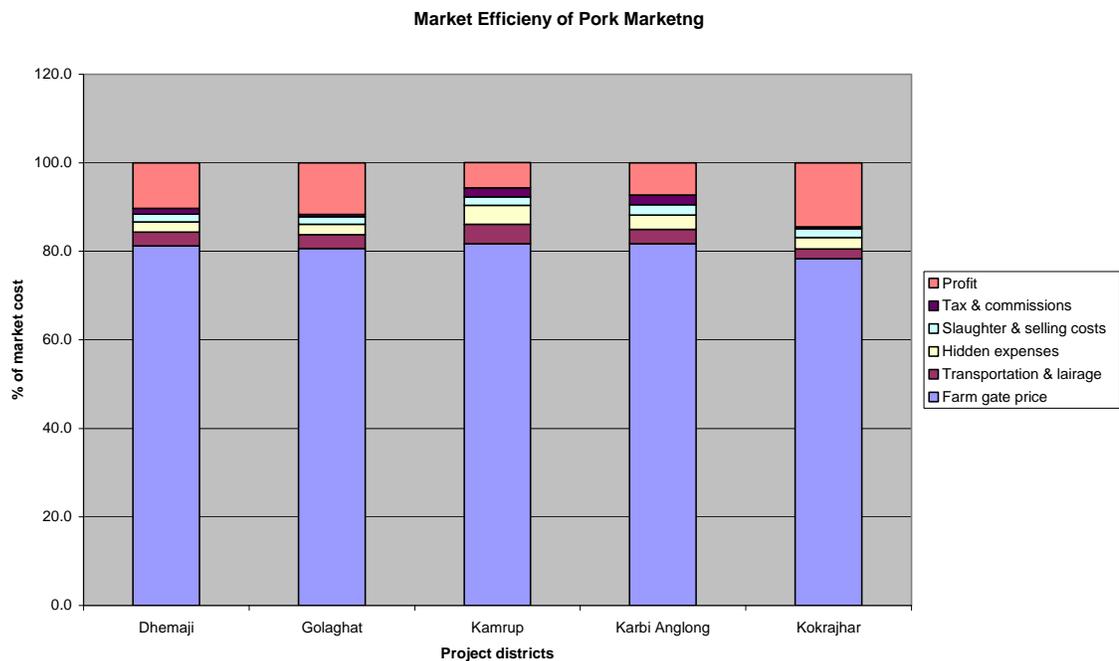


Figure 7: Relative marketing costs for pork in Dhemaji and the other surveyed districts.

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

The major inputs for pig production are piglets, labour, feed and veterinary supplies. Dhemaji is the highest producer of piglets in the state. It not only produces the requirement for the state but also meets the needs of those districts in Assam and the neighbouring states of Arunachal Pradesh and Nagaland that are deficient in pigs. Because a large proportion of households in the Mising and Deori communities keep one to three sows, they buy few piglets. Only a small section of pig rearers from the Bodo, Sonowal Kachari,

Rabha and Hazong communities procure piglets from the market. Relative to these traded piglets, the supply from public sector sources (government breeding farms) is negligible: about 25 piglets in 2006. The prices of piglets sold privately or through traders vary depending on breed, age, sex, growth performance and source. Body size corresponding to age has a strong bearing on the price of the piglets. Dhemaji pig keepers mostly prefer Large Black crosses (black-coloured piglets with drooping ears and elongated bodies which are crosses between Large Black and indigenous pigs) and/or Hampshire crosses. Pig rearers reported that Large Black and Hampshire crosses grow faster and have higher litter size than other breeds. Black colour is also a factor of choice especially for those who rear pigs for religious purposes. A veterinary informant confirmed that white-coloured pigs (Large White Yorkshire) were least preferred. These preferences were common to all sections of producers in all the surveyed markets.

Season greatly influences the price and availability of piglets, which are higher during the winter months (November to March) and lower during the time of flooding. 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 Dhemaji, as elsewhere in Assam, pig production is mainly based on family labour and feeds gathered or produced by the household. Purchases of feeds, apart from some crop and milling by-products, are not frequent. Except for a few small-scale commercial units and government pig farms, the use of commercial concentrate feed is negligible (much less than 1% of total feed). Major feed sources used by pig producers are rice polish and the residue of rice-based country liquor (locally known as *juguli*) along with periodical use of *Colocasia*. These feed ingredients are generally available to most families. Those who do not have a sufficient quantity of rice polish to feed year-round procure it from nearby milling units or local feed suppliers. Unlike in Kamrup and Karbi Anglong districts, no difference in the price of rice polish of no. I and II qualities was reported and pig keepers appeared unaware of the existence of two qualities of rice polish. The price only varied because of seasonal scarcity. During August to November when rice polish is scarce and flooding occurs, the price is higher (Rs. 12 to 25 per tin of about 5 kg rice polish) than during other months (Rs. 10 per tin). This is much cheaper than in Kamrup. Apart from rice polish, the other major feed ingredient is *juguli*. Tribal households having surplus *juguli*,

sell it to nearby villagers at Rs. 5 to 6 per tin of 5 kg rice. The women in farming families which keep pigs play an active role in the procurement and/or collection of piglets and feed.

In respect of veterinary supplies, there was a private veterinary clinic in Gogamukh. In the other two surveyed areas, there was no veterinary clinic but veterinary medicines were sold in the human pharmacy. Pig keepers travel long distances to procure medicine from these private veterinary clinics and human pharmacies. When interviewed, the veterinary clinician in the Gogamukh town stated that though he had sufficient stocks of veterinary medicines, he did not have any swine fever vaccine due to a shortage of supply. Unreliable electricity supply is another problem making it difficult to maintain the cold chain required for the vaccine. Of the available medicines, sales of deworming drugs were the highest followed by mineral and vitamin mixture and antibiotics. It was reported that the majority of farmers came to the veterinary clinic without a doctor's prescription.

3.3. *Pork consumption and preferences*

Marketed non-vegetarian food in Dhemaji mainly comprises pork, chicken, chevon, fish and eggs of which pork is traditionally preferred. As described in Section 3.1, almost all tribal people along with some OBC communities (especially Ahom and Chutiya), whether in rural and urban areas, consume pork irrespective of age, sex or educational qualification. Pork consumption was also reported amongst communities other than tribal and OBC, possibly because of the predominant food habits in the district. Chevon and beef were reported to be the least preferred types of meat, while in riverine areas, the demand for and availability of fish (both fresh and dry) was reported to be high. It was reported that during the flood season when road conditions were bad, on many occasions fishermen could not sell all the fish they caught and they conserved it by sun-drying or smoking.

Consumers preferred fresh pork. Preference for fat or lean meat varied depending on individual choice, although it was reported that the Mising community preferred lean meat. As a result, fat pigs were generally procured by traders for onward supply to the neighbouring districts of Dibrugarh and Sivsagar. Pork from white-coloured pigs was less preferred than that from black pigs, perhaps because it was associated with higher fat

content or because of traditional consumer preferences for meat from black pigs. Apart from fat and lean meat, the consumption of feet, heads and offal was reported among poorer sections of the community. These products were sold at Rs. 40 to 60 per kg. Because of the extensive crossbreeding, there were reported to be very few purebred indigenous pigs and it was not possible to assess the demand for and price of their pork in Dhemaji.

As far as seasonality is concerned, demand for pork was reported by pork retailers to be higher during winter months (December to February), maybe because of cooler climate and various festivals that occur during that period. Conversely, demand was relatively lower in summer (July and August) and during flooding. Unlike in Karbi Anglong district, variation of demand of pork within a month was not reported, probably because of the low proportion of salaried employees in the district. On the other hand, as in other districts, demand for pork was reported to be relatively higher on Sundays than other days. In rural areas, demand was usually much higher on weekly market days than on other days. During festivals like New Year's Day, *Magh Bihu* (the agriculture-based festival of the whole Assamese community) and *Holi*, demand for pork was reported to be much higher. As market committees control the pork price (Town committee in the case of Dhemaji town), usually it did not vary by season. However, once the price increased (often during the festival season) it did not come down and generally did not change for at least another year.

It was learnt from the pork retailers in Silapathar area that the frequency and quantity of pork consumption had increased significantly over the last two to three years, especially because of increased incomes and the influx of workers for construction work on roads and the Bogibeel Bridge, the fourth over the mighty river Brahmaputra. The increased consumption stimulated by construction workers is expected to continue till the end of the construction work in 2012. Likewise, in the Gogamukh area, it was learnt that frequency and quantity of pork consumption had increased significantly over the last few years as business grew in Gogamukh town. In interviews with household consumers and pork retailers, it was reported that household pork consumption varied between 500 g to 2 kg per week (average about 0.75 kg) depending economic status.

