DGIS/DANIDA GOB

MINISTRY OF WATER RESOURCES

BANGLADESH WATER DEVELOPMENT BOARD

MEGHNA ESTUARY STUDY

DRAFT MASTER PLAN

VOLUME 5 : AGRICULTURE AND FARMING SYSTEMS

September 1998

DHV CONSULTANTS BV

in association with

KAMPSAX INTERNATIONAL
DANISH HYDRAULIC INSTITUTE

DEVELOPMENT DESIGN CONSULTANTS
SURFACE WATER MODELLING CENTRE
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ABBREVIATIONS

ADB	Asian Development Bank
ASSP	Agricultural Support Services Project
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BLRI	Bangladesh Livestock Research Institute
BRDB	Bangladesh Rural Development Board
BRRI	Bangladesh Rice Research Institute
BS	Block Supervisor
CDSP	Char Development and Settlement Project
CEP	Coastal Embankment Project
DAE	Department of Agricultural Extension
DAM	Department of Agricultural Marketing
DLS	Department of Livestock Services
FD	Forest Department
FSR&D	Farming Systems Research and Development
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
MOA	Ministry of Agriculture
NAEP	New Agricultural Extension Policy
RAM	Rural Assembly Market
RPM	Rural Primary Market
SRDI	Soil Resource Development Institute
T&V	Train and Visit
WFP	World Food Programme

1. INTRODUCTION

Farm households and the farming systems in the offshore area of the Meghna Estuary are very complex systems that use multiple resources to secure their livelihood and survival. Their existence is based on field crops; the homestead production of food, fodder and fuel crops; and livestock kept at the homestead. The rearing of livestock highly dependent on free grazing and other fodder sources from the surroundings both inside and outside embankments as well as free resources for fuelwood and other products. Furthermore the majority of the households are dependent on aquaculture or fish catch from the sea during parts of the year. Agriculture is a term often used for the production of field crops; therefore the word farming will be used in this report to cover activities of the complex farming systems of plant cultivation and livestock production in the field, homestead and communal areas.

Development of the Meghna estuary has been given low priority in the past. At present it is an area of marginal value for farming and because of biophysical conditions it has a low potential for increased productivity. High soil and low soil fertility in general are major biophysical constraints. The geographical remoteness of the islands and the instability of the land have also contributed to the low priority for development in the past years. In addition to the low potential of the land for plant production, farming in the area is also constraint by a high frequency of pre and post-harvest crop loses and high levels of animal diseases.

The majority of the farmers are resource-poor farmers that practice a low-input type of agriculture. Many farmers do not have title to the land they are farming, particularly where land has developed more recently. The random way of settlement and the practise of 'land-grabbing' mostly by powerful absentee landlords, the tradition of using land as collateral and the high degree of indebtedness of farmers have lead to a complicated system of sharecropping, mortgage and lease cropping. Furthermore, the serious erosion in some places resulting in farmers loosing their land has worsened the situation for many households and left them with nothing and the only alternative to settle on new and very poor land outside the embankments. Often animals are sold to cover immediate expenses, which makes a new start even more difficult for a large part of the farm household.

1.1 Focus area for farming development in the MES area

The MES study area is part of eight different districts. None of the districts are entirely included in the study area. Four of the 'inland' districts are only part of the study area by a narrow strip of land along the coastline. However the most extensive land areas are the offshore islands in the southern part of the estuary. This is where most accretion takes place and where existing polders as well as potential areas for empoldering are found. The offshore islands will be the focus of this paper. In the following when mentioning farming in the MES area it is with reference to these off shore islands in the southern part of the study area.

The offshore islands in the south are more or less covered by five thanas belonging to four different districts (Patuakhali, Bhola, Noakhali and Chittagong). Three of these Thanas are entirely within the study area (Manpura, Hatia and Sandwip), but two (Char Fasson and Galachipa) have most of the land areas outside the MES study area. These five thanas will in this report be referred to as the focal thanas (see maps Figure 1.1 and Figure 1.2).

1.2 Availability of baseline information

Up-to-date statistical information is not presently available for the individual thanas. The baseline-information provided in the following should be perceived as a general description of the farming system in the offshore islands, the constraints and potentials.

An agricultural census including livestock data has been carried out in 1996-97. The statistics is expected to be published by year 2000. The last thana agricultural statistics were published by Bangladesh Bureau of statistics in 1985, based on data collected from 1979-80 to 1982-83. The last livestock statistics was published by BBS in 1994 based on data collection in 1988-89.

Some data on soil salinity and fertility for the coastal area has been recorded by BARC. The series of Thana Guides, published by Soil Resources Development Institute is not yet complete. At present only Thana Guides for Sandwip and Hatia are available. Most of the soil sampling and analysis was, however, undertaken several years ago. In relation to the MES feasibility studies soil analysis has been carried out in certain areas.

The MES project has completed agro-economic, socio-economic and farming systems surveys, all contributing to the understanding of the farming systems and the livelihood of the farmers. The following will be based partly on secondary information and partly on primary information from surveys as well as observations from the field.

It has been noted through the Farming Systems Survey that there are some differences between information given by the Thana officers and the farmers. In general Thana officers gave higher figures for crop yields as well as the information on the use of HYV compared to the information given by farmers.

The land has a low potential for production and has been given low priority for development in the past. This is also reflected by the lack of research carried out to develop the farming systems in the area. Most agricultural research has been concentrated on systems and areas with higher immediate potentials, and most of these developments are not directly adaptable in the offshore chars. However BRRI is conducting test for salt tolerant improved varieties, although the field tests are not carried out in the coastal or offshore char land. BARI does not conduct trials in the MES area except some trials on different species of Khesari (*Lahtyrus sativa*). Research or development in livestock production, particularly applicable to livestock production in the coastal chars have so far not been undertaken by the government agencies.

2. THE FARMING SYSTEM

The off shore islands in the southern part of MES study area (south of the two ds/m river salinity line for May – see Figure 1.2) have been calculated to total 195,709 ha (1957 sq. km.).

The first attempt to develop the coastal areas included in the MES area was done by the Coastal Embankment Project (CEP) which started in 1961. This resulted in the formation of several polders, as listed in Table 1, with a total area of about 99,520 ha (995.2 sq. km.). In some areas parts of the polder has been eroded, e.g., in Hatia and Sandwip. Therefore in reality protected area is less than 99,520 ha, and for some areas like the northern polder on Hatia more of a theoretical situation, as the embankment is completely missing several places. Due to lack of maintenance of sluice gates, damage of embankments, siltation of the drainage system, and erosion, flooding and salinity are problems that continuously inhibit the agricultural production. Rehabilitation of polders have been carried out in relation to the Rehabilitation of the Coastal Embankment Project (CARDMA, 1988).

The 10 polders in the MES area cover approximately 99,520 ha. Of the 96,189 ha[1] outside embankments approximately 53,000 ha are covered with mangrove forest. This means that the agricultural land, grazing areas and fallow land outside embankments consist of approximately 43,000 ha.

Average population density in the MES area has been projected to 475 per sq. km. resulting in an estimated total population of approximately 930,000 people on the offshore islands of the focal Thanas of MES. With an average household size of 5.6 persons there are approximately 166,000 households in the focus area.

[1] As the present figure for empoldered areas is lower than the original figures given in Table one because of erosion, the proportion of land outside embankments is in reality higher than this estimate, but for a general picture of the situation these figure have been accepted.

