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LIVING INTELLIGENTLY WITH FLOODS

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Table of contents

1. Background	1
2. Study of flood impacts and control strategies.....	3
2.1 Assam context	3
2.2 Study methodology	3
3. Study results.....	4
3.1 Impact of floods on incomes and livelihoods.....	4
3.2 Impact of floods on crops and livestock.....	5
3.3 Health problems and health access.....	6
3.4 Government relief measures	6
3.5 Survival strategies	8
3.6 Flood management.....	10
3.7 Microfinance and thrift societies	10
4. Dibrugarh and Dhemaji districts: Dairy livelihoods.....	10
4.1 Introduction.....	10
4.2 Marketing channels and price spread.....	11
4.3 Livestock production challenges	11
5. Conclusions	13
6. Recommendations.....	13
6.1 Immediate flood relief.....	13
6.2 Agricultural development.....	14
6.3 Water resource management and community participation	14
6.4 Role of World Bank	15

Tables

Table 1. Employment categories of study respondents.....	3
Table 2. Impact of floods on respondents' income.....	4
Table 3. Percentage of farmers using different rice cultures.....	5
Table 4. Quantity of relief materials	7
Table 5. Quality of relief materials (perception of majority of respondents)	7

1. Background

India's Northeast is magical, beautiful, evocative, and distant – distant from mainland India in the geographic sense, as it shares over 98 percent of its land borders with other nations and is connected to the rest of the country by the narrow Siliguri corridor, popularly known as the Chicken's Neck. Through this sliver of land move goods and people, oil and gas, legal and illegal trade of every conceivable source and kind, ranging from fabric to teak wood, drugs to bulk chemicals, furniture to fashion accessories, and coal.

Eight states make up this vibrant and troubled region: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. The population of the region is about 40 million, of which nearly two-thirds occupy the dominant state of Assam. There are some 250 ethnic groups, with origins in Tibet, Myanmar, Thailand, southwest China, and even Cambodia, that have migrated to and settled in the area over the centuries. A wide variety of languages and dialects is spoken, but there are few written records in the original orthography, where it existed; most of the hill tribes, which were converted to Christianity in the 19th century by various Western missionary groups, follow the Roman script, which has been used to give written form to their oral traditions.

As much as 34.28 percent of the region's population is under the poverty line, compared to the national average of 26.1 percent. Population density is generally below the national average of 324 per square kilometer, with Arunachal Pradesh the lowest at 13 persons per square kilometer, while Tripura and Assam have 304 and 340 persons per square kilometer respectively. The livelihood of the population is to a large extent dependent on the rivers that flow into and through the region – no less than 40 rivers fall into the Brahmaputra basin and smaller river valleys such as the Barak. It may be noted also that 52 rivers flow into Bangladesh from India (from Assam, Meghalaya, Mizoram, and West Bengal).

The Brahmaputra valley forms a narrow natural trough through which high waters surge during the floods and heavy rain of the summer months (May to August). Assam, with its broad floodplains and flanking hills, accounts for 9.4 percent of India's total flood-prone area and some of its highest rainfall statistics, and is the northeastern state most affected by the annual flood surges. It is accordingly the main focus of this study.

Heavy floods devastated the rural economy of Assam in the summer and fall of 2004, displacing over 3 million people, killing over 200, washing away livestock, and causing extensive damage to crops and property. In many places, the fresh rice seedlings crucial for the winter crop were completely ruined. These consequences of the floods underlined the importance of focusing on livelihood issues in Assam, in particular in the Brahmaputra and Barak valleys.

A number of factors inhibit effective development in the basin of the Brahmaputra and its tributaries, and indeed throughout the Northeast:

- Most policies and much of the work that is done are reactive and uncoordinated.
- There is little transparency in government work or tight review and supervision of work contracted out to private companies.
- The nongovernmental sector is scattered and, while growing in influence, is not truly effective except in a few areas.

- Public participation in planning is low: while rural communities are the worst affected by flooding, virtually all antierosion and flood protection activity and work is left to the government and its departments.
- The implementation of antierosion and flood protection measures is often crisis generated, with insufficient advance preparation.