Amongst different types of pork, preference is mainly for fresh, warm and newly slaughtered pork. Smoked pork is also liked, but it is produced only when the consumers have surplus pork especially after any feast or rituals. To prepare the product, pork is boiled and smoke-dried for two to three days. It can be stored for 10 to 12 days. Households reported that smoked pork is tastier than fresh pork. However, unlike in Kamrup district, no frozen or processed pork products were observed in the areas surveyed in the district.

Responses during the household interviews indicated that expenditure on food was about 50% of the total consumption expenditure and that on non-vegetarian food was about 25% of food expenditure. Of the non-vegetarian food expenditure, about 70% was spent on pork (estimated from a sample of 15 households). This is consistent with the high per capita consumption of pork in Dhemaji (Table 7).

From the interviews with the wide range of informants, it was concluded that in addition to the tribal and OBC communities, who are traditional consumers of pork, about half of non-tribal people in the district are now eating pork. It was also concluded that the trend of increasing pork consumption is expected to continue as a result of the growth of the population and of the economy and an increasing preference for pork. In the Silapathar cluster, the influx of construction labour was increasing demand for pork locally. Current trends suggest that both the quantity and frequency of pork consumption will increase among current consumers within their households.

3.4. Food safety and human nutrition issues

Given the extensive management of most pigs in Dhemaji, one potential food safety risk is the infestation of pigs by worms, particularly the zoonotic tapeworm *Taenia solium*. This can be transmitted among humans and between humans and pigs causing neurocysticercosis. Humans can acquire taeniosis (tapeworm infection) through consumption of pork. Consumers who were interviewed said that in order to reduce the risk of worm infestation, they always cook pork by boiling it for a long time. Customers ascertain the quality of pig meat by visual inspection and previous experiences. Moreover, when buying pork, experienced consumers always looked for the presence of cottonseed-

like follicles in the meat (measly pork) and 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, looking for cottonseed-like follicles in the eyelids and tongue of the pigs, which is an indication of infestation with worms, and did not buy infected pigs. Therefore, it appears that knowledge of the disease and its manifestation and traditional cooking practices greatly reduce the risks to human health from cysticercosis in Dhemaji district.

Farmers, traders and consumers were also aware of the danger of humans contracting Japanese encephalitis, a disease transmitted by mosquitoes. District key informants reported that the disease mostly occurred in areas adjacent to the foothills of Arunachal Pradesh and in riverine areas irrespective of ethnic groups or the rearing system of pigs, which serve as the intermediate host for the disease. Interviewed households in Akajan area reported that there were cases of encephalitis in the village. They perceived that eating pork from infected animals might infect them. It appeared that there were no serious attempts by the government to make pig producers and consumers of pork aware of the disease's epidemiology, although the distribution of medicated mosquito nets was reported in some areas.

In Dhemaji, as elsewhere in Assam and throughout the NE, there is little or no formal infrastructure for slaughtering of pigs or for the display of pork, especially in rural markets. Generally, pork is sold at the roadside or weekly market place displayed on a gunny bag or polythene sheet without any measures for hygienic slaughtering or sale of the pork. Only a few retailers in Dhemaji, Silapathar and Gogamukh towns sold pork over a platform of bamboo or timber. Besides, in the absence of a source of potable water in the market, retailers mostly used water from ponds, tanks or river for cleaning the offal. This practice may pose health hazards to the consumers of the pork/offal. Other risks to human health can arise from the practice of slaughtering diseased pigs and selling the meat to consumers.

Moreover, there is no specific regulation for registration and inspection of pork outlets under the Dhemaji town committee. However, it was learnt that, unlike in Kamrup and Karbi Anglong districts, the veterinary officer in Dhemaji inspects the pork sold by retailers (there are no wholesalers) more frequently than in other surveyed districts and puts a stamp

on the meat. But the process of inspection cannot be termed as in the true spirit of pre- and post-mortem inspection. As informed by veterinary informants, the lack of official regulation, absence of a slaughter house and inadequate coordination among the town committee, AHVD and police administration were the main reasons behind poor inspection of pork markets.

In respect of nutritive value, consumers were not very aware about the nutritive value of different types of meat except knowing that pork had a relatively higher fat content than other meats. With the trend to consume more meat amongst most sections of urban and rural populations, it was noted that the expressed preference for pork was guided by taste rather than nutritive value.

3.5. Main issues in consumption and marketing

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

1. Pork is the first choice of meat amongst the majority of people in Dhemaji. They comprise primarily the ST, OBC (Ahom and Chutiya) and general communities. As a result, there is a much higher per capita consumption of pork (estimated at 3.23 kg/annum) than in Kamrup (estimate 0.92 kg/annum).
2. Consumption was almost exclusively of fresh pork, the demand for which was growing quickly in traditional and non-traditional pork-consuming households in both urban and rural areas. Some smoked pork was also eaten but there was no supply of or apparent demand for frozen or processed pork.
3. Detailed consumption studies are required to validate the preliminary projections of the increased demand for pork (presented in Section 3.1).
4. In response to the growing demand, the number of pork retailers has increased to the extent that some run their businesses on a part-time rotational basis.
5. Retail sales of pork, both in urban and rural areas, are mainly through informal markets that lack the infrastructure for hygienic slaughter of pigs and sale of pork.

6. There is concern among consumers of pork as well as retailers about the infestation of pork by the zoonotic tapeworm *Taenia solium* (measly pork), but this does not pose a serious threat to public health because of the traditional ways of cooking pork. On the other hand, there were reported cases of Japanese encephalitis (in which pigs serve as an intermediate host) in humans in Silapathar-Akajan area with no apparent systematic government action to address this threat to public health.
7. In contrast to other districts and towns in Assam, there were regular public health inspections of pork in Dhemaji town, although there were no specific regulations for the registration and inspection of pork outlets under the town committee. Better coordination amongst the AHVD, town committee and police administration would further improve the supervision of the public health management of animal-source products like pork.
8. In the light of the increasing demand for pork, these deficiencies in public health measures should be addressed through risk analysis along the production-to-consumption value chain. A structured evaluation of the practices of pig producers, traders and pork retailers is required. 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.
9. In contrast to the other surveyed districts, Dhemaji had a large piglet surplus to local needs (probably two-thirds of all production). The surplus piglets were sold to piglet-deficit districts in Assam and the neighbouring states of Arunachal Pradesh and Nagaland. The surplus of piglets in Dhemaji depressed prices relative to other districts thereby stimulating lucrative opportunities for traders.
10. Demand for piglets and pork was higher during winter than summer and flooding. This seasonal variation influences producers to synchronize their production cycle with the market demand, thereby generating more income in winter.
11. Flooding during the monsoon constrained the production and sale of pigs resulting in some loss or distress selling. This could be mitigated by improved roads and communication which would also facilitate the supply of farm inputs.
12. Despite these difficulties, marketing systems for piglets and slaughter pigs appeared to be efficient with attractive prices for producers and reasonable margins for market agents. However, rent-seeking ("hidden expenses", i.e. bribes to police) added to marketing costs during the transport of piglets, increasing their cost and

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

13. Despite these issues, it was clear that the market/supply chain was a significant and growing source of income and employment and that most piglet traders and pork retailers consider the trade as a primary source of livelihood.

4. Pig production systems

4.1. Ethnic and geographic distribution

Pig production is widely distributed in Dhemaji because of the presence of pig-rearing ST and OBC communities throughout the district. To carry out our field survey, three areas were identified based on ethnic and geographic diversity and accessibility: Batgharia (about 5 km west of Dhemaji town), Gogamukh (about 40 km west of Dhemaji town) and Silapathar (towards the northeast adjacent to Arunachal Pradesh) (Figure 1 and Table 11). Pig production in the Batgharia area is practised by Mising, Bodo and Sonowal Kachari communities while in Gogamukh area it is a popular farming activity amongst the Mising, Sonowal Kachari, Ahom and Chutiya communities. Mising, Deori Ahom and Nepali are the main communities that keep pigs in the Silapathar area.