Figure 1.1: Focal Area for Potential Farming System Development

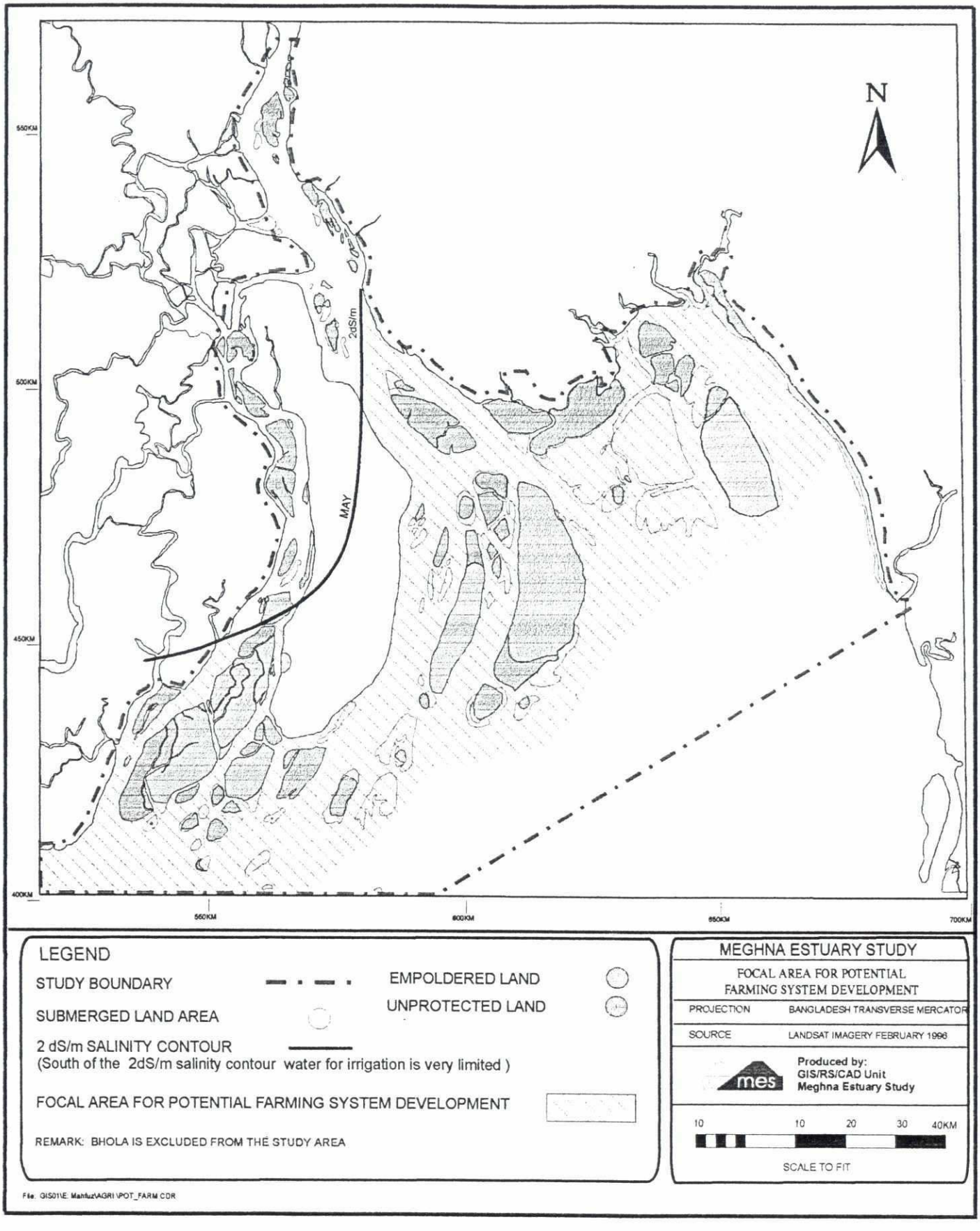


Figure 1.2: MES Thanas and Districts for Farming System Development

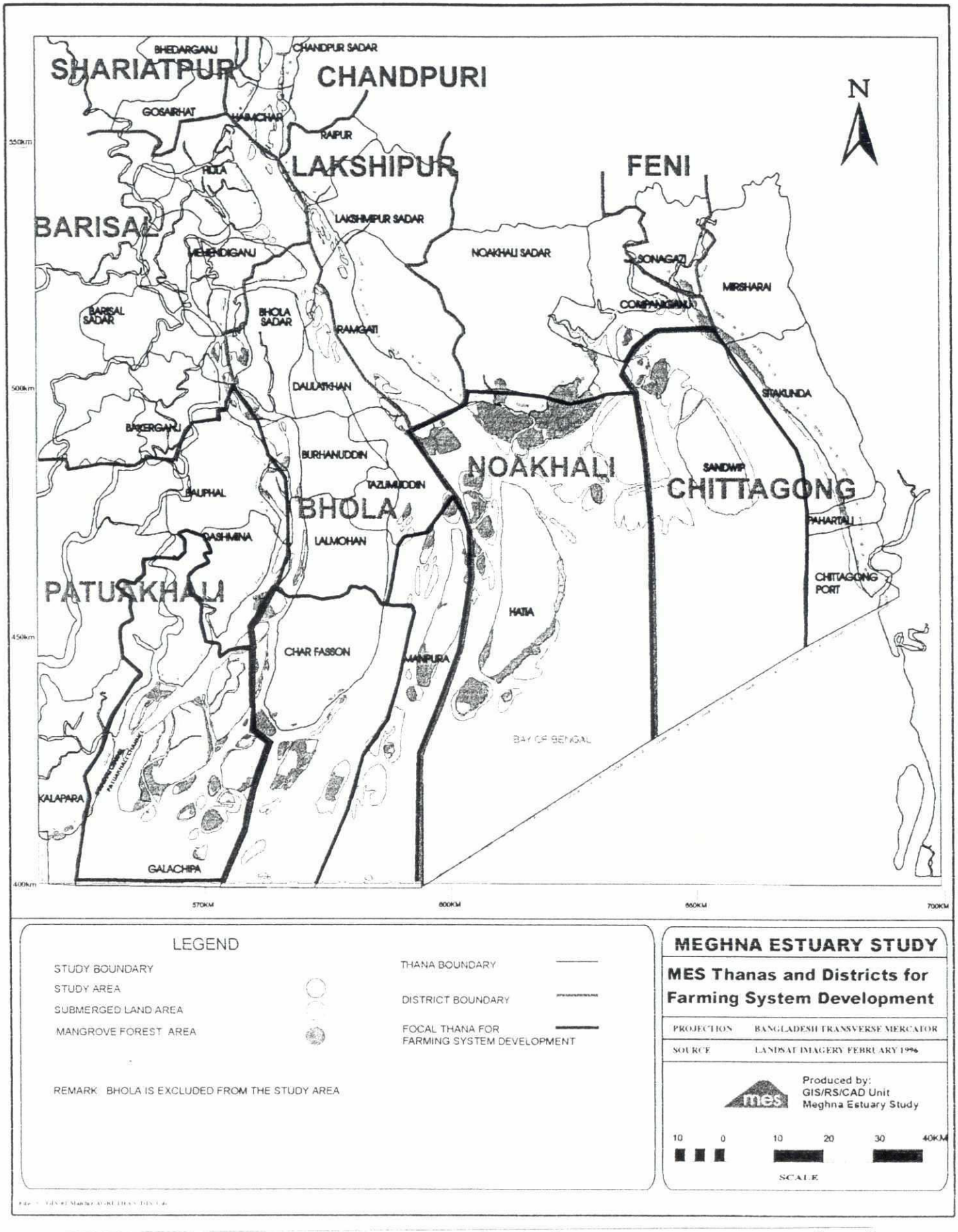


Table 2.1: Polders in the MES area (Source: MES/BWDB)

Polder no.	Name	Area (ha)	Thana	Year of completion	Year of rehabilitation
72	Sandwip	13,110	Sandwip	Early 60's	1994-1997
	subtotal	*13,110*			
73/1A	Char Iswar & Nal Chira	21,000	Hatia	1965-66	Rehabilitated several times
73/1B	Burir Char	25,440	Hatia	1965-66	- do -
	subtotal	*46,440*			
58/1	Hazirhat	3,050	Manpura	1993/94 (1982)	N/A
58/2	Char Pathila	4,390	Manpura	1994 (1987)	N/A
58/3	Faizuddin	1,310	Manpura	1983 (1980)	1994
	subtotal	*8,750*			
55/3	Char Kajal	11,350	Galachipa	1991	N/A
55/4	Char Montaz	7,440	Galachipa	1991	1997 (FFW)
52/A	Chhota Baisdia	5,530	Galachipa	1991(June)	1997 (FFW)
52/B	Rangabali	6,900	Galachipa	1991(June)	1997 (FFW)
	subtotal	*31,220*			
	TOTAL	99,520			

Source: MES survey; BWDB

The majority of the households are involved in farming. Even landless households might grow some crops or trees around the house and keep some livestock and poultry.

Farm units are small (average less than one ha). Rice is the main crop harvested at least once a year. Some crops are grown in limited areas during the winter/dry season. An average farm unit would have some poultry, a few goats and perhaps one or two cattle. Depending on the age of the settlement the homestead area would be more or less developed with some trees and other plants for different purposes. The poultry are kept at the homestead area, while the cattle and to a certain extent the goats are allowed to graze freely or herded. The homesteads are raised areas of various sizes occupied by one or several households, typically not more than 0.1 ha per household.

Traditionally it is the men in the household who carry out the work in the field. Occasionally women are seen working in the field. The larger livestock are the responsibility of the men. The women take care of the work that can be carried out in the homestead area, drying of paddy and threshing, and they keep smaller animals like poultry, ducks, goats and sheep. Also the cultivation of crops and trees at the homestead area is traditionally women's work, and only the more heavy work like cutting of branches involves men. Collection of fuelwood and other fuel sources for cooking is women's work. Children take part in women's work and collection of fuelwood is often undertaken by children as well as herding of livestock.

Cropping seasons are Kharif I, Kharif II, and Rabi season. Kharif I is the pre-monsoon and early monsoon season, normally March - June. The rice grown during this period is referred to as Aus. Kharif II is the monsoon season, normally July - October. The rice grown during the Kharif II season is Aman rice, broadcast (B. Aman) or transplanted (T. Aman). Rabi season is the winter period normally beginning in November and ending in February. During winter Boro rice can be cultivated where irrigation is possible. Very little Boro rice is grown in the offshore islands of the MES. A limited area of Boro rice is cultivated in Sandwip.

The river around the offshore islands is too saline for irrigation during the dry season. Furthermore the fresh groundwater on the islands is either very limited or non-existent. This is partly why farming in the coastal area is different from many other parts of the country.

With protection of the land by embankments, proper drainage and sufficient number well-functioning sluice gates there is, however, some potential in improving the water management by storage of water in the khals, ponds and drainage systems.

Outside embankments the agricultural production is mainly limited by the frequent tidal flooding that maintains the salinity levels of the soil. Inside embankments the main problems are drainage congestion, causing flooding with rainwater during monsoon, and the occasional salt-water intrusion. The problems inside embankments mainly relate to lack of maintenance of the drainage and protection system, damaged embankments and sluice gates, as well as exceptionally high storm surges.

2.1 Agricultural production

2.1.1 Land classification and crop recommendations

Duration and depth of flooding together with the possibilities of irrigation are, in Bangladesh, major determining factors for which crops can be cultivated in a particular area. The classification of land types in Bangladesh, i.e., highland medium highland, medium lowland, lowland, and very lowland, relates to normal depth of flooding during the flooding season.

The MES area consists mainly of medium highland, flooded up to 90 cm depth. Near to the coast the extent and depth of flooding on tidal and young estuarine flood plains fluctuate seasonally and daily according to tide levels in adjoining rivers and creeks, except where flooding is prevented by embankments.

Table 2.2: Area of different categories of land in the coastal thanas of MES area

Unit: ha

Thana	Highland (above normal flood level)	Medium Highland (flood depth: up to 90 cm for more than two weeks continuously)	Medium Lowland (flood depth: 90 to 180 cm)	Lowland (flood depth: 180 to 275 cm)	Total
Galachipa	0	56,090	10,944	0	67,034
Char Fasson	0	38,616	12,628	0	51,244
Manpura	0	8,393	3,689	0	12,082
Hatia	0	42,900	0	0	42,900
Sandwip	734	20,468	0	0	21,202

Source: BARC, 1990
Note: Very low land normally flooded deeper than 275 cm during the flood season has not been recorded in this survey

Seasonal flooding is mainly shallow, but fluctuates tidally. Flooding inside the embankments is most often by rainwater or usually non-saline river water. Flooding by salt water occurs mainly on the land margins and during exceptional high tides in the monsoon season, and when storm surges associated with tropical cyclones occur.

The following crop recommendations from Soil Resources Development Institute relate to flood levels:

On highland it is only the imperfectly drained or impermeable soils or soils which can be made impermeable by puddling that may be suitable for transplanted Aus or Aman paddy. The potential for Rabi crops is dependent on access to water or irrigation.

Medium highland is suitable for crops which can tolerate shallow flooding, like broadcast or transplanted Aus paddy and transplanted Aman paddy (jute is also mentioned as a potential crop for medium highland, but jute is very sensitive to salinity and therefore not a potential crop for

the coastal estuary). Early Kharif dry land crops, which mature before flooding starts, can be grown on permeable soils, and late Kharif and early Rabi dry land crops on soils, which drain in September. Medium highland flooded deeper than 60 cm is, however, not suitable for HYV transplanted Aman.

Medium lowland is flooded too deeply for transplanted Aus or transplanted Aman paddy to be grown reliably. Mixed broadcast Aus and deep water Aman is common practice. Long Aman seedlings may be transplanted as the floodwater recedes, if it does so early enough. Dry land Rabi crops are widely grown on soils that drain in October and November.

Lowland is flooded too deeply for broadcast Aus or transplanted Aman but suitable for deep water Aman. Dry land Rabi crops can mainly be grown if floodwater recedes before December.

The high and medium lands have potential of greater intensity of cropping than low or very lowlands. When the high and medium lands have irregular relief, hard soil layers and lack of irrigation facilities it is difficult to grow any other crop except T. Aman paddy.

In some medium low lands it is preferred to grow Aus paddy during pre-monsoon rainfall followed by Rabi crops, instead of growing T. Aman paddy. This might be the case where there is a good market for the Rabi crops.

Also in lowlands B. Aman paddy can be followed by Rabi crops if the salinity is not too high. In some cases Aus is grown as a mixed crop with B. Aman.

2.1.2 Cropping patterns in the MES area

The most common type of land in the MES area is Medium Highland. As mentioned above Medium Highland is suitable for crops, which can tolerate shallow flooding, like broadcast or transplanted Aus paddy and transplanted Aman paddy.

Paddy is the most extensively grown crop in the coastal islands. During the monsoon most areas are cultivated with an Aman crop. Where possible this is preceded by broadcast or dibbled Aus in some areas. Depending on salinity and water availability either retained in the soil or kept in reservoirs other crops like groundnut, chillies, various pulses, oilseed, and vegetables are cultivated during the winter season. Triple-cropping is aspired but only feasible in very limited areas because of the increasing salinity during Rabi and Aus season and the lack of non-saline irrigation water and limited possibility for control of the water levels. In many places even double cropping is not feasible.

The capillary effect, which draws saline groundwater to the surface in most soils in the estuary, gradually increase soil salinity during the dry season. At the end of the Rabi season and beginning of Kharif one the salinity level can be rather high and cultivation is only possible after the monsoon has leached out some of the salt. For the same reason it is important to get Rabi crops established as early as possible to avoid damage by salt to get a reasonable yield.

According to BARC (Fertiliser Recommendation Guide 1997) the coastal saline soils are largely single cropped, Fallow – T. Aman – Fallow being the predominant cropping pattern. Double cropping (Fallow – T. Aman - Rabi) is practised in some places. Triple cropping (direct seeded Aus – T. Aman – Rabi) is rarely practised.