This paper therefore proposes a strategy for living intelligently with floods, with the main objectives of improving the quality of flood awareness and strengthening local capacity to undertake measures related to disaster preparedness, risk mitigation, prevention, and coping with the threats posed by flooding. The focus is on realistic, time-bound strategies that can improve the quality of life. Strategies considered include:

- Farmers' innovative interventions to develop combined traditional rice crops that can survive high water and can be replicated across the floodplains
- Introduction of better-quality cattle and veterinary extension services, reducing the vulnerability of those dependent on crops
- Improved design and wider use of high platforms that can be used for refuge during floods (and may in certain circumstances be a better option than construction of embankments, which are often viewed as interventions that trap floodwater while "leaking" funds)
- Creation of a network of boats to deliver health services to those most vulnerable to floods.

Such a set of strategies, which are low cost and easy to implement by public-private partnerships, would improve livelihoods, incomes, and human dignity, and reduce ill health, risk to life, and losses from damaged homes or lost livestock.

The impact of the 2004 summer floods was highly visible at Majuli Island in Jorhat District, one of the largest river islands in the world, which is particularly threatened by erosion. The island has been a primary research site for the Centre of Northeast Studies since 2001. C-NES was picked as one of the 20 winners of a national World Bank award (India Marketplace 2004) recognizing innovative proposals for transforming the rural economy. The title of the C-NES proposal, "A Ship of Hope in a Valley of Flood", captures the significance of the design of a safer, stronger, midsize ferry or large country boat capable of delivering health services to those affected by floods at times of high water in the Brahmaputra valley. Such innovation is extremely relevant to the theme of living intelligently with floods, as it exemplifies the capacity of communities to use local technology and local skills to simply but effectively upgrade current technology in order to tackle health and other issues at the grass-roots level for the benefit of marginalized groups.

C-NES has used the ship, which is named *Akha* or Hope, to conduct 14 health camps at different islands in Dibrugarh District, upper Assam. Over 5,000 residents of these islands have been treated for various ailments by doctors from the Assam Medical College, Dibrugarh, and additional medical staff provided by the district administration and health authorities. Measures have included an immunization program to protect children from polio and other preventable diseases.

2. Study of flood impacts and control strategies

2.1 Assam context

Assam is situated in a high rainfall area with an average annual rainfall of 2,546 millimeters. About 60 to 70 percent of the monsoon rain is received within a span of 3–4 months (May to August). The high rainfall in a limited timespan causes major problems in the form of floods, erosion, and drainage congestion in the plains districts of the Brahmaputra and Barak valleys. The recurring floods have extensively damaged the rural economy of the state, with extensive sand casting of once-fertile lands, especially on the north bank of the Brahmaputra, and riverbank erosion throughout the state is among the factors forcing many rural families to migrate to towns.

The number of people affected by floods and the amount of damage have increased steadily over time. The National Flood Commission has estimated the area vulnerable to floods in Assam at 3.1 million hectares of the Indian total of 33.5 million hectares for India (Government of Assam 2003–04). Based on the incidence and extent of flooding the state is categorized into two broad areas: chronically flood affected and occasionally flood affected. Nearly 73 percent of the flood-prone area is chronically flood affected.

2.2 Study methodology

The study was carried out in the flood-affected areas of Jorhat and Golaghat districts of Assam. A total of four community development blocks were covered in the study: Dhekergharah, Kamalabari, Ujani Majuli, and Golaghat North. In each development blocks of at least four villages were selected randomly; the total sample size was 210. The required information was collected by interview, and the analysis was mainly qualitative and descriptive in nature.

Respondents in the Jorhat-Golaghat region comprised mainly farmers, small business owners, self-employed and government employees, and college students (table 1).

Table 1. Employment categories of study respondents

Employment categories	Number	Percentage
Farmers (all categories)	163	54.33
Landless farmers engaged in on-farm activities (wage earners)	37	12.33
Persons engaged in nonfarm activities (small business owners or otherwise self-employed)	25	8.33
Persons engaged in off-farm activities (livestock owners)	32	10.67
Salaried persons	23	7.67
Students	20	6.67
Total	300	100

Questions asked covered such themes as the impact of floods on household and village economy, the effectiveness of flood control measures, rural infrastructure, and antiflood strategies followed by people.

In addition, in section 4 there is a description of the continuing independent research in Dibrugarh and Dhemaji districts into livelihoods based on dairying, which is a major source of income as well as having wider social functions, but which suffers from many drawbacks including lack of disease control and inadequate fodder. This is a sector that has received inadequate attention in the past but is relevant to the terms of reference of this study, which require assessment of “further livelihood and production systems currently used to reduce vulnerability to floods, distinguishing, as applicable, between communities living inside/outside embankments, those living on higher ground as well as recently displaced settlements”.