4.2. Classification of production systems

Table 11 shows the characteristics of the pig production systems in the three clusters by ethnic group. In Dhemaji, pig production is a small-scale, market-oriented enterprise which serves as an important source of supplementary income for all the households that rear pigs. Apart from income generation, it also has a significant role in various socio-religious festivals, especially amongst the Mising community. They not only rear pigs for sale but also for religious festivals like *Koushak*, *Uram* and *Daha-kage* at which home-reared pigs (especially of black colour) are invariably required. Some households even slaughter a pig in the event of a visit by an esteemed guest. Therefore, subsistence use (household consumption) of pigs in Dhemaji is higher than in the other surveyed districts in Assam. There is also a popular tradition amongst the Mising community in which at least one pig is reared for each girl-child. The income generated is spent or credited to the girl. The importance of pig rearing for socio-religious and economic purposes, coupled with the scavenging system of production (which needs less purchased feed), resulted in the Mising community keeping larger herds than other communities. However, over the last 10 to 15 years, the Mising community has reduced herd sizes from 8 to 10 pigs to

three to five per household possibly because of feed scarcities and the gradual shrinkage of grazing land caused by population pressure and extensive siltation.

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

Ethnic groups and their areas	% Households with pigs	Pig pop. (%)	Livelihood importance	Herd type	Surplus + or deficit -	Source
Mising/ Deori: Batgaria, Jonai Silapathar, Gogamukh	90	60	Important	Breeding: 70% Fattening: 10% Breeding & fattening: 20%	Fattener + Piglet +++	Visiting traders/ weekly market
Bodo/ Rabha/ Lalung/ Sonowal Kachari: Gogamukh, Cement Sapori, Nalbari	90	20	Important	Breeding: 10% Fattening: 80% Breeding & fattening: 10%	Fattener + Piglet –	-do-
Ahom, Chutiya & General community Batgharia, Dhemaji Gogamukh, Jonai	70	20	Important	Breeding: 20% Fattening: 70% Breeding & fattening: 10%	Fattener + Piglet –	-do-

Source: key informants during field survey

Herd types are breeding, fattening or both breeding and fattening. Herd type was influenced by religious beliefs and customs amongst the Mising community. While other communities in flood-prone areas also prefer to rear pigs for breeding in order to generate cash from selling piglets, they only maintain the parent stock during flood.

Because flooding recurs every year, Mising community people generally build their residential houses on a platform (locally called *Chang Ghar*) under which pigs are housed. Leftover kitchen waste and other waste materials are consumed by pigs kept under the platform. On the other hand, amongst the other communities (Bodo, Rabha, Ahom, Chutiya and Sonowal Kachari), pig rearing practices are quite similar to those of the other districts in Assam surveyed for this study in that they use tethering or penning for fattening (Table 11). It is estimated that in 80% of households, pigs were looked after by women. Women made the decisions related to selling pigs and use of the funds in fewer than half of the pig-rearing households.

All ethnic groups in all the surveyed areas in Dhemaji considered rearing a few pigs an important supplementary source of livelihood. On the other hand, it was only the small number of households with so-called stall-feeding units which considered pig rearing as a primary source of livelihood. In these units, it was the man who had the key role in all the decision-making processes. The interviewed families were happy with the current demand for and price of pigs.

Unlike in other surveyed districts, the rearing of pigs under the *adhiary*⁹ system was not commonly observed in Dhemaji maybe because piglets were available at relatively low prices. Therefore, the need for credit to buy piglets was relatively less although it was required for meeting recurrent expenses especially during and after flooding periods. Due to the lack of micro-credit lending agencies in the district, the credit requirements of smallholders were generally met by local money lenders or thrift societies which charge higher interest rates (5 to 10% per month). As in the other surveyed districts, insurance companies were not keen to insure smallholder piggery units in the district.

⁹ *Adhiary* means 'half'. Under the system, financially sound persons procure piglets and give them to poor farmers to rear. Feeding and management of pig is the client's responsibility. At the end of the production cycle, the pig is sold and the profit equally distributed between the two parties. If the pig dies in the course of rearing, both parties bear the loss.

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

Management type	Units %	Breed type	Housing	Main manager	Manure use
Scavenging	70	Crossbred	Under a platform	Female	Not used
Tethered/penned	28	Crossbred	Tethering 70% Penned 30%	Mostly female	Not used
Stall-fed	2	Exotic/ crossbred	Permanent shed	Mostly male	Not used/ as manure

Source: key informants during field survey

The pig management systems in Dhemaji 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, especially on the northern bank of Brahmaputra and in other parts of South and Southeast Asia, is not seen in Dhemaji district. The current systems of pig management in Dhemaji are discussed below.

Scavenging: In contrast to the other surveyed districts, the scavenging system of pig management was the predominant system in Dhemaji, especially amongst the Mising and Deori communities. Over two-thirds of all households keeping pigs allow their pigs to scavenge (Table 12). In contrast to Kamrup and Karbi Anglong districts where mostly indigenous pigs are reared under this system, crossbred pigs predominate in Dhemaji. Approximately 70% of the pigs owned by the Mising and Deori communities (the major tribes in the district) are reared under this system. As mentioned earlier in this section, these communities traditionally rear pigs under the *Chang Ghar*¹⁰. 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*. They usually prefer to scavenge in low-lying areas. While scavenging, they consume grass shoots, roots, earthworm, insects, tubers of

¹⁰ A house over a platform made out of bamboo or timber. People live in the house over the platform and pigs are kept below the platform.

Colocasia etc. In the morning and evening, they are provided with feed made of rice polish, *juguli* (residue of country liquor) and/or *Colocasia*, depending on availability. As informed by the interviewed households, the system is advantageous because pigs are well protected from rain, heat and cold under the platform, require less labour and need less feed as they consume leftover food under the *chang ghar* and from the surrounding. Unlike other communities, the Mising usually are not offended by the entry of other people's pigs into their premises because pigs are not merely considered a source of income but they are an integral part of socio-religious life. Nevertheless, where land holdings are small and there is nearby cropping land, some people restrict the movement of pigs to their own premises or at the roadside by tethering (with a long rope and frequently changing the position) in order to prevent crop damage.

Tethered/penned: In the survey clusters, it is estimated that about 28% of pig rearing households, especially from the Bodo, Rabha, Hazong and Ahom communities, managed herds of one to five pigs under this system. About 80% of these households kept fattening pigs (pigs reared for slaughter), while 10% kept breeding sows for the production of weaners (Table 11) and the remainder both sows and fattening pigs. Both tethering and penning (70:30) were observed in each of the surveyed areas. The management system involves the pigs being tethered in the backyard or penned within a bamboo/timber enclosure. Farmers that rear pigs by tethering reported that the rope used as a tether resulted in a distinguishing mark on the pig's chest and on many occasions led to a maggot-infested wound.

When pigs are penned, the pen is usually kept in the same place throughout the year without cleaning which results in a dirty habitat. Some research carried out in India suggests that pigs reared on mud floors achieve higher weight gains than those on concrete floors (Jain *et al.*, 2000). In our study, the comparative performance under backyard conditions was not assessed.

Consistent with the report by Bora (1984), pigs in the tethered/penned systems were provided with the required feed and water within the enclosure two to three times a day. The pigs were mostly crossbreeds and herd size usually did not exceed five for fattening units or three for breeding units. Herd size in these communities was smaller (one to three

pigs) than in the Mising/Deori communities possibly because of dependence on household supply of feed as the pigs do not scavenge. Labour was not hired for managing pigs in these systems. The feed and labour constraints meant that the households were not keen to expand their existing units. Rather, households preferred to achieve higher growth rates (greater throughput in a fixed time) and avoid pig mortalities. Households with only one or two piglets, however, might introduce one or two more for fattening.

Stall-fed: It was estimated that approximately 2% of households (including SHGs) in the surveyed areas managed their pigs in a semi-permanent pigsty. The production objective was purely commercial. These stall-fed herds varied in size between 4 and 30 and the pigs were reared for breeding or fattening or both. Unlike in Kamrup district, there was no integration of stall-feeding pigs with fishery. Pig manure was either unutilized or underutilized as manure. Male members of the farming families played key roles in managing the units. In the SHGs, men held the posts of president and secretary. The type of pigsty construction may affect pig performance. Research in India has shown that intensively fed pigs on a concrete floor with asbestos roof performed better than those on an earthen floor with a tile roof (Kumar *et al.*, 2004). This finding contradicts that of Jain *et al.* (2000).