Paddy Crops

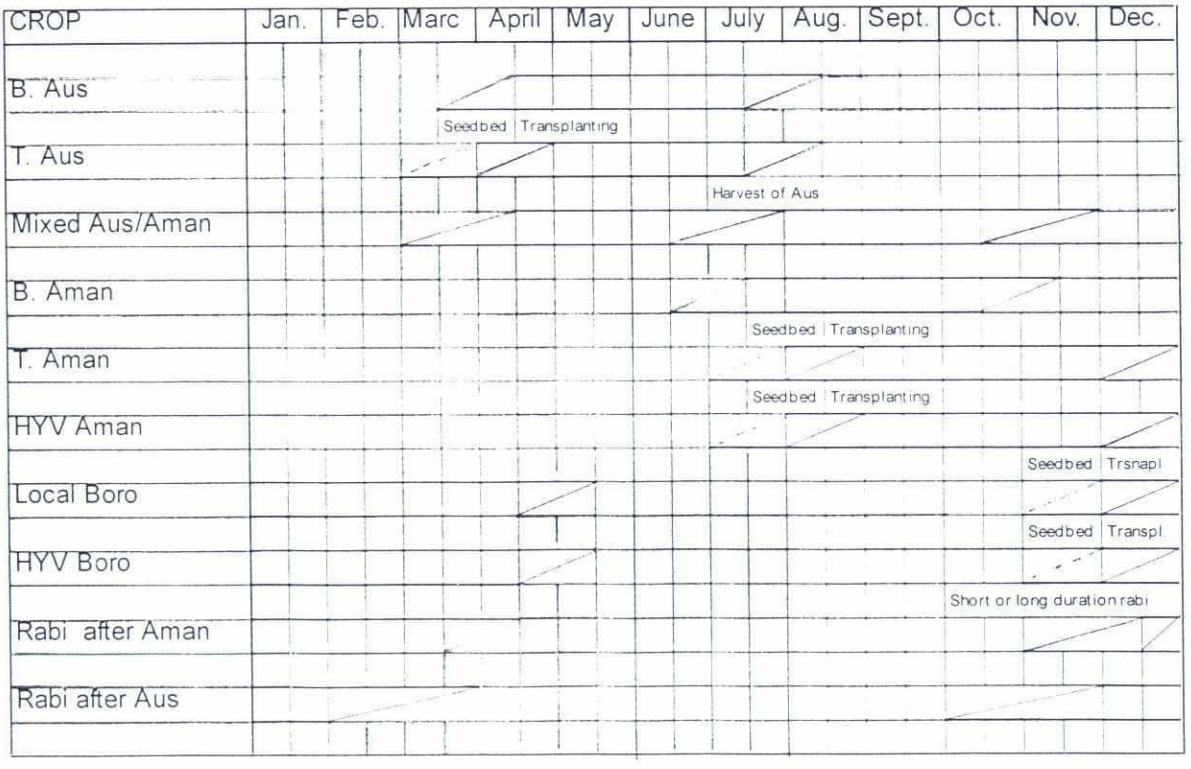
The monsoon is the season for cultivation of rice in the estuary. Aus paddy (Kharif 1 or early summer crop) is sown during March to May and harvested in July to August, whereas T. Aman paddy (Kharif 2 or late summer or autumn paddy 2) is sown in July to September and harvested in November to January. There is also B. Aman paddy, which is sown in March or April and harvested in November - December. It is grown in the low-lying area under 180 to 270 cm of water. In the Rabi season Boro paddy can be grown in limited areas with access to irrigation

from November till early February and harvested in April to May. The local varieties of Boro are sown in November or December, transplanted in December to January and harvested in March to April.

Of the three paddy crops, Aus paddy, which gets the longer days sunlight (photoperiod) in May and June, has the shortest growing season up to four months from seeding to maturity. T. Aman paddy needs a somewhat longer growing season up to five months due to the shorter photoperiod in September. Boro paddy cultivated in February and March where the photoperiod is short has the longest growing season 5.5 to six months. The longer the growing season the higher is the yield of paddy: Boro has the highest yield, T. Aman has a moderately high yield, and Aus paddy has the lowest yield.

Normal practice of growing Aus is broadcasting seeds on moist high or medium highland or dibbling seeds or seedlings in wet and soft char land or along riverbanks. Normal practice of growing Aman is transplanting because the rainfall is more secure during the Kharif two and the transplanted rice has potential of a higher yield. Broadcasting of deep water Aman and Aus is also practised on land where flooding cannot be controlled. Dibbling of Aman is rare and not practised in the Meghna estuary.

Figure 2.1: Cropping Calendar for various crops in the coastal islands of the Meghna Estuary



Note: These crops are mostly rainfed.

The local varieties of paddy in the coastal islands are highly adapted to the unfavourable conditions of the coastal area, but they are low yielding and do not respond well to high amounts of fertiliser. A range of improved varieties with high potential yields, when grown under the right conditions, have been developed. However, most of these varieties do not grow well in the coastal area. They are not salt tolerant, often more susceptible to diseases and flooding. Furthermore, the improved varieties are more costly to grow (seed and fertiliser costs are high) and therefore represent a higher risk for cultivation in the coastal area where losses are frequent.

In lowland areas some B. Aus is sown in March and April mixed with the seed of deep water B. Aman. The Aus crop matures and the whole crop is harvested before the land is deeply flooded. The Aman crop then grows again from ratoons and floats with the rising water level and can be harvested in November-December. In this way the farmer will get a crop even if deep flooding damage the Aus or there is insufficient water for the Aman crop.

Rabi crops

The crops in the dry/winter season are mainly pulses, oilseeds, vegetable, groundnut, chilli, and sweet potatoes. The selection of Rabi crops is largely dependent on salt tolerance and also on seed availability. How large an area is cultivated with Rabi crops depends on seed availability as well as labour available for land preparation and harvesting of the preceding Aman crop. Early establishment before salinity level rises is important for many Rabi crops. The limited market access in most of the offshore islands has been reported to affect the choice of crops and a low interest in growing Rabi crops. For information on salt tolerance of various crops see Appendix 1.

Pulses: The most widespread pulse in the area is Khesari (*Lathyrus sativus*). Beans are consumed and the residue is a valuable animal fodder. Other pulses are Mung and Masur (lentil).

Oilseed: Mustard is the predominant oilseed crop and is grown on most land types. Other oilseed crops are soybean and groundnut. Groundnut is mainly consumed.

Vegetables: Various vegetables like cabbage, chilli, cowpea, potato, onion and sweet potato are grown. Green leafy vegetables like spinach (Puisak) and amaranthus (Lalsak) can grow well in saline soils during winter (Project Manager, Helen Keller International). However, vegetables are not grown much in the char areas as the farmers get a higher income from pulses or oilseeds.

2.1.3 Cropping intensities in the offshore islands

The national estimated average cropping intensity on cultivable land is reported to be almost 175 per cent (BBS 1997). The data from the agricultural statistics 1982-83 show that the two islands, Sandwip and Hatia had higher cropping intensities than the rest of the area. These two islands were empoldered in the sixties, while the other areas were not protected except for Manpura where the embankment was under construction in 1980-83. At present the MES area under Char Fasson Thana (Char Kukri Mukri) is not protected. Large parts of the MES area in Galachipa are now protected by embankments. Cropping intensities for the five coastal Thanas is shown in Table 2.3, for more details see Appendix 2. The cropping intensities in Nijhum Dwip in the agro-economic survey were found to be a maximum of 120 per cent.

It should also be mentioned here that the Thana Office estimates in general are more 'optimistic' regarding both yields and cropping intensities than MES field observations and farmer surveys can support.

Table 2.3: Cropping intensities in Sandwip, Hatia, Manpura, Char Fasson and Galachipa

Unit: per cent

Thana	Cropping intensity (Upazila Statistics 1982-83, BBS 1985)	Cropping intensity (1995-96 estimates fromThana Agricultural Officer)
Sandwip	162	133
Hatia	136	195
Manpura	112	178
Char Fasson	116	150
Galachipa	117	135

2.1.4 Agricultural yields

Yield of paddy and Rabi crops varies a lot, depending on protection of the land, salinity, and use of agrochemicals. Yearbook of Agricultural Statistics of Bangladesh 1995 gives estimates of yields of major crops by region (former district) based on sample surveys. Estimates are given for five consecutive years (1990-91 to 1994-95).

The figures for the four regions of which the coastal islands of MES is a part (Chittagong, Noakhali, Barisal and Patuakhali) do not show much variation between years, and there is no trend of general increase over the years (see Appendix 3). There is some variation between the regions. Average figures are close to the figures for Noakhali Region. The average yield estimates are given in Table 2.4 together with data from the Upazila Statistics 1982-83 and the MES Thana Survey (average of the five coastal thanas) and the Agro-economic Survey in Nijhum Dwip and South Hatia. Detailed data is found in Appendix 4, 5 and 6.

Table 2.4: Estimates of various crop yields in the coastal islands of MES area

Unit: kg/ha

CROP	BBS, Agricultural Statistics, 1995	Upazila Statistics, 1982-83	MES Thana Survey	Agro-economic Survey in Nijhum Dwip & S. Hatia	Survey in Char Montaz & Kukri Mukri	MES Farming System Survey
B. Aus	935	1,200	1,900	(77-1,294) 820	-	-
T. Aus	-	-	-	-	-	-
B. Aman	835	-	-	-	-	-
L. T. Aman	1,302	1,100	1,700	(148-835) 701	(366-2,144) 944	(192-1,647) 940
HYV Aman	1,960	-	-	-	-	-
HL. Aman	1,667	-	-	-	-	1,475
Local Boro	1,439	2,000	2,900	-	-	-
Khesari	738	-	-	(203-388) 230	-	-
Mung	633	-	-	(148-237) 231	-	-
Linseed	-	-	-	(185-193) 193	-	-
Rape/Mustard	498	-	-	-	-	-
Groundnut	987	-	-	(914-1,151) 943	-	-
Rabi chilli	716	-	-	(124-521) 318	-	-
Garlic	2,297	-	-	(430-1,976) 955	-	-
Onion	2,799	-	-	-	-	-
Sweet potato	7,485	-	-	(2,633-2,843) 2,716	-	-

The estimates given by the Agricultural Extension Officers are considerably higher than the statistical figures, the figures from the Agro-Economic Survey in Nijhum Dwip/South Hatia and the Farming System Survey carried out in Char Montaz, Rangabali and Char Biswas. In Nijhum Dwip and South Hatia the majority of the households in the survey were situated outside embankments and reported frequent losses, but also the households situated inside embankments had relatively low yields. In Char Montaz, Rangabali and Char Biswas the majority of the households in the survey are situated inside embankments, but still the average yields are relatively low. However there might be areas, particularly the medium highland inside the older

polders at Sandwip and Hatia, where conditions for cultivation and access to various inputs are better and therefore yields in general higher.

The yield estimates in Table 2.4 are low when compared with the potential medium yield estimates given by e.g. SRDI's Thana Guides and the Fertiliser Recommendation Guide - 1997 for Bangladesh, Table 2.5. This might reflect the low potential of the area as well as the low amount of agricultural input.

Table 2.5: Potential yields of various crops in Bangladesh

Unit: kg/ha

Crop	Moderate Yield Goal, Fertiliser Recommendation Guide - 1997	Potential Medium Yields, SRDI Thana Guides
B. Aus	1,800-2,200	2,300-3,000
T. Aus	-	-
B. Aman	-	2,000
L. T. Aman	2,500-3,100	2,500-3,200
HYV Aman	3,100-3,900	3,000-3,900
Local Boro	2,500-3,100	2,500-3,200
Khesari (Grass pea)	1,100-1,300	-
Mung (Green Gram)	900-1,100	-
Linseed	1,100-1,300	-
Mustard	900-1,100	1,000-1,200
Groundnut	1,600-2,000	1,600-1,900
Rabi Chilli	1,800-2,200	-
Garlic	11,000-13,000	-
Onion	13,000-17,000	-
Sweet Potato	29,000-35,000	-

The majority of improved varieties of rice are not suitable for the coastal areas. Varieties must be relatively salt tolerant and resistant to diseases. At present most of the farmers in the focus area do not purchase seed, but produce their own seed for the next season. A recently developed salt tolerant variety BR-23 might have some potential in the coastal area.