3. Study results

3.1 Impact of floods on incomes and livelihoods

Over 85 percent of respondents had variable incomes due to seasonal fluctuations and other factors, including occurrence of natural calamities. Average monthly income was found to be Rs. 3,482, with an average seasonal fluctuation of Rs. 562 per month (table 2).¹ Except for salaried persons (7.7 percent), many respondents said that their incomes dropped considerably during the time of high water, sometimes to zero. This was true particularly of daily wage earners, as they could not go out to seek the regular short-term employment they were able to find during the rest of the year. Animal owners were also badly affected, as disease and scarcity of fodder took a high toll of animals and reduced productivity. Dairy farmers said that milk yield decreased many fold after the flood as grazing land was destroyed and animals had to live on nonconventional fodder such as sugarcane leaves, banana leaves, bamboo leaves, or merely on hay. Milch animals were most adversely affected; once their milk yield fell, it was found almost impossible to raise it again.

Table 2. Impact of floods on respondents’ income

Respondents	Average monthly income (Rs.)	Average drop of income due to flood (Rs.)
Farmers	3,750	550
Wage earners	785	645
Nonfarm workers	3,200	780
Off-farm workers	3,135	360
Salaried persons	6,720	..
Students	..	..
Average	3,482	562

.. Zero or insignificant.

Respondents, particularly wage earners, reported that they had a limited choice of activities to meet daily needs. At the time of flood some earned seasonal income by catching and selling fish

¹ Conversion: 1 US dollar = 44 Indian rupees (February 2006).

or by collecting driftwood and logs floating down the river and selling these illegally to sawmills, furniture stores, or to local markets. Examples from Majuli Island and other communities living by the banks of the Brahmaputra indicated that the collection of driftwood was becoming a profitable livelihood option. Twenty-three respondents (7.6 percent) said that they collected firewood at the time of flood and sold the surplus for much of the rest of the year. Severe degradation and loss of cultivable land, along with a reduction in production and productivity of crops, has forced a number of respondents (21 percent) to seek nonfarm occupations.

3.2 Impact of floods on crops and livestock

Floods cause extensive crop damage, particularly to paddy. Four distinct types of paddy were grown in the study area (table 3):

- *Sali* (winter paddy), the major crop grown in the kharif season (June to October)
- *Ahu* (autumn paddy), the early rice grown between November and May
- *Boro* (summer paddy) grown between December and May
- *Bao dhan* (deep-water paddy) grown in areas subject to inundation by floodwater.

Floods generally affected ahu during the maturity stage and sali in its early and late periods of growth.

Table 3. Percentage of farmers using different rice cultures

Paddy	Development block			
	Dhekergarah	Kamalabari	Ujani Majuli	Golaghat North
Sali	100	100	100	100
Ahu	48	48	69	3
Bao dhan	34	82	90	..
Boro	4	..	..	45

.. Zero or insignificant.

In the study areas, farmers said that for the last 15 years they have been unable to improve production levels because of floods, waterlogging, loss of fertility of land, and sand deposits. Another major problem was the unavailability of seedlings after the flood. Respondents in Golaghat North development block said that some governmental, nongovernmental, and other agencies, such as Krishi Vigyan Kendra (Khumtai) and Assam Agricultural University, had provided the seedlings. More than 20 percent of respondents said that they had to bring seedlings from other flood-free villages where there was surplus.

During the flood, diseases such as foot-and-mouth disease and bovine diarrhea may reach epidemic levels. A majority of respondents (58 percent) said that they did not get any useful assistance from the state veterinary department and treated diseased animals at their own expense. Many animals died due to lack of treatment or medicine, as the veterinary centers were located at substantial distances from the survey area villages. Other complaints included lack of medicines and field staff. Indeed, during the study period, in the Dhekergarah

development block, hemorrhagic septicemia took an epidemic form, killing hundreds of buffaloes, while doctors were allegedly unable to treat affected animals due to lack of availability of vaccines and staff.