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 6 to 7 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 80 kg, possibly reflecting the more intensive feeding and other management practices in the AICRPP. In the project, the average litter sizes at birth and at weaning (6.91 and 5.91, respectively) were lower than those reported by our study informants (7 to 12 and 6 to 9, respectively). Breed differences may explain some of the variations.

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

Production traits	Stall-fed/ tethered and stall-fed	Tethered/ penned	Scavenging
Farrowing interval (months)	6-7	6-7	6-7
No. of litters in lifetime	4-5	4-6	4-6
Litter size at birth	7-12	4-16	4-16
Litter size at weaning	6-10	4-10	4-10
Age at weaning, days	50-60	50-60	50-60
Weight of fatteners at 10 months (kg)	60-80	60-70	60-70

(Source: key informants during field survey)

In respect of age at weaning, AICRPP staff weaned piglets at 56 days of age while field practice varies from 50 to 60 days depending on market demand and quality of piglets (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 reveals that weaning at 42 days of age did not adversely affect piglet survival. As would be expected, the performance of scavenging pigs was lower than in the other management systems (Table 13), reflecting the poorer feeding and other management practices for pigs of lower genetic potential.

4.3. Breeding and reproductive management

Dhemaji is well known among the farming communities of Assam and neighbouring states for its piglet production. Piglets from Dhemaji are supplied to Kamrup, Darrang, Morigaon, Nagaon, Karbi Anglong, Dibrugarh and Sivsagar districts of Assam and to the neighbouring states of Arunachal Pradesh and Nagaland. Due to large-scale indiscriminate crossbreeding amongst various breeds, pure indigenous pigs are hardly available in the surveyed areas. Most pigs are Large Black and Hampshire crosses, which were reported to be equally available. Farmers reported that their productive performances were similar, but for socio-religious reasons, the black crosses (from Large Black) are preferred over the black-cum-white crosses (Hampshire). District key informants mentioned that during the early 1980s,

the government pig breeding farm at Dirpai, Dhemaji, Nirijuli pig breeding farm in Arunachal Pradesh and a few progressive pig breeders and missionary schools introduced the Large Black breed to Dhemaji and Lakhimpur districts and to Arunachal Pradesh. Subsequently, Lakhimpur and Dhemaji became the major sources of Large Black pigs. The Ghungroo crosses found in Kamrup district were not present in Dhemaji.

Apparently systematic crossbreeding was not practised. Consequently, it was not possible to ascertain the degree of exotic blood in the different crosses and it is assumed that there is large variation. In 2006, only 25 piglets were available for distribution from the AHVD breeding farm in Dirpai, Gogamukh and these were of the Large White Yorkshire breed, which is not liked by small-scale producers. Unlike other surveyed districts, lack of quality piglets was not reported as a constraint to smallholder pig production.

It is estimated that almost all the available piglets in the district come from smallholder units. The majority of producers rear their own piglets while some procure 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 private farms.

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 and sows are used for breeding until they are three to four years of age. Thereafter, the parent stock is usually replaced by its own progeny. 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, paying Rs. 60 to 200 for each service. This is much cheaper than in the other surveyed districts, presumably because of the availability of breeding boars in the village. It was reported that some boar owners provided free service to their neighbours. Stall-feeding units invariably had their own breeding boars and did not depend on others for breeding services. Informants estimated that a boar gave three to five services in a month, which is less than the intensity of services by boars in Kamrup district. It was said that the breeding cycle was managed to avoid litters during flood season (June to August) and that producers preferred litters during winter when piglets fetched higher prices. Research findings suggest that the largest and

heaviest litters at birth and at weaning occur when sows farrowed during post-monsoon season (Phookan, 2002; Deka *et al.*, 2004; Roychaudhury, 2005). Some research in Assam (Nath *et al.*, 2003) has reported higher mortality with shorter farrowing intervals of 200 days.

There was no evidence of organized selection of breeding boars or of efforts to maintain specific male:female ratios of breeding stock in a village. Apparently in the surveyed areas there had been no awareness or training program by government or NGO agencies on crossbreeding or within-breed selection, yet the adoption of crossbreeds to replace indigenous breeds had been the major management change. Other changes include the start of stall-feeding units by some pig producers and SHGs under government sponsored programs and in recent times, the use of deworming drugs and mineral and vitamin mixture by a section of producers.

Piglets were generally weaned and sold at 50 to 60 days of age, although some of them were pre-weaned at 45 days to reduce the farrowing interval and obtain two litters in a year. It was understood that producers were not aware of recommendations on age of weaning or problems associated with pre-weaning cases. Unlike in Kamrup and Karbi Anglong districts, there were no reports of breeders being paid in advance for piglets.

4.4. Feeding management

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

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

Ethnic groups	First major component	Second major component	Third component	Occasional feed resources
Mising	<i>Juguli</i>	Rice polish	Kitchen waste	<i>Colocasia</i> , fish meal, egg, mineral vitamin mixture
Bodo	<i>Juguli</i>	Rice polish	Kitchen waste	<i>Colocasia</i>
Sonowal	Rice polish	<i>Juguli</i>	Kitchen waste	<i>Colocasia</i>
Kachari				
Ahom/Chutiya	Rice polish	Kitchen waste		<i>Colocasia</i> , <i>juguli</i>
Deori	Rice polish	<i>Juguli</i>	Kitchen waste	<i>Colocasia</i> , fish meal, egg, mineral vitamin mixture
Stall-fed units	Rice polish	Maize, fishmeal, mineral and vitamin mix	Vegetables, <i>Colocasia</i> , tapioca etc.	<i>Juguli</i>

Source: Primary household survey

As Table 14 shows, the major feed sources are rice polish and the residue of rice-based country liquor, known as *juguli*. Occasional feed resources are *Colocasia*/taro (*Colocasia esculenta*) locally known as *kachu* and kitchen waste. The proportions of these items vary depending on the food habits of the ethnic group, availability of feed resources, price of feed ingredients and, of course, availability of household labour to collect these ingredients. For instance, although *juguli* is considered a major feed ingredient amongst the Mising and Bodo communities, it is not amongst the Ahom (especially *Katcha* Ahom) or Chutiya communities who only occasionally prepare country liquor. Dependence on scavenged feed is not commonly observed amongst communities other than the Mising. Unlike in other surveyed districts, in Dhemaji there was no perceived threat of disease from feeding kitchen waste. All members of the Mising community regularly feed pigs on

kitchen waste which the *Chang Ghar* housing system facilitates. Although *Colocasia* was fed to pigs by most producers, particularly poor farmers who cannot afford to procure rice polish or *juguli*, its limited availability (maybe because of flooding and sandy soils) restricts its use (Table 14). The whole plant is harvested, cut into pieces and boiled before being fed mixed with rice polish and *juguli*. Use of *Kolmou* (a plant grown in low-lying areas) as pig feed was reported by some households, especially those in riverine areas. Use of tapioca (cassava) as pig feed was observed only in Silapathar area. A breeding farm under the Rural Volunteer Centre (RVC), Silapathar, grows tapioca and bananas on a small plot of land for feeding its pigs. Keeping in mind the emerging feed scarcity, it was felt that cultivation of tapioca, *Kolmou* and other root crops could be advocated in Dhemaji for smallholder pig keepers.

As mentioned earlier, the use of concentrate feed is limited to a few stall-fed units including government pig breeding farms and a few SHGs promoted by the DRDA and AHVD. A feed supplier in Gogamukh reported that he sold small quantities of concentrate feed to some of the SHGs promoted by AHVD and DRDA. One SHG said that though it initially started feeding concentrates, it later stopped because of the high price: Rs. 14 per kg. Another feed supplier in Silapathar reported that he could not sell concentrate feed to pig farmers as they were not interested in spending money on concentrates. As a result, the use of commercial concentrate feed is negligible (much less than 1% of total feed). On the other hand, through our survey it was learnt that some smallholder producers, especially breeders, provided maize, fishmeal and mineral mixture to their pigs while many reported that they gave eggs to breeding boars before and after natural service. But most backyard producers were not aware of the existence of such feeds or of their nutritional qualities.