Salt-resistant BR-23 and other crops

The paddy BR-23 is a photoperiod sensitive and salt tolerant HYV T. Aman crop, recently developed by BRRI. It can tolerate salinity levels up to 5-6 mmho/cm. According to BRRI 50 days seedling may also be transplanted in September and October. Flowering starts by the middle of November and 30 to 35 days later the paddy can be harvested in late December or early January. This type of late variety of HYV Aman is recommended in case the earlier variety of Aman in coastal or plain lands is damaged by storm or flood water in August or September.

There are two other salt tolerant Indian varieties of Aman rice. These are Pokkali and Nonabokra. The former can tolerate salinity of the soil up to 10-12 mmho/cm, but is highly affected by pests. The other variety Nonabokra is more or less suitable for saline areas and are not affected by pest and disease. Besides, Purbachi or China Boro is a HYV paddy which can be used especially for Boro. It can also be used as Aus crop. Prubachi is a salt tolerant Aus paddy which can resist salinity up to 8-10 mmho/cm. Another salt tolerant Boro paddy is BR-9 (Sufala). The above mentioned varieties have yet to be tested in the coastal islands of the estuary.

2.1.5 Cultivation practices

Land preparation

Land preparation is done by plough drawn by a pair of draft animals. The plough is basically a piece of wood tipped with a small steel share which can plough to a depth of 7.5 - 15 cm, breaking of the hard surface but not turning the soil over. Land preparation begins up to three

to four weeks before sowing/transplanting, depending on soil moisture and the availability of labour and power. The land is generally ploughed three times depending on the type of crop. After ploughing, the land is laddered by drawing a wooden ladder-like implement across the land a number of times to break the clods and level the land. A pair of draft animals can plough and level 0.3 ha per day. It might, however, take a farmer with a pair of animals much longer than 10 days to prepare one ha of land, when conditions are less than optimal, e.g., bad weather, sick animals, lack of food and fodder.

Power tillers are not very common in the coastal islands. Only a few wealthy farmers have financial resources for such an investment. It has been shown that the overall cost of land tillage per ha is much cheaper by power tiller than by a pair of bullocks. A farmer in Rangabali spent Tk 1,500 to prepare his three acres with a power tiller. With a pair of bullocks the costs would have been Tk 2,700.

Sowing, broadcasting, transplanting and dibbling practices

Paddy seedlings for transplantation are raised in nurseries located near water sources. The land is ploughed and the soils are pulverised before seeds are sown.

Before transplanting rice the land is puddled by flooding the field and laddering when the soil is saturated. The seedlings are 21-30 days when they are transplanted. The transplanted seedlings need irrigation or rain water at the interval of 8-10 days, depending on the moisture retention capacity of the soil. The seedlings are transplanted in line, so that weeding operation between the rows becomes easier. The plant growth in the transplanted field is much better than in the broadcast field.

Most Aus is broadcast. It is sown at the beginning of the monsoon as soon as the first rain starts. Broadcast seeds need some water in the dry land for germination, but do not need so much water as transplanting in puddled land. The seed rate by the broadcasting method of paddy is, however, three to four times higher than by the transplanting method and usually the yields are lower.

The yield is higher in case of transplanted crops, provided there is sufficient water. Aman, Boro and the improved or high yielding varieties of Aus paddy, are normally transplanted in irrigated or rainfed areas, while the local varieties of Aus paddy are generally broadcast in the non-irrigated areas with intermittent rainfall.

Sowing seeds or transplanting seedlings in the char land along riverbank or estuaries, or in forest soils are generally done by the dibbling method. The people in the char land along the coast or riverbanks usually prick wet and soft lands with the help of pointed sticks, hoes or fingers. After making small holes into the soil, seeds or seedlings are placed inside and covered by the soil mass. By this method they grow paddy and other crops. In most cases they get very low yields. Yet farmers grow these crops by sowing seeds without any care and effort, and even without cultivation of lands. In some years when crops are not found worthwhile harvesting, it is left for livestock grazing.

Application of fertiliser

Animal manure, which is not used for fuel in the household, is applied to the field. Chemical fertilisers are available to a limited extent in the area, but most farmers do not have adequate resources to pay for chemical fertilisers.

Weed control

Weeding depends on the resources of the farmer and the severity of the problem. Racking (with a wooden harrow) or hand weeding is done when necessary and labour is available. The weeds are used as animal fodder, green manure or compost.

Pest and disease management

Incidence of insect damage is fairly high in rice crops. The local varieties are more resistant to diseases than improved varieties; still the damage from various pests is generally very high. However, pesticides are rarely used due to the high prices.

Harvesting

Paddy and all other crops are harvested by hand. Threshing is also done by hand or by using cattle to trample the grain on the ground. In some areas paddy is threshed with small treadle powered machines.

Post-harvest processing

Threshed paddy is dried for four to five days on a tarmac road, mat or drying floor, and then winnowed before storing. Farmers face particular problems in drying the Aus crop that is harvested during the monsoon. Post-harvest pests affect stored paddy, especially if not properly dried. Paddy is parboiled before milling. Some farmers take the paddy to a rice-husking mill for polishing where such facilities are available.

2.2 Livestock production

Livestock plays a very important role in daily life for the subsistence rural economy of the estuary. The agricultural production is depending on livestock for draught power and the animals are also important for rural transport. The animals are major source of high quality protein in the diet with a year round production. Livestock, especially large and small ruminants, also serve as capital savings. Livestock, next to crops is the most important sub-sector of agriculture in Bangladesh. The contribution of the livestock sub-sector to the nations agricultural gross domestic product is about 11 per cent. This sub-sector accounts for more than 18 per cent of agricultural export earning and employs about 20 per cent of the total labour force. Nationally about 12 million households evenly distributed throughout the country are livestock keepers. Most farming households and many non-farming rural households are livestock keepers. According to National Survey on Livestock and Poultry in Bangladesh 1988-89, 65 per cent of household owning livestock have large ruminants (cow, buffalo) while 42 per cent keep small ruminants (goat, sheep) and 89 per cent keep poultry (chicken, duck, pigeon). In the MES area covering Chittagong, Noakhali and Patuakhali region the household reporting livestock is given in Table 2.6, which are close to national figures except the sheep and goat population which are less, probably due to their large scale death in 1970 and 1991 cyclones.

Table 2.6: Number of households reporting livestock and poultry, by region

Unit: '000

Region	Total Households with livestock	Bovine animals			Sheep and Goats			Poultry		
		HH reporting	%	Number	HH reporting	%	Number	HH reporting	%	Number
Bangladesh	11,676	7,473	64	20,984	4,883	41	12,486	10,350	88	96,753
Chittagong	616	405	65	1,083	151	24	332	553	89	5,265
Noakhali	576	329	57	823	128	22	305	550	96	5,760
Patuakhali	270	161	60	623	68	25	180	250	93	3,540

Source: Survey on Livestock and Poultry in Bangladesh 1988-89, BBS, 1994

Significant relationships are found between the size of land holding and the kind of livestock kept. Surprisingly, more than 50 per cent of small farms (under 0.6 ha) keep large ruminants, compared with 37 per cent for large farms (larger than 3.0 ha) and 10 per cent for medium farms (0.6 to 3.0). Goats and sheep are kept by 62 per cent of small farms, with number for medium and large farms being insignificant. Poultry ownership follows a pattern similar to goat ownership indicating that small scale livestock activities are a significant part of the economic activity of small scale farmers.

In the MES socio-economic survey it was found that only very few households had no income from livestock and poultry. The figures from Urir Char, Nijhum Dwip, Char Montaz, and Kukri Mukri show that 4.1, 1.9, 2.7, 2.0 per cent respectively had no income from livestock and poultry. However, this does not necessarily indicate that these households do not have livestock.

The first plant species that gets established on the accreting mudflats is Uri grass (*Oryza coarctata*). The farmers usually cut and carry the grass from the mud flat when the soil is still soft and cannot bear the trampling by cattle. With further consolidation buffaloes are brought in and grazed. If the land goes to the Forest Department (FD), the FD starts plantation with keora (*Sonneratia oapetala*) under the cover of Uri grass and do not allow grazing for three years till the planted materials are above the reach of the animals. However, the forest employees usually do not restrict cut and carry system unless the grass collectors do harm to the plantation. After three to five years the growth of Uri grass subsides and replaced by Dhub grass (*Cynodon dactylon*) which grows with monsoon rainfall and animals are grazed freely during monsoon and post monsoon months. The animals while in the forest also graze on other creepers, leaves of keora trees and any other palatable materials available to the animals.

Farmers with a large herd of cattle are known to take their animals controlled by herders to the accreting land covered with natural grass pasture (Uri grass) to establish ownership of the land (land-grabbing). Most often only the large and influential farmers can afford to pay a herder and take advantage of the distant free grazing areas in new chars and grazing in the forest. For the small and marginal farmers who in general have little group organisation it is difficult to use these resources.

Large livestock are mainly tethered and housed in small shelters within the homesteads in the wet season unless specific grazing areas have been retained near the foreshore or on designated land near homesteads. The stock are fed stacked hay, fresh cut grass, tree loppings and water hyacinth, the latter mainly late in the wet season when the weed is rampant on ponds and in waterways

In certain areas the number of livestock and poultry per household is high. The agro-economic survey in Nijhum Dwip found the average number of cattle to be 3.4, goats/sheep 3.0 and 26.0 chicken and ducks per household. This is much higher than national or regional average. The fodder resources are plentiful because of the extensive agriculture, the large forest area and the grass covered mudflats near by.

In Appendix 7, thana estimates of total number of livestock (except poultry) of the five thanas, covering the off shore islands of MES, is presented. Livestock per household has been calculated for 1994-95. Overall average of cattle for the five focal thanas is 1.3 per household with Hatia as the lowest with 1.0 head of cattle and Manpura as the highest with 2.5 head per household. The number of goats and sheep was surprisingly low around 0.5 per household ranging from 0.3 to 0.9. The number of households in the individual thanas is calculated based on the BBS household data from 1991 increased according to the population growth in the MES area (1.67 per cent overall, but 0.3 per cent for Sandwip and 4.3 per cent for Manpura, the three other thanas adjusted accordingly).

2.2.1 Breed and breed characteristics of livestock species

Cattle

The predominant indigenous (Deshi) animal is a small nondescript *Bos indicus* type. The mature body weight is between 150-200 Kg. The slow growing, shy breeding animal has an average age at first calving of 45 months and has a lactation period of about seven months. The prolonged inter-calving period is about 38 months. No improved breed has so far been introduced in the islands. The priority purpose of cattle is draft power particularly for cultivation of land. In the empoldered islands with the increasing cropping intensity and the greater need for timely land cultivation, the demand for draft power is increasing. To meet the demand even

cows are being harnessed to the plough. Small local breeds of cattle are preferred because they are adequate for local farm, easily housed within the limited homestead space and easily managed by women and children.

Under these circumstances milk, meat and hides are largely by products of the draft herd. However, in spite the high price of milk the average daily yield of milk during lactation is little over one litre per cow. Also the traditional grazing areas are going under the plough to produce rice which under the existing price structure are financially less attractive but often the only choice in a subsistence economy.

Excluding the 35 per cent landless, the bulk of the estuarine household farms is a little above one ha of land, much of it on a share-cropping basis. Hire of draft power for cultivation will cost between Tk 2,500 to 3,000 per hectare per season but timely preparation of land is so critical that hiring is a risky business. Ownership of cattle is highly desirable, although they constitute a high capital investment. To minimise the size of individual herds, whilst at the same time ensuring their continuity, systems of exchange exist between villagers.