3.3 Health problems and health access

Outbreaks of disease tend to increase at the time of flood. Diseases such as gastroenteritis, diarrhea, dysentery, and viral fever were reported to be common during and after the floods. Lack of availability of medicines and doctors and poor road conditions exacerbated the situation. For Golaghat District, the nearest public health center was 10 kilometers from the study area; other areas, including Majuli, reported difficulty in reaching the nearest public health center. One of the suggestions that emerged from interviews was the setting up of mini public health centers or well-equipped village dispensaries. This area is among those targeted by the National Rural Health Mission announced by the prime minister in early 2006. Almost all respondents advocated mobile dispensary on boats or in vehicles to extend prompt medical support to the needy. In Majuli, respondents were of the opinion that there should be at least four such mobile hospitals that can also be used for rescue and relief operations.

3.4 Government relief measures

Different government agencies undertake relief and rescue measures during and after floods. In the floods of 1986, 1988, 1991, and 1996, more than 40 percent of respondents said that they had saved their own lives but little else, depending during those periods entirely on state government relief measures while they lived for five to ten days on the embankments and in the relief camps. In recent years, however, respondents reported that water levels had been lower than usual, apart from the devastating flood of 2004, and people had only to seek the recourse of safer, higher ground for one and two days.

Respondents were questioned on the quantity and quality of relief measures (tables 4 and 5). In Golaghat District respondents said that the quality of the relief materials was not good, but those in Majuli and Dhekergarah indicated otherwise, while in Kamalabari the quality of mustard oil was viewed as poor. This implies some degree of efficiency in the distribution of relief supplies by the district administration and nongovernmental organizations in Jorhat District, where Majuli is located. This may be in part a response to the focus of critical media on the island and its administration in recent years. The low assessment of the quality of relief measures by the people of Golaghat may be a reflection of their higher expectations, given that this is Chief Minister Tarun Gogoi's constituency and is therefore considered a VIP district.

Table 4. Quantity of relief materials

Particulars	Development block			
	Dhekergharah	Kamalabari	Ujani Majuli	Golaghat North
Rice/flour	1 kg per head for 5 days	5 kg per household/year	5-10 kg in a year	5 kg per household/year
Dal	100 g per head for 5 days	1 kg in a year	1 kg in a year	0.5-1 kg in a year
Mustard oil	100 ml per day	250-500 ml	250 ml	250 ml-1 liter
Salt	1 kg	1 kg	1-2 kg	1-2 kg
Tea	100 g	..	..	..
Sugar	1 kg	..	..	..
Vegetables	..	..	..	..
Washing soap/ detergent powder	1 kg det. powder 1 toilet soap	..	..	..
Cloth	As available	..	As provided by NGOs	As provided by NGOs

Note: g grams, kg = kilograms, ml = milliliters.

.. Zero or insignificant.

Table 5. Quality of relief materials (perception of majority of respondents)

Particulars	Development block			
	Dhekergharah	Kamalabari	Ujani Majuli	Golaghat North
Rice/flour	Good	Average	Good	Poor
Dal	Good	Average	Good	Poor
Mustard oil	Good	Poor	Good	Poor
Salt	Good	Good	Good	Poor
Tea	Good	n.a.	n.a.	n.a.
Sugar	Good	n.a.	n.a.	n.a.
Vegetables	Good	n.a.	n.a.	n.a.
Washing soap/ detergent powder	Good	n.a.	n.a.	n.a.
Cloth	Average	n.a.	n.a.	Average

n.a. Not applicable.

3.5 Survival strategies

Depending on generations of personal experience, the villagers covered in the survey spoke of their strategies to live with floods. These were primarily either avoidance strategies or minimization strategies, the first seeking to avoid the impact of the floods and the second to minimize the damage that communities and individuals knew they were bound to suffer.

3.5.1 Avoidance strategies

Raised houses

Over the centuries, the Mishing tribal group in Majuli and other parts of the upper stretch of the Brahmaputra has developed the elevated *chang ghor*, a bamboo house on stilts that can be dismantled or quickly restored after a flood surge. These houses were generally not submerged in normal floods. Other groups had structures where the upper part of the house was used as a granary and the lower part as a barn. These were used to save the food grains and hay or even to shelter people at times of high water. People without these had elevated tables made of bamboo or used the ceilings to keep food grains or other agricultural produce safe from high water.

Boats

Many people in the flood-affected areas are forearmed with boats. Most respondents (over 50 percent) had one or two boats; 19 percent had two boats, 39 percent had one boat, and the rest made rafts from banana tree trunks at the time of need. When roads and houses were inundated, boats and rafts served as the chief mode of transport and doubled as shelter.