Table 15 presents the reported seasonal availability of the feed resources used in the surveyed areas. Rice polish tended to be scarce and costly from July to October when the old stock of paddy is exhausted and the new crop not yet harvested. Since *sali* (winter paddy harvested in November) is the major paddy crop, scarcity of rice polish is reported six to seven months after harvesting. The rice polish obtained from the other types of paddy (*ahu* and *boro*) that form 10% of total production is not sufficient to meet the deficit. During this period of scarcity, producers try to substitute rice polish with *Colocasia*, *Kolmou* and banana. In the same way, when *Colocasia* is scarce during November to April,

it is substituted with rice polish. *Colocasia*/taro is a common pig feed in other parts of the tropics. The Australian Centre for International Agricultural Research (ACIAR) (<http://www.aciar.gov.au/web.nsf/doc/ACIA-6NE7TR>) is currently carrying out research projects aiming to improve taro production. The results of these projects could be relevant to Assam and other states in India. Maize was also reported to be scarce during summer months. As would be expected, most feed ingredients in flood-prone areas were said to be scarce during the recurring floods of June to September.

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

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

A: Available NA: Not Available Sc: Scarce

(Source: key informants during field survey)

It is clear, therefore, that the reported feeding practices are almost invariably dependent on locally available feed sources which, when fed at traditional levels to young crossbreeds, result only in moderate growth rates (Table 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, 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 Meghalaya include buckwheat and various legumes (Gupta and Bujarbaruah, 2005), maize grain up to 80% and rice polish up to 50% along with good quality vegetable protein and mineral mixture (Gupta, 2006) and raw sweet potato tubers up to a maximum level of 40%

dry matter (Yadav *et al.*, 2005). Other studies in Assam have examined factory tea waste (Chetia *et al.*, 1991), garbage (Bora, 1999) and cabbage (AICRPP, 2005). Presenting these options to pig producers using participatory methods to evaluate their fit relative to the availability of household labour, land and other resources would be one way to move towards faster growth rates and increased throughput from existing units. Other options, such as ensiled sweet potato vines and tubers (Gupta, 2005; Peters *et al.*, 2005; Beckmann, 2006; Ilangantileke, 2007), quality protein maize (QPM) (CGIAR, 2005), 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 be remembered, however, 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, swine fever, piglet diarrhoea, pneumonia, piglet anaemia, mange, foot and mouth disease (FMD) and haemorrhagic septicaemia (HS). Apart from these, trampling death was reported among the pre-weaned piglets throughout the district. Veterinary staff said that of these, worm infestation was most common followed by piglet diarrhoea, swine fever, pneumonia and some non-specific problems like hernia and closed anus/eyelids among piglets. Respondents during the field surveys reported that swine fever was more prevalent in the district, although there was no confirmatory diagnosis. Reports from the field surveys confirmed that parasitic infestation was more common when pigs scavenged or were tethered, as reported by Bandyopadhyay (2002).

Farmers reported that piglet mortality in indigenous pigs was very low or nil, although only three to six piglets are born in a farrowing. The veterinary assistant surgeon (VAS) of Gogamukh Veterinary Dispensary reported that apart from swine fever and worm infestation, HS is also a concern. Therefore, he uses a combined vaccination of HS and Black Quarter in his jurisdiction to protect pigs against HS.

Several studies have suggested that local (indigenous) pigs are very susceptible to piglet diarrhoea and pneumonia (Pal *et al.*, 2000), while it has also been reported that diarrhoea, pneumonia and trampling are the major causes of piglet mortality (Murugkar, 1998). These findings are consistent with the reports in our interviews. Nevertheless, diseases were not said to be major constraints to pig production in the surveyed areas. On the other hand, the practice by producers of slaughtering and selling diseased adult animals will reduce the financial losses resulting from disease but represent risks to public health.

Despite the prevalence of swine fever and the mortalities it caused, only a few households (veterinary staff estimated fewer than 5% of pigs) vaccinate their pigs against the disease, apparently because of their inadequate knowledge of this preventive measure, the low availability of the vaccine and the fact that the vaccine, when available, comes in a vial of five doses, more than required by most pig units. Additionally, outbreaks of swine fever in vaccinated animals (especially the vaccine made by BIO MED) in different parts of the district discouraged many of the farmers from vaccination. It was also learnt that for a long time, the AHVD has insufficient stock of swine fever vaccine and that the supply from the private veterinary clinic (located at Gogamukh) was also irregular. In the current year, the department had only 150 doses for the whole district. Given these circumstances and experiences it is not surprising that many producers in Dhemaji district are not motivated to vaccinate their pigs against swine fever.

Veterinary informants considered that the use of deworming drugs is satisfactory in the district given their estimate of about 80% of pig keepers who use the drugs. However, our field survey suggests that only about 30% use dewormers, suggesting the need for better assessment of the costs and returns to the use of dewormers. It was also reported that mineral mixture was used by only 2% farmers, indicating that there may well be opportunities to improve pig performance through strategic supplementation. District veterinary informants mentioned that the departmental supply of medicines and vaccines is very poor and not even sufficient to meet the requirement of 300 pigs in a year.

One private veterinarian at Gogamukh reported that most of his customers come for deworming drugs followed by calcium tonic and antibiotics, indicating some awareness of the perceived benefits of deworming drugs and mineral and vitamin mixture. A human

pharmacy in Silapathar stocked veterinary medicines and reported that the volume of business had increased from Rs. 10,000 per annum 10 years ago to Rs. 100,000 at present, reflecting the increased use of medicine by livestock rearers, especially pig producers.

In the event of sickness in their pigs, it was estimated that about 60% of producers visit a veterinary dispensary, private veterinary clinic or human clinic to procure medicine, based on their description of the pig's symptoms. Richer producers, especially breeders, were said to call a veterinarian or veterinary field assistant (VFA) to treat their diseased pigs. A visit by a veterinarian costs Rs. 40 to 150 (much less for a VFA), depending on the type of disease and distance from the hospital. Therefore, on many occasions, calling a VFA is preferred to a veterinarian. Again, some poor producers treat their animals themselves using human medicine like antipyretics (e.g. paracetamol) and anti-diarrhoea drugs. It was reported that poorer producers usually sought advice from the experienced producers of the village or those with experience of a veterinarian having treated their pigs.

Many of the farmers and key informants mentioned that rural people in remote areas do not get easy access to veterinary services because of poor road connectivity, lack of veterinary hospitals and irregular presence of veterinarians in the hospitals. Many farmers treat their pigs by using traditional herbs/medicine. Some were reported as superstitious and had magical beliefs, called locally *Tantra Mantra*. Table 16 lists some of the traditional medicines and remedial measures. Farmers were of the view that these medicines were effective on some occasions and that they were readily available and affordable.

Castration of male piglets is generally performed by a skilled person in the villages against payment of Rs. 10 to 20 per castration. Farmers reported that on many occasions after castration piglets, suffered from maggot-infested wounds because of poor or no use of antibiotics and/or antiseptics.

Table 16: Traditional herbs and treatments used in Dhemaji district for some pig diseases

Disease or symptom	Treatment or preventive measures
Diarrhoea	Do not allow to drink water <i>Manimuni pat, Madhuriam Pat, Masundari and Germanit lota, Tezmuri pat</i>
Fever	Paracetamol tablet (human preparation)
Maggot-infested wound	<i>Chengmora, golden sada, white Madar Phool pat</i> and Patrol
Anorexia	<i>Ganja, dry fish</i>
FMD	<i>Chengmora,</i> Confined in muddy water
Mange	Wash the body with leftover water after washing of fish Medicare shampoo <i>Pachatia pat or Man Sada pat</i>
Cough	<i>Letaguti</i>

Source: key informants during field survey

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 low. Research in India (as elsewhere) has shown that level of education, size of the farm, socio-political participation and exposure to mass media extension agencies positively affect attitudes towards vaccination (Sasidhar, 2001). However, it was reported that government and non-government extension services were very poor in all the surveyed areas.

4.6. Main issues in production systems

From the field surveys and the information gathered from secondary sources, various conclusions could be drawn about the pig production systems of Dhemaji district. At the same time, there are some important issues that relate to the constraints to and opportunities for improving pig production to generate income and to increase livelihood security.