Buffaloes

In the estuarine environment buffaloes are a preferred species as they are better adopted to plough the mud flats and can feed on coarser roughage that grows in the newly accreting chars and in the forests. They can tolerate more salinity than cows and are more resistant to disease. In the new chars the buffaloes are kept in large herd 50 to 250 in a herd under care of herdsmen. The buffaloes found in the coastal region are Indian water buffalo type, mature body weight is 350 - 450 Kg. They are seasonal breeders and come in heat in post monsoon months with the increased availability of fodder in the chars, and they calve in spring. The average milk yield is about 2.5 to three kg per day during lactation which is seven to eight months.

Buffalo milk contains more fat and non-fat solids than cow's milk and are preferred by local people for making ghee and curd. There is scarcity of quality stud buffalo bulls and no improved breeding and management have been initiated in the area.

Goats

The major breed of goat is the Black Bengal. The breed is famous for its high prolificacy, meat and skin quality. The Black Bangal goat is well adapted to humid climate and produces twins and triplets and has the potential of being developed as 'Broiler goat'. The average live weight of an adult goat is 16 to 18 Kg. Goats are reared by marginal and landless households and children and women take care and are considered an important activity in the existing integrated small holder farming system. The marginal and landless households prefer goat rearing as it only requires small capital investment, simple housing and easy management. They can be grazed on fallow lands after crop harvest. They selectively nibble weeds in weed infested and row planted rice crop during mid stage or they can be tethered along road sides and embankments. Goats can survive on tree leaves of a number of species frequently found in the estuarine villages. The goats mature at an early age, have short gestation period and generation intervals. Goat meat is higher priced than beef meat and the milk is easily digestible by children and old people.

Sheep

Sheep found in the coastal area are coarse wool type, small in size about 10-12 Kg adult live weight and well adapted to the saline environment. In some islands sheep are preferred to goats for their selective browsing on the leftover of cattle and buffalo and considered less menacing than goats. In the past cyclones the sheep casualty was extremely high and some islands are yet to be restocked.

Chickens

In the estuarine area most of the households rear chicken. Normally chicken are scavenging and seldom receive supplementary feeding. The local "Deshi" type is poor egg producer and lays 40-50 eggs in a year with behaviour of pronounced brooding. No impact of cockerel exchange programme with improved breeds like Rhode Island Red or White Leghorn undertaken by the Livestock Department is seen and is probably lost after a couple of generations of in-breeding amongst the off-spring. The indigenous Deshi birds are small in body size about 1-1.5 Kg and well adapted for scavenging condition and probably more resistant to prevalent common diseases. Commercial farms with improved breeds are non-existent probably because of poor preventive coverage, non-availability of day old chicks, formulated feed and poor marketing network. The local birds are ideal for reproduction by natural brooding. However, a semi-scavenging model with artificial hatching and balanced feeding has shown to increase income of small holder poultry rearers in other parts of the country. No similar project has been initiated in the study area.

Ducks

Like chickens, duck raising is widely practised by the housewives in the area especially in the empoldered villages, having large number of ditches that favour natural growth of fresh water snails and duck weed. The area is ideal for duck raising on a commercial basis but their number is low because of shortage of natural feed during the dry months. The fresh water snails do not survive during the post winter salinity and this increases the cost of supplementary feeding. However, a few large flocks, with 50-250 improved ducks (Khaki Campbell) were seen in the project area foraging in the depressed part of the island low egg production was reported due to natural feed scarcity. The flock size is reduced through sale of surplus ducks at the end of winter season.

The ducks are preferred by housewives living around the fresh water pools in the island, as they produce 100-150 eggs per year, more meat and are resistant to many diseases that affect chickens.

2.3 Homestead production of food and crops

Each village is normally divided into a number of raised homestead areas comprising of often more than one household group with their houses, ponds, small upland cultivation fields and the village forest. The raised platforms are usually above normal flooding and therefore suitable for planting of tree species. Woody vegetation at homesteads has a positive effect on soil moisture through shading and increased mulching, for the benefit of other plants, e.g., vegetables. The trees growing at homesteads also provide easy access to fuelwood, fodder and other products. Homesteads provide about 70 per cent of all wood consumption, and about 90 per cent of all fuelwood in Bangladesh (Khan and Alam, 1996).

Most coastal homesteads develop around a pond excavated to provide high land. The exceptions are some homesteads near Khals where excavation from the side of the Khal and deep ditches surrounding the homestead boundary provide enough soil for the homestead area.

A study of the traditional homesteads in coastal Bangladesh found the average homestead size to be 0.238 ha. Excluding grazing areas at the homestead the average size was found to be 0.202 ha. The study included households on Sandwip, Hatia, Kukri Mukri, Patuakhali and some locations outside the MES area.

2.3.1 Utilisation of homestead plants

The study found a large variety of plants in the homesteads: 104 large perennial trees and palms, sixteen varieties of seasonal vegetables, two species of tall grass used for the walls and thatch of houses, three pond-side plants used for mat weaving, three spice plants and four ornamental shrubs. The principle utilisation of the different species found in the above

mentioned study is shown in Table 2.7.

Table 2.7: Principal utilisation of homestead species

Principle plant use	Number of species	Per cent of total species
Palm products	4	3.0
Timber	22	16.7
Fuelwood	31	23.5
Commodity/fuel	13	9.8
Fruit	14	10.6
Fruit/fuelwood	9	6.8
Fruit/timber	14	10.6
Spice	4	3.8
Vegetables	16	3.0
Ornamental	5	12.1

Source: ADB TA 2304-BAN, 1998

The importance of the homestead trees as fuelwood supply was confirmed in the MES Farming Systems Survey. In Sandwip where there is no mangrove forest the households depended entirely on the homestead trees, manure and agricultural crop residues for fuel. In Rangabali, Char Biswas and Char Montaz a few households reported to buy fuelwood for a few months a year.

According to the national figures (1994) for energy sources in Bangladesh, agricultural residues contribute 62 per cent of the total, wood fuel 13 per cent, dung eight per cent and only 17 per cent from hydropower and fossil fuel.

2.3.2 Crops and trees in the homestead

In the above mentioned study it was found that despite the diversity of homestead species, only 18 species make up 75 per cent of the plant numbers recorded of which palms and bananas are the most widespread. Kukri Mukri being the most seaward of the sample areas was mentioned to be somewhat different as prominent plants on the homestead was still derived from flood deposited seed not usually retained in more mature homesteads.

Betel palm is the most prolific plant in much of the coastal area. Its products are consumed in the homestead and sold commercially. Banana is prominent throughout most homesteads, and is the major commercial fruit in the coastal area. It is pioneer plant highly suited to new boundary lines on the margins of the homesteads. It is, however, susceptible to wind damage until it is protected by other growth. It provides a nutritious fruit, a quick cash return and emergency fodder for livestock. Its leaves are very commonly employed as screens to ensure privacy for women around the houses before a mature vegetative cover has been developed. The leaves subsequently provide continued privacy for the bathing sites at ponds. Mango is grown for the fruit but also for timber in coastal areas. The fruit quality of mango is affected by the high rainfall and humidity and does not compete in quality with that from the drier inland districts. The. *Artocarpus* (Jackfruit) and two *Diospyros* species were also found by the above mentioned study to be amongst the most frequent plants in coastal homesteads. The farming systems survey of MES for the offshore islands can, however, not confirm this as Jackfruit was found to be very rare in both Sandwip and Nijhum Dwip. They are dual purpose trees grown for fruit and timber. Coconuts are similarly common throughout the coastal area where they most often are grown as a cash crop.

In addition to trees and palms there are a broad range of vegetables, herbs and medicinal plants in specific beds near the houses and as understorey to other tall growing plants. Table 2.8 shows results from the ADB TA 2304-BAN study for the areas relevant to MES area.

Table 2.8: Ranking of most common trees and palms by sample district

Species	Sandwip	Hatia	Bhola	Patuakhali
Areca cateshu (betel nut)	2	1	1	1
Musa sapientum (banana)	1	3	2	2
Mangifera indica (mango)	7	4	8	3
Samanea saman (raintree)	10	5	5	5
Cocos nucifera (coco nut)	5	7	12	7
Diospyros philippinensis	4	8	10	10
Phoenix sylvestris (date palm)	3	-	7	4
Artocarpus heterophyllus (jackfruit)	-	2	6	8
Swietenia macrophylla (mahogany)	6	-	3	12
Diospyros peregrina	-	9	9	9
Borassus flabellifer	12	-	11	11
Lannea coromandelica	-	6	-	6
Calophyllum inophyllum	8	-	-	-
Citrus grandis	-	14	-	-

Source: ADB TA 2304-BAN, 1998

From the homestead study the following characteristics were also reported: The highest banks are used mainly for raintree and other major timber and fuelwood species as well as the palm *Borassus flabellifer*. Betel palm that is adapted to a seasonally high water table tended to be more frequent along the lower banks and internal plantation areas. While mango was grown throughout all the homesteads, most trees were immature and clearly being used as a timber source. Mango wood, which can be burnt green, is a useful emergency fuel source.

The findings of the MES Farming Systems Survey support the above study. In Sandwip mainly species as betel nut, mango, jackfruit, banana and some guava was found in the homestead area, but also albizzia (karoi) mainly grown for fuel. The homesteads in the western part of the estuary were more diversified and with larger number of trees.

3. MAIN CONSTRAINTS TO THE DEVELOPMENT THE FARMING SYSTEMS

The offshore islands of MES provide quite different farming conditions from what is found in the inland areas of Bangladesh. The main differences are:

Physical constraints

- limited fresh water supply for irrigation during dry season, affecting most of the estuary apart for the very northern part of the study area (northern tip of Bhola)
- high salinity - salinity levels vary in the study area, but there is a tendency for increased levels of soil salinity from west to east, with salinity levels highest in the Sandwip area
- low fertility - fertility of the land varies according to the land use, but the general picture is that content of plant nutrients and organic matter is low, and so are the CEC levels
- the damage and losses caused by cyclones.

The physical constraints are the immediate and main reasons for low productivity of the farming system, caused by low yields from crops in the field and the homestead and low cropping intensities, resulting in low food and fodder production and low income generation. Furthermore cyclones and flooding damage crops and kill livestock.

Remote geographical location

The remoteness of the offshore islands in the southern part of the estuary is a limiting factor for the supply of inputs as well as marketing of the production. Dependency of local tradesmen limits the farmers' options for securing supply and sale of products as well as influencing timing

and prices.

The high risk of damage from storm surges, flooding, pests and animal diseases combined with the remoteness of the area has furthermore made it less attractive and accessible for development. As a result it has been given low priority for development in the past. The extension service in the area is poor and the access to proper credit facilities is very limited. The low potential of the area is also reflected in the lack of research with focus on farming in the offshore islands.

Lack of planning

Land use conflicts of spatial character are found in existing polders between forestry, livestock production, agricultural cropping and fish and shrimp cultivation as there has been no overall land use planning carried out in relation to the physical interventions. Embankments are destroyed for intake of saline water for shrimp cultivation eliminating the possibilities for improved water management. Construction of roads has blocked drainage systems. Communal grazing land has been taken into other uses.

3.1 Biophysical and derived constraints to increased productivity

3.1.1 Agriculture

At present crop yields are relatively low throughout the southern offshore islands of MES area. The yields vary to a high extent depending on the location, inside or outside embankments, as well as the drainage conditions.

The low agricultural productivity of the coastal islands in the MES study area is caused by a combination of factors. Tidal flooding or salt-water intrusions during cyclones damage the standing crop and increase the salinity of the soils. Drainage congestion inside embankments causes flooding during the monsoon and damage to the Aman crop. The low yields are also a result of the low soil fertility. Severe pest and disease attack occurs frequently in the standing crops, as well as post-harvest losses due to rodents. Lack of draft animals or lack of healthy draft animals or power tillers make timely preparation of the land for sowing or transplanting difficult which also affects the productivity.