Adaptation of cropping systems

May to July is the normal flood period in the Brahmaputra valley. Farmers do not cultivate the winter crop in the time recommended by government specialists but instead have developed their own coping strategies, which are creative and practical.

They grow the tall, bold-grained indigenous rice varieties, which do not require much care. Transplanting of winter paddy is done in the second fortnight of August. Cultivation of boro paddy (summer rice) in the flood plains is a new idea that many farmers have developed over the past three to four years. It gave a higher yield than winter paddy. Almost all popular summer rice varieties in these areas are Bangladeshi in origin (for example Jai Bangla, Biplab, Number 9). But these varieties have a number of drawbacks: they require greater application of chemical fertilizers and irrigation water, they are prone to preharvest sprouting if the rains come early, and, above all, the price of the produce is low because of inferior crop quality. It is cultivated as a chance crop or flood-escaping crop. In the lower land bao dhan (deep-water rice) is usually cultivated; it is bold-grained with low production, and is tolerant of moderate floodwater.

Crop diversification and mixed cropping

This was one of the critical mechanisms adopted by respondent farmers to guard against heavy losses. In the study areas, particularly in Dhekerгарah and Kamalabari development blocks, farmers cultivated a number of crops in different landholdings. Mixed cropping of ahu and bao dhan rice was a common strategy in the low-lying areas. If the weather was favorable the ahu crop was ready before the flood. Even if there was early flood damage to the ahu, farmers said that all was not lost as they were able to harvest sections of the bao dhan crop. Agricultural

researchers and experts say that this system can be replicated across the state and become a central part of the flood-resisting strategy, augmenting the successful spread of shallow tubewells (groundwater levels are located at low depths in the state), which has helped improve food grain production in Assam in the past five years. This is an approach that both the central government and the Government of Assam might find beneficial to adopt. Policy changes need to be supported by a major campaign at the field level among farmers to popularize this experiment as part of a social risk management framework and extension program. When this information was shared with other farmers and agricultural specialists from other parts of the state at workshops in Guwahati and Jorhat (November 2005), a number of farmers indicated their willingness to experiment with the new system. However, extensive multiple cropping and growing winter vegetables using groundwater is necessary in the dry season, when many lands lie fallow: production can be linked to cold storage units with processing units located nearby for value addition, with the product then transported to either nearby markets or other rural or urban centers, according to prices available.

3.5.2 Minimization strategies

Government relief measures

Respondents reported that they received governmental and nongovernmental assistance (from, for example, relief agencies such as the International Red Cross and the Assam Red Cross) during and immediately after floods. This was primarily aimed at helping them to survive in the short term; there was no illusion that such relief was anything more than an annual stopgap measure, and the perception was that there was inadequate long-term government strategy to deal with floods.

Assets disposal

Disposal of assets during financially testing times was another strategy adopted to cope with flood events. As many as 32 percent of respondents said that they sold bullocks, cows, pigs, or other animals after flood.

Off-farm income

About 22 percent of respondents, particularly small-scale and marginal farmers, reported going, after a flood period, in search of off-farm jobs in the nearby towns and cities in the unorganized private sector.

High-level refuge

Over 60 percent of respondents believed that use of high platforms was a viable alternative to embankments for sheltering people and livestock during floods. Further studies are required to see where such platforms can be best located: there was a perception that since Majuli Island is highly prone to high water and embankments have failed to deal with the annual surges (largely because they have been poorly built and designed), such platforms would work well there. Discussions with villagers over the past years in different parts of the flat floodplains of Assam – not just on the islands, but in the erosion-prone regions of the narrow valley² – have indicated that such innovative efforts would be welcome. It was also suggested that such

² In the 2004 floods, barring the two hill districts, 23 valley districts were badly hit by high water.

platforms could be a good location for the daily or weekly market (23 respondents). Platforms should be sufficiently high, at least 2 to 5 feet (0.66 meters to 1.63 meters) higher than the embankments, should accommodate at least 500 people and their livestock, and should be made of erosion-resistant material rather than silt or sand. Respondents suggested that there should be at least three such platforms in each village. Some respondents said that digging of the riverbed in the dry season to deepen channels and improve navigation could be taken up in a few areas on an experimental basis, but a majority (60 percent) did not believe that this measure would be effective.