1. Consistent with the hypotheses presented in Section 2.3, piggery in Dhemaji is invariably a marketed-oriented small-scale backyard enterprise practised mainly by ST and OBC communities (especially Ahom and Chutiya) to generate income, accumulate capital and fulfil socio-cultural obligations. These small-scale enterprises depend upon family (mainly women's) labour and on other local inputs, particularly feed, of no or low opportunity cost.
2. Unlike in Kamrup district, pig production in Dhemaji is not concentrated in certain areas but occurs throughout the district. There is some variation amongst the different communities for production objectives and housing and feeding practices (Tables 11, 12 and 14).
3. Although it is a small-scale enterprise (generally one to five pigs), its contribution to the livelihood of the majority of the tribal households is significant. Many poor tribal households' plans for expenditure on day-to-day household maintenance, repairing of houses, marriage, treating patients and paying school fees are based upon the income generated from pigs.
4. The quantity and quality of locally available feed resources – mainly from the household's crop by-products – are major factors limiting the scale and efficiency of pig production. Unlike in the other surveyed districts, the scavenging system of pig rearing is most prevalent in Dhemaji; scavenging replaces the mid-day feed. Along with *Colocasia* (taro), the feeding of tapioca and *Kolmou* were reported in some areas. Nevertheless, feed scarcity – especially during the flood season – is such that producers prefer to maintain only the parent stock during that period. Therefore, improved feed and feeding practices will be key interventions to increase productivity and profitability. Participatory methods will be required to evaluate their fit relative to the availability of household labour, cost, convenience, land and other resources.
5. Current feed resources mainly supply energy but are deficient in protein, mineral and vitamins. This deficiency could be offset by feed milling units/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 are promotion of some of the non-conventional feed resources (e.g. rice bean – *Vigna*

umbellata – and legume forages) and improved varieties (e.g. tapioca, *Colocasia/taro*, sweet potato) documented by various R&D organizations. The expertise of the animal nutritionists from R&D organizations will be critical to the success of the process.

6. It was clear that in Dhemaji, traditional management practices continue to dominate pig production systems with a few exceptions. Almost all indigenous pigs have been replaced by crossbreeds, with crosses of the Large Black and Hampshire breed preferred over other exotics, and the pure scavenging system has evolved to restricted scavenging (tethering by a long rope often on common properties).
7. Despite the preference of farmers for Large Black and Hampshire pigs, government breeding farms promote less popular Large White Yorkshire breed of pig. Therefore, re-assessment of the government breeding programs is required. Innovative community-based systems, in which well-bred crossbred boars are central, should be developed to sustain crossbreeding. AI may have a role to play.
8. As the majority of the Mising community keep breeding sows, Dhemaji is the major producer of piglets in Assam. Areas in the state and the adjoining states of Arunachal Pradesh and Nagaland which are deficit in piglets are supplied from Dhemaji district. Supplies of piglets from government pig breeding farms are scarce and expensive.
9. Closely related to these breeding and feeding issues were the reports by most interviewees that they had inadequate knowledge about breeding, feeding and health care management (medication and vaccination). There was no systematic government approach to address this lack of access to technical extension advice appropriate to traditional management systems (see Section 5), although there were some sporadic initiatives in the form of training on intensive management of pigs. This practice is not popular amongst the farming communities. Clearly, much more work is required to ensure that extension programs are need-based and client-oriented. The extension approach should take care to address how to improve production through incremental steps achievable within the limits of current household resources, especially feed and female labour.
10. Despite swine fever being reported as a major disease constraint, there were inadequate attempts to confirm the diagnosis, to identify the possible causes of vaccination failure and to assess the economic losses resulting from the disease.

There had not been any awareness campaign amongst producers, suppliers and vaccinators about the importance of supply, storage and use of quality vaccine. For example, it was not possible to maintain a cold chain due to frequent power failures.

11. Alternatives to vaccine control are, therefore, required. The recommended approach is 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.
12. In general, veterinary services through government dispensaries and private clinics would benefit from strengthening by receiving support from unemployed veterinary graduates and skilled village-level persons. This may be an important area of intervention. The village-level persons may be trained in vaccination, castration and first aid treatment.
13. Lack of working capital (particularly for purchasing feed) was a recurring constraint observed during the field survey, especially during the flood and post-flood periods. Currently, credit facilities for smallholders are provided by local moneylenders or thrift societies which may be exploitative in nature. It would appear that more effective schemes for availing credit are required. Extension of micro-credit through NGOs may be a viable alternative to address this credit need of poor rural households.
14. Currently, insurance coverage of pigs in Dhemaji is either nil or negligible. Insurance companies are not interested in insuring smallholder pigs. Therefore, to minimize the risk of loss (e.g. due to flooding), efforts should be made to provide insurance coverage to smallholders' pigs through Group Insurance Schemes from nationalized insurance company.
15. Finally, it is noted that the demand for piglets produced in Dhemaji continues to grow. However, despite this favourable market environment there was a marked lack of investment in more intensive production systems.

5. Policy and institutional issues

5.1. Regulatory environment

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

- registration and inspection of pork outlets
 - veterinary services
 - extension services
 - transportation
 - market levies
1. Unlike the situation in Kamrup district, veterinary staff reported that there were no (or they were not aware of) specific regulations for the registration and inspection of pig and pork outlets in Dhemaji town, nor were there regulations concerning pig rearing. Therefore, the official supervision of pork marketing was limited to visual inspection of the pork 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. There is a government regulation that VAS should be transferred within three years from one dispensary to another. On many occasions, they are transferred much earlier. Interviewed VAS in all the surveyed districts reported that they do not get sufficient time to understand the problems of livestock producers in the area and to take up necessary measures to overcome the problems. Therefore, they suggested that their stay should be extended to at least five years. Further, it was learnt that many of the senior-level district posts are lying vacant with junior staff responsible for administration, often resulting in poor motivation and a lack of accountability. In addition, the dilapidated condition of many buildings and equipment of the veterinary dispensaries or hospitals and quarters discourage the staff and result in poor service delivery.
 3. Although there are three veterinary extension officers under the AHVD, they are generally involved in other non-extension activities owing to lack of physical (vehicles, information, extension and communication materials etc.) and financial resources. This

has contributed to the poor level of awareness and knowledge amongst small-scale pig producers about pig management. Furthermore, there has been no systematic effort by the government or by non-government agencies to ensure an effective, farmer-oriented extension service.

4. In respect of the licensing of vehicles for carrying live pigs and pork, the Department of Transport regulations permit vehicles to transport goods and livestock. But all the interviewed pig or pork sellers reported that they are harassed by the police who ask for a separate permit for the transportation of pigs, pork or money. This harassment and rent-seeking has discouraged many traders from the business.
5. At markets, pig, pork or piglet sellers and piglet traders pay a cess fee or levy either to the local market management committee or to the local *mahaldar* (lessee). The cess fee varies from Rs. 10 to 50 per day depending on the market.

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

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

1. Government pig breeding farms at Dirpai, Gogamukh under the AHVD were renovated and 25 Large White Yorkshire pigs (20 sows and 5 boars) introduced in 2005. The main objective of the farms is to produce quality piglets for sale especially for breeding, and to serve as a demonstration unit. Piglets are sold to individual pig producers and SHGs. In 2006, the farm produced only 25 piglets, but even for those, there was little demand amongst smallholder producers. A senior veterinarian strongly advocated introducing the Large Black breed in place of the Large White Yorkshire in order to better serve smallholders.
2. The AHVD is implementing the RSVY program in Dhemaji with financial assistance from Government of India. Under this scheme, about 600 SHGs were formed for rearing of pigs, of which 83 SHGs were each provided with four crossbred piglets, some farm utensils, medicines and vaccines along with the cost of transporting the piglets. As per the departmental record, each SHG altogether received assistance worth Rs. 12,000 while the total project cost of the piggery unit was Rs. 36,600. As per the

provision of the scheme, the concerned SHG was supposed to construct the pig sty using its own resources. The SHGs in Gogamukh and Batgharia reported that although they had constructed the pig sty to satisfy the conditions of the scheme, they were not happy as they had to spend at least Rs. 10,000 to 15,000 for the shed to avail a benefit of Rs. 12,000 or so. It was understood that producers are not interested in rearing only four pigs because they rear the same number in the traditional system with a much lower investment. It is suggested that the scheme should be revisited to address the producers' grievances.