Soil salinity

Many crops fail to grow in saline soils. When salt accumulates in the root zone it will interfere with the crop growth when the concentration exceeds tolerance limits. Because the salt creates a higher osmotic potential the plants will suffer from water stress even though sufficient water may be present in the root zone. Many plants do not grow well in even slightly saline soils (2-4 mmho/cm).

Most crops suffer from salt injury when EC values exceed four mmho/cm. Rice can tolerate salinity in the soil up to three mmho/cm without any yield reduction. At higher salinity levels the yield is reduced. Salinity levels of five mmho/cm can cause reduction up till 25 per cent reduction and at seven mmho/cm the yield is reduced with about 50 per cent. (Water Quality for Agriculture. Irrigation and Drainage Paper 29, FAO, Rome)

The most sensitive Rabi crops are found to be cowpea, onion, pepper, potato, sweet potato, radish, corn, carrot, beans and others. These crops tolerate salinity levels up to one to two mmho/cm. The less sensitive crops like, tomato, cucumber, broccoli, sesbania, groundnut, sorghum and beet grow satisfactorily at salinity levels exceeding two to four mmho/cm. Soybean and sunflower oilseeds tolerate salinity levels between 5.0 and 5.3 mmho/cm before plants are affected and yields reduced.

For examples of different crops' reactions to salinity see Appendix 1.

Some land near the coast is tidally flooded with salt water for part or all of the year. For land inside embankments the general picture is that salinity levels are moderate or low, but they fluctuate seasonally. However sodium rarely exceeds 10-15 per cent of the total exchangeable bases in any soil layer. High saturation of the exchange complex with sodium is harmful because this may destroy soil physical properties and offset plant nutrition.

The soil surface of the majority of the land in the coastal islands becomes saline to varying degrees in the dry season. Slightly and very slightly saline soils are extensively found in the area, and moderately and strongly saline soils to a lesser extent. In most areas the salinity is caused by the capillary movement of moisture from saline groundwater to the surface even in areas protected by embankments. Evaporation of this moisture concentrates salt on the surface. In protected areas the topsoil as a whole is rarely more than slightly or moderately saline, and the salinity is quickly reduced by heavy pre-monsoon and monsoon rainfall. However, on affected soils, the salt concentration is sufficient to prevent crop cultivation in the dry season or reduce the yields of Rabi crops. Very occasionally, yields of Kharif crops are also reduced if dry spells within the rainy season allow salt to be drawn back to the soil surface. The distribution of saline soils is irregular. Salt concentrations vary considerably within small areas, even within fields. Salinity levels may also vary between years, depending on the dates of onset and ending of the dry season and whether or not rainfall occurs within the dry season.

Flooding with salt water during storm surges caused by cyclones may also increase ground water salinity and subsequent soil salinity levels in affected areas for a period of months or years after the event. In the south eastern part of the coastal islands the water remains saline also during the monsoon season and tidal flooding with salt water during the monsoon occurs frequently where there is no flood protection

Salinity measurements from the coastal Thanas Galachipa, Char Fasson, Manpura, Hatia and Sandwip are showing a trend of increasing salinity from west to east, with Sandwip mentioned as the only location where moderately and strongly saline soils are found (BARC). Measurements of the salinity are, however, dependent on the time of year for the sampling as well as the weather conditions shortly before the samples were taken, and the figures in Table 3.1 might not be constant over the year.

Table 3.1: Salt affected areas in the coastal thanas of MES area

Unit: '000 ha

Thana	Very slightly saline (S1) (< 2mmho/cm)	Slightly saline (S2) (2-4mmho/cm)	Moderately saline (S3) (4-8mmho/cm)	Strongly saline (S4) (8-16mmho/cm)	Total salt affected area
Galachipa	25.10	39.90	0.00	0.00	65.00
Char Fasson	2.14	4.61	0.00	0.00	6.75
Manpura	0.00	12.08	0.00	0.00	12.08
Hatia	0.00	33.40	1.00	0.00	34.40
Sandwip	9.80	4.40	4.00	2.60	20.80

Source: BARC, 1990

During the dry season large variations have been observed in the area. Fields with salt accumulating on the surface are found outside embankments, but also inside embankments, in particularly where the water management systems are inadequate or, as some areas in Char Montaz, where the land level inside the embankment is very low. From the surveys it is also known that salt damage or Rabi crop failure due to salinity is common in the coastal areas.

Soil fertility

The Meghna Estuary Study area is classified, according to the FAO physiographic unit, 'Young Meghna Estuarine Floodplain (FAO 1988, Land resources appraisal of Bangladesh for agricultural development). The sediments are deep silts which are finely stratified and slightly calcareous (Calcareous Alluvium).

The soils are generally poor in organic matter content; most of them range from less than one per cent to 1.5 per cent. The low organic content is an indicator for low fertility and a heavy and difficult soil. Higher contents of organic matter makes land preparation easier and increases the capacity for retention of plant nutrients. The pH values of the soil range from 6.0 - 8.4, mainly moderately alkaline, the pH value of the surface soils being lower than those of the subsoil. The higher pH values can cause micro nutrient deficiencies.

The general picture of the content of macro plant nutrients is that total amount of nitrogen (N) is low, around 0.1 per cent, the available phosphorus (P) is medium, most of the soils range from 15 to 25 ppm. The soils contain variable levels of exchange bases but a general feature is a higher Ca and K saturation of the exchange complex compared to Na and Mg in most of the soils. Deficiencies of the micro-nutrients zinc and copper are widespread in the coastal islands of MES. Boron toxicity sometimes occurs in coastal saline soils because of high B content in the intruding sea water.

The content of organic matter in the soil is depleted further by the current agricultural practices. Only limited amounts of animal manure is added to the fields as most is used for fuel. The majority of the organic material is removed from the field, paddy for food and straw for fodder and fuel. Sometimes even the roots are removed when there is scarcity of fuel.

The application of chemical fertiliser is very limited in the coastal islands of the estuary, partly because most households do not have the resources to purchase the fertiliser and partly because the supply to the islands is limited and uncertain. The use of green manure is not very common. Crops that can be consumed or sold seem to have higher preference for cultivation.

Flooding

Partly or total crop losses are not uncommon in the coastal estuarine islands. Flooding with saline water cause damage to the standing crop and so does to deep and prolonged flooding by non-saline water. Flooding might also increase disease attack. In the areas, which are not protected by embankments, crops are lost in the field due to inundation with saline water. In other places the embankments are not high enough and tidal waves during cyclones cause damage to the crops. Some places the embankments have been damaged (sometimes deliberately for intake of salt water for shrimp ponds) and do not protect the area against saline water intrusion. The drainage systems of the polders are often not maintained adequately or have been disturbed by other constructions, e.g., roads.

Data on damaged areas of crops have been collected from thana offices. In the five southern coastal Thanas (Sandwip, Hatia, Manpura, Char Fasson, and Galachipa) average 11 per cent of the crop areas were damaged yearly from 1991-1996. Particularly damage to the Aus paddy was reported (17.5 per cent), mainly due to soil and water salinity, but also high levels of damage to Aman paddy was found (10.4 per cent) mainly due to water-logging and pest attack (see Appendix 9).

Pests and diseases

Frequency of pest-attack and diseases on the standing crop is high in the study area. MES surveys found very frequent loss of crops due to pest attack. Flooding might increase the damage caused by certain pests. Several pests are considered to be major pests in the estuary, among others rice stem borer, ear cutting caterpillar, rice mealy bug, rice bug and rice gall midge. Tungro virus is also causing major losses in the paddy field (see further in Appendix 10). Post-harvest losses particularly by rodents are also a problem of severe character.

Pesticides are expensive and most often beyond what subsistence farmers can afford. The supply is furthermore very limited.

Shortage of draught animals

Draught animals are needed for cultivation, harrowing and threshing. Conditions of the draught animals in the offshore islands are often poor. As a result of low agricultural productivity and lack of fodder resources in general, they are often ill-fed and the rate of diseases is high. Immature animals might also be used. Frequent unavailability of working animals due to diseases adversely affecting overall agricultural production, as the land cannot be prepared in time for the crop to give a satisfactory yield, or the crop is planted to late to be able to withstand early flooding. Even if farmers have suitable land for triple cropping this might not be possible when there are no healthy and strong draught animals.

According to some farmers in a MES survey in Char Montaz there was no shortage of draft animals in the area, but due to diseases mainly Foot and Mouth Disease (FMD) many affected animals could not be used.

However in some areas, mainly recently settled areas it is only few households who have a pair of draft animals. Reports from Nijhum Dwip confirmed that situation. Often milch cows have to perform as draft animals.

The large farmers are purchasing power tillers for use in their own land and charge heavily for hire to other intending users. In the area it is estimated that about two to four per cent land is going under power tiller cultivation each year. Most farmers, however, cannot invest in such equipment and power tillers have not yet made any significant headway towards development of agriculture. Furthermore spare parts are not easily available in local markets and fuel is expensive, and maintenance of power tillers is often poor.

3.1.2 Livestock

Fodder shortage

The main constraint in livestock production in the estuarine area is seasonal scarcity of feed. Rice straw is the main component of fodder for cattle and buffaloes in the monsoon. The cattle have to subsist on less than what could be considered a maintenance diet.

During seasonal shortage of grazing, e.g., when the field is under rice cultivation, relatively large herd owners send their animals in the forests or newly accreted Chars with Uri grass under care of hired herdsmen. The smallholders have to subsist on the scraps of grasses in and around the village embankments, riverbanks and roadsides till the rice field is harvested. In the embanked area the land is considered too scarce to set aside for any fodder or pasture. No fodder crop is grown for cattle. Only a part of the Khesari (*L. sativa*) grown in Rabi season is grazed by the milk producing cows. The animals loose weight and strength during the dry months. The situation worsens if there is drought and poor production of plants/weeds in the fallow rice fields.

Cyclones

The frequent cyclones and storm surges are another major constraint in livestock production in the estuarine area. In 1970 cyclone the farmers of several islands reported that their entire livestock population was completely wiped out. In 1991 cyclone a few buffaloes and cows that took shelter on Killahs (earthen mounds) and in the forests survived but again the sheep, goat, chicken and ducks perished. The cattle that survived the surge starved or suffered from pneumonia and scarcity of salt free drinking water. Since 1970 a number of Killahs have been constructed by Bangladesh Red Crescent Society (BDRCS) with World Food Programme (WFP) wheat assistance ('food for work') but there are too few to accommodate the livestock population and they are not maintained properly. Such Killahs with salt free drinking water facilities are very important for the survival of animals in the offshore islands, particularly in areas without embankment and a protective forest belt.

Diseases

The seasonal infectious diseases are the other major problem in animal production in the estuarine area. The estuary receives all the washings including the infected carcasses disposed in the upstream rivers. The climate and conditions are conducive to the maintenance of infectiousness and spread of disease organisms.

With high animal population and large areas of surface water remaining after the rainy season combined with poor nutrition and lack of vaccines and drugs most major animal diseases inevitably result. Substantial losses occur due directly to livestock mortality and indirectly through debility and loss of productivity both in draft power and milk, meat, egg production. Common animal diseases that frequently occur in the area are given in Table 3.2.

Table 3.2: Common animal diseases of the estuarine area

Type of Animal	Type of bacterial diseases	Viral diseases	Parasitic diseases
Cattle	*Anthrax*, Black quarter, *Haemorrhagic septicemia*	Foot and Mouth Disease (FMD)	*Paramphistomaides*, *Fascioliasis*, Nematodes
Goat	*Entero-toxaemia, Pluero pneumonia, Anthrax*	Goat pox, PPR	*Fascioliasis, Haemonchosis*, Trematodes
Sheep	*Entero toxaemia*	Sheep pox	"
Chicken	Fowl cholera, fowl typhoid	New Castle Disease Fowl pox	*Ascaris, Coccidiosis*
Duck	Duck cholera	Duck plague	*Coccidiosis*
Pigeon		Pigeon pox	*Coccidiosis*

Source: Department of Livestock Services, Personal communication

The preventive vaccination facilities are inadequate and the service delivery of the Livestock Department seldom reaches the areas. The animals are reported to be heavily burdened with internal parasites and flukes.