In 2004, over 300 embankments that had degenerated through age or were poorly built gave way during the floods. The result was the highest human death toll and the worst floods in decades. Few new strategies seem to have been developed in response, though the prime minister announced the formulation of a high-level committee to suggest long-term ways of tackling the problem of floods in Assam and other states of the region. He also has been pressing for the setting up of a Brahmaputra valley authority on the lines of the Tennessee Valley Authority.

3.6 Flood management

As regards the power of ordinary people to resist floods, or their voices being heard in matters related to flood management, there was a great deal of hopelessness and helplessness expressed by respondents. A common theme was that there was very little that ordinary people could do to check floods and erosion. The responses were extremely varied: many respondents said they had no answers; others remarked that the assistance of “foreign experts” should be sought; some blamed those living in upland areas such as Arunachal Pradesh for deforestation and flood. Significantly, almost all held the embankments responsible for floods. They blamed the state government and its various flood protection arms for building embankments indiscriminately without any planning or forethought. One respondent used the analogy of the same amount of water being contained in a glass and in a saucer to make the point that containment deepens flooding. A majority of respondents felt that if the embankments were removed, floodwater would spill onto flood-prone areas with a degree of uniformity and deposit fertile silt and clay on farmlands, increasing their productivity.

3.7 Microfinance and thrift societies

Some questions in the study pertained to the existence of self-help groups and credit and thrift societies in the villages. The existence of women’s self-help groups was noted in all the villages under study. The exact number of functional and nonfunctional self-help groups could not be ascertained, though it seemed that more than 60 percent were functional. The concept of credit and thrift societies had not spread widely, and these were found in only five villages. These operated as self-help groups, with internal lending among the members only.

4. Dibrugarh and Dhemaji districts: Dairy livelihoods

4.1 Introduction

Livestock production is an important livelihood option for many people in developing countries, where most farmers practice multipurpose, nonintensive methods of livestock rearing. Small-scale and marginal farmers keep animals for food, fiber, fertilizer, fuel, and draft

power, as a buffer in case of crop failure, and to perform certain social and cultural functions. In farming systems where animals are reared and crops are also cultivated, land appears to be used in a more sustained manner than in monoculture farming systems. Thus, crop residue is fed to animals, animal manure provides soil nutrients, and animal draft power reduces the demand for other forms of power and hence for fossil fuels.

Such mixed systems often make a major contribution to economies at national, regional, and district and village levels, but their importance tends not to be recognized by economists and planners and is not reflected in official statistics or in policymaking. In India, livestock contributes about 30 percent of total farm produce, and 80 percent of livestock products are belong to small farmers with three to five animals and less than 2 hectares of land.

In addition, land is extensively used to graze cattle. This is especially true in Assam, where cattle graze freely on open land and are not stall fed. The quality of stock is poor and milk production is very low: consequently, the nutritional benefits of milk are often lacking in diets, and calcium deficiency among infants, the young, and the elderly has been described by officials in Assam as an extensive problem. Veterinary services are generally inadequate, especially at times of flood, and many veterinary officials and doctors prefer to work in the towns of the Brahmaputra valley rather than visit rural areas.

“You will rarely find a senior veterinary officer from the government in a village either for inspection work or to deal with problems, they just don’t go there”, said one senior government official.

A comparative study was carried out of livestock population, milk production, and other data obtained from two dairy research sites in two districts: Kareng saporu in Dhemaji District and Charikholia saporu of Dibrugarh. Twenty-five cattle owners from each saporu were randomly selected to take part in the study.

The findings showed that the average daily milk production per buffalo was 13.16 liters in Kareng saporu and 21.84 liters in Charikholia saporu. Average daily milk production per cow was 4 liters in Charikholia saporu, and 6.7 liters in Kareng saporu.

4.2 Marketing channels and price spread

Kareng saporu and Charikholia saporu are around 35 kilometers and 40 kilometers respectively away from the main market and city of Dibrugarh. Milk is first transported distances of 20 kilometers from Kareng and 35 kilometers from Charikholia by river on ferries and small boats; the remaining distances are covered on bicycles or rickshaws. The milk is carried in open cans and is exposed to contamination and pollution. The journey takes up to four hours and representatives of hotels and restaurants collect the milk, as do local milk vendors who distribute it door to door. A simple flowchart shows the marketing channel for milk:

Producer (cattle owner) ---> collector (boatman) ---> hotelier/distributor ---> consumer

The buyers pay between Rs. 12 and Rs. 20 per liter for cow milk and Rs. 15 to Rs. 25 per liter for buffalo milk to the cattle owner. Payments are made every two weeks.