3. In Dhemaji, the DRDA is promoting SHGs in each block under the *Swarnajayanti Gram Swarajgar Yojana (SGSY)*¹¹. The number of SHGs formed in the project districts along with some of their details are presented in Table 17. About 60% of the SHGs are involved in pig keeping, indicating the importance and growing opportunities for piggery in supporting the livelihoods of the rural poor. Of the pig-rearing SHGs, about 1173 had availed themselves of a revolving fund and another 312 had availed themselves of project finance, although there were reported cases of diversion of a part of loan to other income-generating activities like weaving. As informed by the DRDA official, the percentage of successful SHGs in the district was close to 60%. Further, the DRDA official mentioned that they were starting construction of market sheds in different parts of the district to provide a platform to the SHGs for sale of their produce.
4. The RVC, Akajan (an NGO) ran a piggery development program in 26 villages of Silapathar area through the "*Gaon Viaksh Kebang*" (Village Development Committee of Mising society) under which one or two piglets (worth Rs. 1200) were offered to individual beneficiaries as a loan. The NGO offered financial assistance to various *Gaon Vikash Kebangs* as a grant but that offered to individuals was a loan by the *Kebangs* in order to revolve the fund. Up to the date of interview (November 2006), the *Kebang* had assisted about 850 beneficiaries and been repaid by about 45% of them. Apart from financial assistance, the beneficiaries received vaccinations (through trained paravets), advisory services and monitoring. It was reported that scarcity of feeds and the loss of pigs during flooding were the most notable problems encountered by farmers in riverine areas. Because of these risks, farmers used to sell the piglets before

¹¹ Organizing farmers into a group of 10 to 20 members, imparting training on organizational management, motivating to build habit of savings, assisting to initiate 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.

the onset of monsoon, maintaining only parent stock during the flood. The NGO considered their program a success and were interested to further expand. As a part of that they had started a stall-feeding piggery unit of 22 pigs of the Large Black and Hampshire breeds with financial assistance from DRDA.

Table 17: District-wise status of self-help groups (SHGs) in Assam

District	No. of SHG formed	Approx. % of SHGs rearing pigs	% of women members	% of SHGs received revolving fund	% of SHGs received credit and 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: Dept. of Panchayat and Rural Development, Govt. of Assam, 2006

5.3. Delivery of livestock services

5.3.1. Clinical and preventive veterinary services

The veterinary dispensaries of the AHVD are the main veterinary service providers in the district. All together, 17 dispensaries and one mobile dispensary provide veterinary care for about 0.26 million cattle and buffalo and 0.14 million pigs. The average number of cattle served by each dispensary in Dhemaji (12,567) is less than the state average of 17,614 (Table 1), but offset by the higher concentration of pigs in Dhemaji (20 pigs per 100 people). Each veterinary dispensary is headed by a VAS with two to three veterinary field assistants and support staff. They treat the animals brought to the dispensaries or visit the homestead if called. In the dispensaries, the supply of medicines and vaccines is grossly inadequate and pig producers get practically no assistance except the advice of the VAS and some first aid treatments.

Apart from government veterinary dispensaries, there is a private veterinary clinic in Gogamukh town run by a qualified veterinary practitioner. In the other surveyed areas, the human clinic is reported to stock veterinary medicine. As mentioned in Section 5.2, the RVC also provides vaccination and advisory services to its beneficiaries.

5.3.2. Breeding services

As described above, one breeding farm under AHVD supplies piglets to producers for breeding purposes. Apart from supplying piglets, the farm specialists also give advice to the producers. As mentioned previously, AHVD has not introduced AI into Assam.

5.3.3. Production and health extension

In the surveyed areas there appeared to be poor extension service. As mentioned in Section 5.1, AHVD had three 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, which dominates pig production in Dhemaji (Table 12). There were some training programs for SHGs organized by the DRDA, mostly on stall-feeding, a system which is not usually taken up by the SHGs. Under the SHG program, DRDA offers Rs. 10,000 as a revolving fund with a credit of Rs. 15,000 from a commercial bank to a group six months after its formation. Thereafter, potential pig-rearing SHGs are trained on the scientific management of pigs and they are linked with the commercial bank for a 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 weaving. This indicates that SHG members have other priorities than pig rearing when receiving credit. Learning about these decisions and their basis will be an important source of information for consideration in designing new public-sector initiatives related to piggery development.

Under the DRDA there were *Gram Sewok/Sewika* (village extension workers) to provide extension services to the SHGs, but they were reported to provide organizational rather

than technical support. When the SHGs were interviewed, it was learnt that DRDA extension workers did not have a missionary zeal to make the program a success. Rather, the SHGs have to bear the expenses for transportation and food (and sometime small bribes) of the *Sewok/Sewika*. At the request of agencies like DRDA, some NGOs also organized occasional training programs. Common to all these extension activities is that they were sporadic in nature and lacked any systematic approach or methods. AHVD staff pointed out that there had been no training-needs analysis, and therefore, it was unlikely that the training programs were client-oriented or need-based.

5.4. Producer organizations

In the surveyed areas, other than SHGs, there were no producer organizations like cooperatives or Farm Management Committees (FMCs). 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 Dhemaji demonstrated that coordination was poor among the different organizations promoting pig production, especially NGOs and AHVD. Nevertheless, in the recent past some joint efforts have been initiated. The major example is DRDA's program to organize farmers into SHGs in which AHVD and NGOs helps impart training and a commercial bank extends credit. However, it seemed that insurance companies were not well linked with other stakeholders in the pig sub-sector and had little interest in insuring livestock and poultry.

5.6. Main policy and institutional issues

From the descriptions given in Sections 5.1 to 5.5, it is clear that there are some policy and institutional issues that constrain pig production and marketing in Dhemaji 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, inadequate incentives for staff and poor operational resources, both physical and financial. Yet it was clear that market-oriented pig production is integral to the livelihoods of the majority of resource-poor rural households in the district and that the continuing increase in the demand, particularly for piglets (Section 3) means that pig production represents a major opportunity for improving livelihood security and increasing incomes. What is lacking is effective extension support to these communities and to groups like educated, unemployed youths.

Given this scenario, it is critical that development policy and its implementation focus on the majority of pig producers who use traditional management practices (but now with crossbred pigs) and who are resource-constrained, particularly for feeds and labour and have very limited access to relevant technical knowledge. The revised policy should recognize that improvements in productivity and profitability will come from incremental production changes developed by innovative, community-based programs that are 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 breeding stock. Programs based on producers' participation (with the involvement of women critical to success) will ensure that their preferences are recognized (e.g. for Large Black pigs rather than Large White Yorkshire breed supplied by government farms) and will develop the improved feed resources essential for increasing the productivity of the small-scale production units. At the same time, the development policy 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 required in the early clinical diagnosis of swine fever. The collective actions required to prevent the spread of infection also need to be put in place.

Policies and institutional approaches that encourage participatory methods will also help overcome the problems observed in the SHG programs, which lacked effective orientation and awareness among the members. Transparency in implementation process of the SGSY scheme with dedicated extension staff is also required to address the grievances of SHGs.

These and related programs illustrated what appeared to be inadequate coordination among the varied R&D stakeholders like AHVD, DRDA, commercial banks and insurance companies, an issue that 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. Because the risk-averse practices of individual resource-poor pig producers may inhibit the adoption of new technologies, micro-credit and insurance through community-based schemes should be an integral part of these programs.

Just as in the production phase of the value-chain, there was poor coordination amongst public bodies in respect of regulation and inspection of pork market. Public health issues resulting from current slaughter and meat-handling practices merit attention from the various government and civic bodies responsible for food safety. Improvements in hygiene should be sought while being conscious of the limit to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices. Given that in Dhemaji most pigs are sold directly to retailers by producers (Figure 3), the focus of the training in slaughter practices and meat hygiene should be these retailers. Given the dispersed nature of the retailing, post-training supervision and monitoring will require special attention.

6. Conclusions and recommendations

Through consultations along the market chain from consumers of pork to retailers, pig traders and pig producers, and with the organizations which serve them, we compiled a detailed overview of Dhemaji's pig sub-sector. Consistent with expectations (Section 2.3: Hypotheses), pig production was a small-scale market-oriented enterprise of tribal and some other than tribal communities (i.e. Ahom and Chutiya). About 90% of rural tribal households reared pigs, mostly crossbreeds. For these households, pigs were an important source of income. Production varied by community. The large majority of Mising and Deori households keep one or more sows and retain some progeny for fattening, with the others being sold. Scavenging provides an important part of the feed for these pigs. In contrast, Bodo, Rabha and Sonowal Kachari households mostly purchase piglets for fattening under tethered/penned management. Because of the large number of smallholders with sows (breeding units), Dhemaji is the major source of piglets in Assam. It also supplies some slaughter pigs to other districts and neighbouring states. However, traditional feeding practices limited pig performance. Slaughter pigs were reported to reach 60 to 70 kg live weight at 10 months of age with the lower weights more prevalent. A major contributing factor was the low protein content because feeds were mainly the by-products of the rice crop: bran and *juguli* (the residue of country liquor). However, pig production was an attractive, profitable business 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. What is more, even close to Dhemaji town there has been, as yet, little or no private sector investment in more intensive systems of production. Annual flooding (a result of the monsoon and the riverine geography) and poor road connectivity also have important impacts on pig production and marketing in the district because households reduce their pig holdings to minimize losses during the floods and because of feed scarcity.