The general awareness regarding of the benefit of round the year balanced feeding and disease control is poor among the farmers. The Livestock Extension Service have few out-reach activities and the extension message does not reach the majority of the farmers.

Although the production of preventive vaccines against major animal diseases have increased over the years with the ADB assisted First and Second Livestock Development Project, but none of the project specifically addressed the remote islands in terms of livestock infrastructure and local manpower development. With the adoption of liberal import policy de-worming drugs are now available in city markets but they are yet to reach the isolated areas under study.

Mortality and production loss due to diseases and malnutrition

No specific study on production losses due to poor nutrition, internal parasitic infestation and disease was undertaken in the area and are difficult to quantify but the losses are estimated to be huge.

Table 3.3: Mortality in animals due to disease under village conditions

Unit: per cent per year

Type of animal	Mortality without treatment	Mortality with preventive care
Adult cattle	5	3
Calf	13	8
Adult buffalo	4	2
Calf	12	5
Goats*	8	3
Kids	24	14
Sheep	8	3
Lamb	24	14
Chicken	20	10
Chicks up to eight weeks**	50	20
Ducks	10	5
Ducklings up to eight weeks	40	10

Source: * Production performance of Bengal Goats with limited amounts of supplementation and anthelimentic drugs in selected regions of Bangladesh, SS Kibria.
** Semi-scavenging model for rural poultry holding, Hans Askov Jensen.

At national level it is expected that about 80 per cent of the cattle herd is infested with internal parasites that causes 50 per cent reduction in milk production, 50 per cent reduction in off take and 10 per cent weight loss in adult males and females. Foot and Mouth Disease alone causes 10 per cent reduction in surplus milk production, 10 per cent reduction in off take and 10 per cent loss in body weight in adult males and female.

In sheep and goat internal parasites cause about 50 per cent production loss due to high kid/lamb mortality, reduced growth and kidding and prolonged inter kidding and lambing period. In poultry 60 - 75 per cent production loss is caused by infectious disease due to mortality and reduced egg production.

Mortality due to various diseases in given in Table 3.3. With preventive vaccination and simple medication mortality can be reduced significantly specially among the young stocks and chicken which have been demonstrated in other parts of the country.

3.1.3 Homestead production

The production of crops and trees in the homesteads are affected by some of the same problems as the production of field crops. Usually flooding is not a problem at the homestead although some of the area might be only slightly higher than field level. Salinity can be a problem during the dry season due to the capillary rise of saline water. It has also been mentioned in relation to other projects that there are difficulties in getting seed and seedlings for homestead production

Overall, the information of particular problems relating to the homestead production of trees and crops as well as livestock production is very limited and needs further investigation.

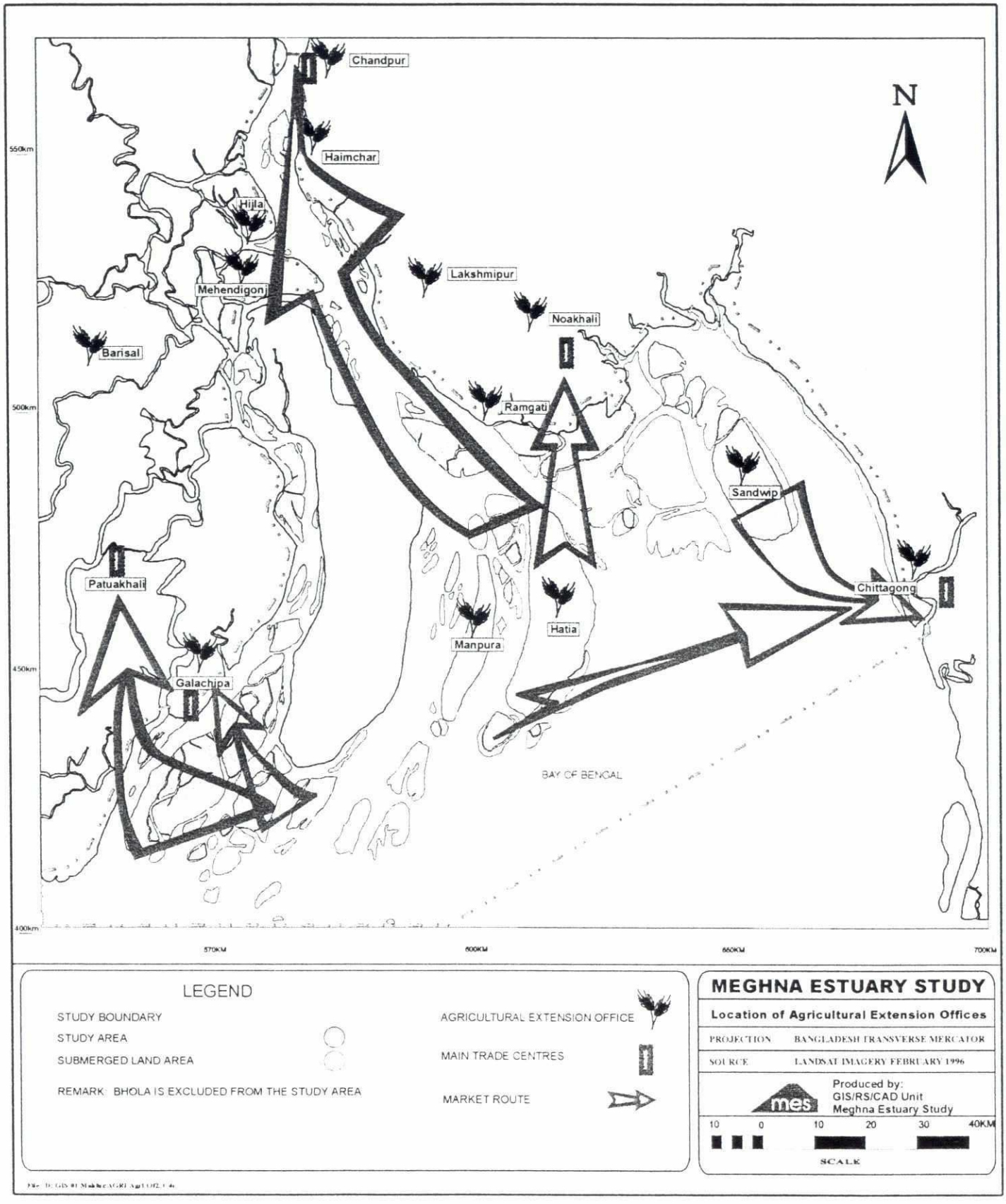
Attention should also be given to research on women's work load. Women spend a lot of time cooking, collecting water, and collecting fuel resources. Easier access to water and good fuel sources would allow women to intensify the production in the home gardens.

3.2 Remote geographical location

3.2.1 Input supply and markets

The supply of inputs for farming is limited in the area, but the demand is also very low. Small amounts of fertiliser and seed are purchased occasionally, in spite the fact that the majority of farmers in the coastal islands have very limited financial resources for the purchase of inputs for their production like fertiliser, pesticides, seeds, veterinary care for livestock, feed supplements, paid labour during transplanting, rent of draught animals

Figure 3.1: Locations of Agricultural Extension Offices and Main Trade Centers



Agrochemicals and seed

With the privatisation policy of the government, fertiliser and pesticide distribution was fully handed over to the private sector in 1994 and at present the amounts of fertiliser and pesticides distributed to the offshore islands is not known. Prior to 1992 agrochemicals were solely distributed by BADC. Their statistics on sale and distribution were kept by district and thana for different years. After the sale was transferred to private dealers in 1993 these records have not been up-dated. Thana Agricultural Offices in the five southern Thanas of the MES area were contacted, but had no information on present fertiliser and pesticide distribution.

In the MES area chemical fertiliser is mainly used for the limited areas with HYV, while fertiliser rarely is applied to the local Aman, Aus or Rabi crops. If fertiliser is used for the local Aman, Aus or Rabi crop it is only low dosages. Pesticides are very rarely used and both demand and supply is highly limited.

At present urea is stored in BADC godowns in the former districts from where urea is sold out to different approved dealers whose records are maintained by IFDC district wise. The other fertilisers are lifted by dealers directly from fertiliser factories and are distributed directly to farmers.

BADC is responsible for distribution of improved seed. In the offshore islands of MES improved seed might also be available from private traders. The volume of improved seed produced by BADC is very limited. Seeds for major crops are mainly provided from the farmers' previous harvest or purchased in the local market.

Marketing

As the share of the production, which is marketed, is relatively small the markets in the area are not well developed. The products are either sold at the local market or to traders travelling in the area. There are no co-operatives in the area to organise the marketing of farm products at a larger scale, and larger storage capacities enabling farmers to sell when the prizes are good does not exist in the offshore islands. The variation between farm-gate price and larger market price generally does not exceed more than five per cent for food grain.

In the offshore islands marketing of perishable animal products like milk is another constraint for intensified production, as there exist no processing facilities except the traditional methods. The farmers receive about 20 per cent less farm gate price than the farmers in the mainland and 50 per cent less than the farmers receive around the major cities. Similarly the inputs necessary for optimum production are not readily available in the islands and the intending users have to pay 20 to 50 per cent higher price than the suburban farmers around the metropolis.

Galachipa, Patuakhali, Barisal, Chandpur, Noakhali and Chittagong are the closest larger markets to the offshore islands. Sandwip has a natural market focus towards Chittagong, as Sandwip is accessible with ferry from Chittagong. For people with access to a boat Chittagong might also be a market option for people from Hatia and Manpura area. Most common larger market for Hatia and Manpura is Chandpur although the islands are accessed by ferry from the Chars south of Noakhali. Manpura might also have some market focus on Bhola, although the markets are not as large as in Noakhali and Chittagong. The Western islands has a natural market focus towards west where both Galachipa and Patuakhali are trade centres of a reasonable sizes (see Figure 3.1).

Department of Agricultural Marketing (DAM) operates with six classes of markets in Bangladesh: Rural Primary Markets, Rural Assembly Markets, Secondary Markets, Urban Retail Markets, Urban Wholesale cum Retail Markets, Urban Wholesale Market. In the MES areas only Rural Primary Markets (RPM) and Rural Assembly Markets (RAM) are found.

Rural Primary Markets are operated by growers, local traders and small retailers. Rural people sell surplus crops and procure the necessities of life and agricultural inputs in Rural Primary Markets. At national level about 90 per cent of the paddy and 70 per cent of milled rice marketed in primary markets is sold directly by farmers.

Rural Assembly Markets gather small volumes of products from farmers and intermediaries for export to other regions or main centres. Traders travel from outside to procure local surplus production.

According to DAM there are the following number of markets in the focal thanas of MES:

Sandwip Thana:	25 RPM and 2 RAM,	Hatia Thana:	31 RPM and 5 RAM
Manpura Thana:	6 RPM and 1 RAM,	Char Fasson:	13 RPM and 2 RAM
Galachipa:	14 RPM and 3 RAM		

(For more information on DAM see section 5).

3.2.2 Extension service

Agricultural extension and livestock extension services are handled by different departments under different ministries.

Agricultural extension

The main function of the extension service under the Department of Agricultural Extension (DAE), Ministry of Agriculture, is the transfer of technology to groups of farmers in each Thana. This is in general done by providing agricultural training at Thana level on the use of HYV seeds, recommended doses of fertilisers, crop demonstrations and water management practices, crop diseases, use of pesticides, credit and co-operative management and various soil qualities and their behaviour at the Thana level. Farmers could also be assisted in procuring seeds, fertilisers, irrigation equipment, pesticides and getting short-term credit from commercial banks. The extension is organised through the Training and Visit system (T&V). Block supervisors pass on improved practices to farming communities via selected farmers.