4.3 Livestock production challenges

Stall-feeding of cattle is not practiced on the islands of the Brahmaputra. Those raising cattle keep their animals under small thatch roofs, but this gives shelter only to one-third of their

herds. In the morning the animals are freed to graze openly after milking. At times, the cattle walk more than 10 kilometers in search of fodder and grass.

In the flood-affected islands, reduction of numbers of productive livestock to optimal levels, improved cattle sheds, and cultivation of fodder grasses are some steps that could lead to increased production. The main challenge facing dairying in Assam, however, is the poor quality of cattle, resulting in low production levels and quality of milk. Also, because of a lack of chilling facilities, there are days when the milk spoils and incomes are lost.

Animals suffer during the floods, with a number of deaths and diseases resulting from lack of fodder, contamination of water, and shortage of medicines, as indicated in the Jorhat survey.

The field research also indicated that an important additional source of income for cattle owners was cultivation of seasonal crops (with small investments in seeds) for sale in village markets and towns, to which they were transported by ferry.

Cultivation of the flood-resistant rice variety *baou dhan* is typical of the Mishing community living in the upper Brahmaputra valley. Rice has great significance in their social and religious life, and over 90 percent of families of Kareng saporis cultivate *baou dhan* and *ahu* rice in mixed cropping. Black gram and mustard grow well on the alluvial sand banks. Cultivation of ginger, garlic, vegetables, and fruits are not uncommon.

Research carried out for this study over the years has shown that dairy-based livelihoods are an important potential growth area. The National Dairy Development Board (NDDDB), which seeks to be involved in farmers' training and improved milk production in Assam, may emerge as a key player in the coming years if the state government continues its campaign for better agricultural production through the Assam Agriculture Competitiveness project funded by the World Bank.

Indeed, NDDDB-trained dairy farmers from an island in Dibrugarh have introduced new concepts of animal rearing and cattle management in their area, including regular vaccination, veterinary care, improved fodder, introduction of improved mixed breeds, and artificial insemination. In recent years the state government has focused extensively on encouraging self-help groups, which are gradually taking over the role of development agents. With better training and capacity building, these groups could become major actors in the development process.

Many farmers in Majuli and Dibrugarh say they want to correlate their traditional methods of animal rearing to modern and more effective systems, reduce overall costs, and increase the productivity and the life span of healthy animals. Regular visits to islands where cattle are reared show that animal care methods have improved little in nearly 50 years; interventions by government are neither visible nor effective. What is needed is a strategic mix of traditional and modern techniques of animal rearing, based on proper study and planning and introduced in coordination with villages, to bring new momentum to the lives of people and help meet basic needs.

5. Conclusions

The rivers of the area are a source of both benefit and calamity. The river route connects islands, isolated sandbanks, and spurs across the valley and is the only transport link available to those who live on the margins – they have no choice. Despite hazards, people continue to live on the banks of the river and its depositional islands (*chars*). The river provides organic and inorganic materials essential for cultivation by depositing silt, yet also washes away large areas of cultivable land.

What have been stressed above are strategies by which ordinary people can live intelligently with floods, as alternatives to large-scale, high-cost dam-building projects whose efficacy in reducing high water and developing irrigation systems is questionable, especially in the light of public opposition to such moves, the lack of clarity about the extent of environmental damage to ecosystems, the displacement of communities, and the burgeoning costs, which also raise the issues of sustainability and who will profit from such developments.

For example, construction of a network of boats to help provide health services, transport, and relief (including rescue) for those most vulnerable to floods would help address the lack of concern or policies for the truly marginalized in the floodplains. Using the sand and silt brought down by the floods and combining these with bricks and mortar, during the dry season, to develop high platforms able to provide refuge for people and livestock during high water could generate local employment and encourage entrepreneurship and skills. Platforms do exist but many of these are too low and have been constructed without local involvement or sensitivity to local needs.

The Government of Assam took a decision in September 2004 to develop platforms to help people cope with the problem of floods every year. A number of organizations, including C-NES, have been advocating such a policy through, for example, presentations to the state political leadership and district officials. It took nearly two years and an unprecedented flood in the state in 2004 for this view to gain acceptance but it is one of the most demonstrable effects of efforts to persuade government to listen to voices from the field.