It was clear from the field surveys that these small-scale pig producers have successfully responded to a vibrant market for fresh pork and piglets; traders and retailers said that demand for pork and piglets in Dhemaji is ever-increasing. About 60% of piglets produced in the district are procured by traders from the piglet-deficit districts of Assam (Kamrup, Darrang, Morigaon, Nagaon, Karbi Anglong, Dibrugarh and Sivsagar) and from the

neighbouring states of Arunachal Pradesh and Nagaland. A small quantity of slaughter pigs are also marketed to Dibrugarh and Arunachal Pradesh. What is more, the local traders were confident that sales of fresh pork, slaughter pig and piglets would continue to grow as a result of the continuing rise in demand from both within and outside the district. Given the increase in demand for slaughter pigs and quality piglets, it is clear that small-scale production must have expanded considerably during recent years to satisfy the increased demand for piglets and pork. These changes have resulted not only in more pigs being produced from the estimated 56,000 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 slaughter pigs, piglets and pork.

These market-driven changes meant that pig producers in Dhemaji were happy with the income they generated. At the same time, they said that they were keen to further increase the size of their herds because of the lack of other income-generating opportunities, but the lack of household feed resources and the damage caused by flooding are major constraints. Hence the conundrum; the market is continuing to demand more pork and piglets, 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.

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

Production constraints and opportunities

1. It was clear that inadequate knowledge about feeding, health care and breeding management was a major constraint to improving the traditional system of production. Similarly, poor knowledge about storage and handling of feed resources and preventive and curative measures that need to be adopted before, during and after flood periods were major handicaps for the farming communities living in riverine areas. Current extension programs were said to be ineffective and limited in their reach and not targeted to the specific needs of the communities and the geography of Dhemaji. Required are tailor-made, needs-based, client-oriented programs delivered 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, to breed productive crosses and to withstand the threats of flooding.

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 three complementary interventions: (i) the participatory testing of non-conventional protein-rich feed resources like rice bean (*Vigna umbellata*) and legume forages including soybean; (ii) testing the profitability for pig producers and for feed suppliers of a protein-rich feed supplement (e.g. incorporating fish meal and a mineral and vitamin mixture) of the type used by stall-feeding units elsewhere in the state and (iii) the participatory testing of improved varieties of crops such as tapioca/cassava, *Colocasia*/taro and, if appropriate, sweet potato. Each of these interventions conforms to the principle of providing farmers with information and technological options that allow them to combine feeds optimally in relation to the cost of production (including family labour) and the contribution of each feed to meeting the nutrient requirements of their pigs for profitable performance.
3. The participatory process may 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, FMD, HS and internal worms. 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. Skilled local people should be trained to castrate, vaccinate and provide first aid treatment to the smallholder pig population. 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.
4. The lack of operating capital and inadequate access to credit were reported as major constraints to maintaining pigs during and after flood periods. To address the issue, it is recommended that micro-credit schemes managed by NGOs should be popularized. Capacity building of existing NGOs for playing the role of intermediate money-lending agencies may be the first step. Since resource-poor producers are risk-averse, a group insurance scheme may also be combined with the credit component.

5. A technical production constraint reported by some producers was the lack of quality breeding boars. A re-assessment of current government breeding programs is required and innovative community-based systematic breeding programs, along with support for private-sector investments, should be encouraged to better meet the unsatisfied demand for improved breeding stock and quality weaners. It is recommended that key elements should be expanding the stock of the preferred Large Black breed and making available quality boars to all breeders in the villages for use in the prevailing fee-paying mating system. Possibility of introduction of AI in pig should be explored by R&D agencies and a need-based and effective training program should be designed for the smallholder pig breeders on care and management of breeding stock.

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 especially during the transport of piglets, slaughter pigs and pork, thereby 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 Dhemaji town, there is no routine pre- and post-mortem inspection of slaughter pigs because of inadequate coordination among the AHVD, town committee and police administration, inadequate manpower and physical resources and the absence of physical infrastructure (like building, water and electricity) for slaughtering and selling of 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 (in Dhemaji often the same person). 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 measles 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. Encephalitis in humans, in which the pig is regarded as an intermediate host, is also a growing concern among consumers and producers, especially in the areas bordering Arunachal Pradesh. It and other zoonotic diseases should feature prominently in any future training program on 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. For more information see http://www.aphca.org/reference/apdc_ph/apdc_index.html.

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 thousands of resource-poor rural households in Dhemaji. And what is more, the continuing increase in the demand for piglets and pork represents a major opportunity for improving livelihood security and increasing incomes, particularly amongst marginalized groups like the tribal, OBC and unemployed youth.
2. What is lacking to exploit these opportunities is effective extension support driven by a policy that recognizes that improvements in productivity and profitability of current producers will come from incremental production changes developed by innovative, community-based programs using participatory methods and 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 that, it is recommended that a planning

and coordination group be established as a platform to catalyse this process and to prepare a policy on pig sub-sector development.

3. To provide effective, timely veterinary services to the livestock keepers, the government may look into the problems and constraints faced by the veterinarians in the field (as mentioned in Section 5.1) and necessary critical interventions may be taken up in a phased manner.
4. Review of the RSVY scheme may be suggested to make it more target-group friendly by incorporating the needs and addressing the interests of the pig producers.
5. It is recommended that the town committees come forward to frame a regulation for registration and inspection of pork. A coordination group should be formed within the town committee with division of responsibilities amongst the partners that include town committee, AHVD and police administration.
6. The DRDA should construct a permanent shed for slaughtering and displaying of pork in all daily and weekly markets. Potable drinking water in the market shed should also be provided.
7. To be effective, the group will have to overcome the current inadequate coordination among the varied R&D stakeholders like AAU-CVSc, ICAR-NEH, ICAR-NRCP, AHVD, DRDA, commercial banks and insurance companies. This issue can be addressed within the overall policy on pig sub-sector development and the pro-poor strategy for its implementation.
8. 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.
9. As well as these production-level interventions, and as was outlined in the “Marketing and consumption issues section” above, public health issues related to current slaughter and meat-handling practices may need attention. The awareness and training programs that have been recommended to improve value-chain and institutional capacity for hygienic pork marketing have to be designed to take into account the limits to how much consumers may be willing to pay for more expensive slaughter and meat-handling practices.

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

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List of abbreviations

AACP	Assam Agricultural Competitiveness Project
AAU	Assam Agricultural University
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
HS	haemorrhagic septicaemia
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
RVC	Rural Volunteer Centre
RSVY	<i>Rastriya Sama Viaksh Yojana</i>
SBI	State Bank of India
SC	scheduled caste
SGSY	<i>Swarnajayanti Gram Sawrozgar Yojana</i>
SHG	self-help group
SIRD	State Institute of Rural Development
ST	scheduled tribe
UP	Uttar Pradesh
VAS	veterinary assistant surgeon

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

Name	Designation and address
Dr Brikodar Lagachu	DVO (i/c), AHVD, Dhemaji
Dr C. Goyari	VAS, AHVD, Dhemaji
Dr Girin Saikia	VAS, AHVD, Dhemaji
Mr Pegu	Project Director, DRDA, Dhemaji
Mr H. Ahmed	APO, Credit, DRDA, Dhemaji
Mr Umesh Deori	Village Head Man, Vill: Barmuriha, Silapathar, Dhemaji
Mr Ravindra Nath and his staff	Rural Volunteer Centre (RVC), Silapathar, Dhemaji
Silapathar Drug Store	Silapathar, Dhemaji
Mr Debabrata Das	Silapathar Poultry Enterprise
Mr Bimol Doley	President, Sordar Chuk Gaon Vikash Kebang, Dhemaji
Dr Joydeep	VAS, Vet. Dispensary, Gogamukh, Dhemaji

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Resource persons

Dr A.B. Sarkar, Former Director of Research, CVSc, AAU
 Mr Dilip Sarma, Director, Centre for Humanistic Development
 Dr M.K. Tamuli, Principal Scientist, NRCP

Appendix 2: Agro-climatic zones

Based on climate, soil characteristics and land use pattern, Assam state has been divided into six agro-climatic zones¹²:

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

¹² Agriculture Department, official website