6. Recommendations

6.1 Immediate flood relief

6.1.1 Refuge from floods

It is a matter of satisfaction that the proposal for provision of high platforms for people and animals at times of high water has been accepted by the Government of Assam.

6.1.2 Water transport

Water transport is the sole mode of transportation over any distance for many people, for example the inhabitants of Majuli, with the ports (*ghats*) serving as the chief outlets to the rest of the world. There is no other way to reach Majuli except the Inland Waterways Authority ferry or the country boat (*bhot-bhoti*) services. Rural water transport, as the cheapest and most widespread form of transport, is of great importance to marginalized communities.

An important requirement is improvement of the existing port facilities, which in turn involves transparency in the use of funds and in the terms and conditions between lessees and the Inland Water Authority. It is crucial to develop a fleet of boats and ferries to reach the marooned and sick during floods with doctors and medicines and other relief materials. Such a fleet could be of general benefit for freight and passenger transport, as well as for health and training outreach, rescue, and relief, and would extend the livelihood options of marginalized communities and give them greater accessibility to government facilities.

6.2 Agricultural development

6.2.1 Crop diversification

Research has shown that greater emphasis should be laid on mixed cropping and crop diversification as a component of village-level planning for integrated socioeconomic development in rural areas.

6.2.2 Dairying

The livelihood potential of dairying could be further realized by maintenance of high standards of hygiene, chilling and pasteurization of milk during collection and transportation, and the establishment of processing units, adding value to the product and widening the product range for the producer and the consumer.

6.2.3 Improved animal quality and health

Artificial insemination contributes significantly to upgradation of local cattle and maintaining the genetic superiority of crossbred cows. This has been shown to increase productivity (in comparison to indigenous breeds) and to improve conception, thus reducing the calving interval.

Veterinary services are uniformly poor in Assam. The rural veterinary health care delivery system must be strengthened through training of paraveterinary technicians and animal health workers, with the support of self-help groups, district administrations, and such organizations as the National Dairy Development Board and C-NES. Trained paraveterinary technicians and animal health workers could provide an interface between rural communities and the formal health care system, providing primary health services and disseminating preventive solutions, such as deworming and vaccination. They can act as change agents by educating and training rural communities on improved animal health and management practices.

An encouraging sign is that a number of educated young people and cattle owners have said that they are interested in learning basic veterinary techniques to serve as paraveterinary technicians. Training in this area as an alternative livelihood is necessary.

Adoption of better management practices would improve animal health and productivity, for example growing submergence-tolerant, semiaquatic grass species in flood-prone areas, and provision of improved infrastructural facilities in rural areas to encourage dairying as a viable livelihood option.

6.3 Water resource management and community participation

Despite millions of rupees being pumped into the region these past decades to build dams and manage floods through engineering interventions such as bullheads, porcupines, and

embankments of doubtful quality, there has been no development of a sustained and sustainable river policy. For such a policy to be effective and realistic, it must consider the perceptions of the people in flood-prone areas, and must encourage and improve existing human resources and skills.

Any antiflood strategy must be people participative, rather than entirely government led, if it is to succeed and be sustained. In this regard, self-help groups in villages and nongovernmental organizations must be involved and empowered in designing and delivering development strategies in rural areas. Such a process would generate rural incomes and jobs, improve living conditions, and benefit rural communities directly, rather than their being dependent on government for relief and rehabilitation.

In Assam, there has been a continuous process of building embankments and bamboo structures aimed at reducing the impact of river currents on shorelines and banks. But there has not been a detailed, structured, logical debate on the efficacy or otherwise of such structures in a river of the scale and size of the Brahmaputra and its various tributaries. There is little transparency on how and where departments spend their money and the process of contract award, and virtually no review of their functioning or accountability. This omission can now be challenged under the state Right to Information Act.

Another proposal worthy of further consideration is the digging of river channels by villagers, under the umbrella of self-help groups, who could then sell that sand for urban construction to generate rural funds and capital.

6.4 Role of World Bank

In conclusion, The World Bank can play a significant role in rural development in the flood-prone areas of the Northeast in general and Assam in particular by encouraging initiatives to promote rural transport; widen livelihood and income-generation options among marginalized groups; and set up self-help groups involving stakeholders at the grass-roots level, including boat makers and their families and associates, improving skills and generating a wave of nonland-based rural employment.