In the MES area support to farmers has, however, been limited. There is not enough staff and the training of the extensionists is very limited. Furthermore, the T&V system has been found to be too rigid for the complex problems faced by farmers. The main message and advice given to farmers has been to use improved varieties and increase the use of agrochemicals. The success of such a high-input system depends on irrigation and low level of risk of crop damage. These conditions are not found in the offshore islands.

Table 3.4: Thana agricultural extension service in the offshore islands

Thana	Staff at present working												
	TAEO	SMO	AAEO	JAEO	PPI	SM	PPM	BS	Head Asst.	Off. Asst.	MLSS	Guard	TOTA
Sandwip	1	-	-	1	1	1	2	14 (22)	1	2	1	2	26
Hatia	1	-	-	1	1	1	2	10 (20)	1	1	1	2	21
Manpura	-	-	-	1	1	1	-	8 (10)	1	1	1	1	15
Char Fasson	-	-	1	-	1	1	2	27 (30)	1	2	1	2	38
Galachipa	-	1	-	1	1	1	2	30 (38)	1	2	3	1	43

Source: MES thana survey, 1997
Note: Figures in brackets indicate the number of sanctioned posts.

TAEO : Thana Agricultural Extension Officer
AAEO : Assistant Agricultural Extension Officer
JAEO : Junior Agricultural Extension Officer
PPM : Plant Protection Mokkadem
SMO : Subject Matter Officer
BS : Block Supervisor
PPI : Plant Protection Officer
SM : Spray Mechanic

The figures in parenthesis in the BS column indicate the number of sanctioned posts of the BS. The Department of Agricultural Extension (DAE) has not yet filled these sanctioned posts. Hence there is shortage of BS in these thanas and the present staff is to cover larger areas than the stipulated 1,000 acres per BS.

Other sanctioned posts of Agricultural Officers in various Thanas have also not yet been filled. In Manpura Thana the posts of TAEO and also AAEO are still vacant. The agricultural extension activities in these Thanas are being conducted by the JAEOs who are not agricultural graduates, but basically possess the school leaving certificate supported by an agricultural training course.

The New Agricultural Extension Policy is being implemented nation-wide, but as the offshore islands have low priority it might take long before the new principles reach the area. To implement the new structure and policy, which is a radical change of approach, there is a strong need for training at all levels. The structure of the New Agricultural Extension is described in details in section 5.

Livestock extension

Livestock extension is the responsibility of Department of Livestock Services, Ministry of Livestock and Fisheries.

The lack of farmers' awareness and absence of farmers' organisations is considered to be the main bottleneck for the livestock development. The livestock extension service do not have on-ground staff like the agricultural block supervisors and therefore there is not much out-reach activities on-going. The main activity of the extension offices is distribution of vaccines.

Table 3.5: Livestock services in the offshore islands

Thana	TLO	VS	VAS	VFA	VC	FA(F)	FA(I)	TLA	Dress -er	LDA/ CCT	MLSS	Guard
Sandwip	1	0 (2)	-	2 (3)	2	1	-	1	-	1	1	1
Hatia	1	0 (1)	1	2 (3)	2	1	0 (1)	0 (1)	0 (1)	-	1	1
Galachipa	0 (1)	1	-	3	2	1	1	1	1	-	1	1
Char Fasson	1	0 (1)	-	1	2	1	1	1	1	-	1	1
Manpura	0 (1)	1	-	2 (3)	1 (2)	1	1	1	0 (1)	-	0 (1)	1

Source: MES thana survey, 1997
Note: The figures in parentheses are number of sanctioned post where not all posts are filled

TLO : Thana Livestock Officer
VS : Veterinary Surgeon
VAS : Veterinary Assistant Surgeon
VFA : Veterinary Field Assistance
VC : Veterinary Compounder
FA(F) : Field Assistant (Fodder)
FA(I) : Field Assistant (Art. Insemination)
LDA/CCT : Lower Division Assistant/Clerk cum Typist
MLSS : Members of the lower subordinate service
Dresser : Surgical Assistant

3.2.3. Credit facilities

Farmers' needs for credit are both small scale short term loans and larger loans on longer terms. Small scale short-term loans are to finance farming inputs as seeds, agrochemicals, hired draught animals and labour, medical treatment for livestock or fodder during acute fodder stress. The larger loans are used for purchase of livestock, perhaps agricultural equipment like water pumps or power tillers, or to pay back other loans. Households may also need credit to meet social obligations and emergencies, while the poorest group of people also may need credit to buy food and other necessities during periods of hardship prior to harvest, or in relation to floods

and cyclone losses. Credit is available from a range of informal sources such as money lenders, input suppliers, relatives and neighbours. Often land is used as collateral for loans, but as private money lenders often have to be paid a high interest the result is not unusual that the farmer looses the land or shares of it.

Formal credit facilities are limited in the offshore islands of MES. The organisations KSS (Farmers Co-operative Society), BSS (Landless Co-operatives Society) and MBSS (Women Landless Co-operative Society) are providing loans with interest rates up to 17 per cent. Such high interest rate is a troublesome affair for most farmers. In the farming systems survey several situations of farmers being heavily indebted by unfavourable credit facilities were reported, in particular from Char Montaz, Rangabali and Char Biswas. The MES socio-economic survey as well as the Thana survey have provided information about the credit situation in the study area. For more information see the Rural Development volume of this report.

3.2.4 Research

Research carried out in Bangladesh is focused on areas with higher potential than the offshore islands. Most agricultural research is not directly applicable in the MES area. Results from research on treatment of livestock diseases and animal production are likely to be beneficial on a broad scale in the MES area.

Farming systems research is a part of the approach of the new extension policy, and this will be an important tool to direct research into more demand led research. It is, however, likely that the focus continuously will be focused on the needs of the majority of farmers in Bangladesh, and that research applicable to the offshore islands will continue to have low priority at national level in the future.

3.3 Lack of land use planning

Infrastructure development has in many of the polders caused drainage problems, when roads and drainage systems are not planned together. Areas where settlement takes place before planning or establishment has been carried out creates difficulties in creating a proper drainage system. A well-functioning drainage system needs an overall plan partly for construction, but also for maintenance and operation. The land use planning should be dealt with at a higher level, but still with peoples' participation. Land use planning should include planning of which activities can take place where, e.g., shrimp cultivation should not be allowed within a polder where agriculture needs protection against saline water and the drainage system is to be used as a water reserve during the dry season. Furthermore planning of the use of the natural resources in the area, e.g., forest resources for fuelwood, fresh water resources from tube wells and free grazing on khas land, should be taken into consideration for the equal benefit of the population.

Land use planning is very important for the well-functioning of the polder. Without planning the results from establishment of a relatively complicated land protection might be far less than expected. However, it is a problem of a more general character for rural development and will not be further discussed in this annex.

4. ON-GOING AND FUTURE PROJECTS IN THE FOCAL THANAS OF MES

At present there are no on-going agricultural or livestock projects in the MES area, but experiences from the following programmes might be relevant for the development of the farming system of the focal Thanas of MES.

4.1 Agriculture

Agriculture Support Services Project (ASSP)

This project is at present being implemented in all Thanas by the Department of Agricultural Extension (DAE). In this project the preparation of the agricultural plan-programme at the head-quarter level has been dropped. The project preparation has now been decentralised and implemented in districts and in Thanas as per programme finally drawn up by the district and Thana level officers.

Bhola Irrigation Project (II Unit)

In operation since 1992. This project will continue until 1998. This project is run by BWDB in association with the DAE.

Agriculture Development Project

This project has been implemented in Southern Regions since March 1989 in 45 Thanas of seven districts of Barisal, Patua*khali*, Jhalakati, Bhola, Borguna, Pirojpur and Gopalganj. The main objective of the project is to encourage and support utilisation of temporary fallow land in Rabi season. Activities include: cultivating the soils with power tillers, raising horticultural nurseries and irrigating soils with low-lift pumps. Initially the project was run by Grameen Bank which purchased a large number of power tillers to realise benefits from beneficiaries. After failure of the Grameen Bank the responsibility was shifted to DAE in association with the BADC.

Integrated Soil Fertility and Fertiliser Management Project

This project has been in operation since 1983 in 100 Thanas of 40 districts which included among others two thanas in Barisal district and a few thanas in Bhola district. Project activities will be extended to remaining Thanas from July 1998. The main objective of the project is, through crop demonstrations, to train model farmers in the application of recommended doses of fertilisers.

Integrated Pest Management Programme

The Integrated Pest Management Programme has covered 240 out of 460 thanas. None of these thanas are within the MES area. Initially the project was financed by FAO. At present DANIDA and UNDP are financing the project. In 11 Thanas of the MES project, each Thana has one Plant Protection Inspector and two Plant Protection Mukkadam. The PP Inspector is mainly responsible to control and check the quality and prices of insecticides, sold by dealers in the thanas. There exist 220 thanas where the agricultural extension service has been excluded from the IPMP and the plant protection activities in these thanas are less prominent.

4.2 Livestock

Second Livestock Development Project, ADB 1985-95

This project covered a wider geographical area than its predecessor, the Livestock Services Development and Training Project, and continued the development of livestock services initiated under the first project but with a more intensive programme to develop technology packages for field delivery and further up grading of the skills of the officers and staff. This second project

also aimed to increase the service delivery capability of the department. Forty two district offices have been constructed and 67 Thana Veterinary Dispensaries have been upgraded to Thana Livestock Development Centres.

The four principal components of the project were animal nutrition improvement, animal health improvement (including vaccine production and distribution, supply of medicines and strengthening of disease diagnostic services), breed and breeding improvement for poultry and cattle and institution building of Department of Livestock Services (DLS). The project is still being implemented under a bridging arrangement.

Participatory Livestock Development Project, ADB/DANIDA, 1997-2002

This has been appraised, awarded and awaits implementation. The project is designed based on lessons learned in the earlier *Smallholder Livestock Development Project* and incorporates the active participation of the farmers and NGOs.

The principal project activities will be technical and credit services to poor farmers channelled through NGOs, for smallholder poultry, beef fattening and goat raising enterprises; upgrading of 66 existing Thana Veterinary Dispensaries to TLDCs and provision of support for livestock activities by DLS including medical equipment for existing district veterinary hospitals; and technical assistance and training for project DLS, PKSF and NGO staff in participatory research and studies.

Other important external assisted projects

The International Development Association (IDA) is financing US$ 50.0 million Third Agricultural Research Project aimed at increasing the efficiency of national agricultural research systems and aims at improving research linkage with technology transfer. The Bangladesh Livestock Research Institute (BLRI) will be adequately funded to take up priority research topics and participatory farming system research. BLRI has developed 23 technology packages for delivery to farmers. Although not specifically designed for the coastal environment some will find application in the MES area.

The USAID supported Agricultural Technology Support Project (ATSP) is funding investments through commercial lending and providing relevant technical assistance to wide range of agricultural processing and distribution activities including livestock products.

The Canadian International Development Agency (CIDA) is planning establishment of two new Animal Feed Mills and promoting local maize production.

Following their success with the earlier project, IFAD and DANIDA are planning financial and technical support for a Second Smallholder Livestock Development Project, again focusing on poverty alleviation and women's development. The Project will target the five coastal districts which comprise the majority of the total MES area. The project is expected to be formulated and appraised in the near future.

The Bangladesh Milk Producer's Co-operative Union Ltd. (Milk-Vita) is engaged in rural milk collection, processing and marketing in Dhaka. The Union is now planning to set up two chilling plants in the near future in Laxmipur and Amtali. This would greatly benefit MES area farmers in milk marketing and in the channelling of inputs necessary for increased milk production.

4.3 Homestead production

A number of international NGOs are presently involved in homestead production activities within the MES project area. Principal amongst these are Helen Keller International (HKI), the Mennonite Central Committee (MCC) and Co-operation for Assistance and Relief Everywhere (CARE). Working alongside HKI is Action AID, which is engaged in home gardening activities in Char areas, including Lalmohan, Bhola and Char Fasson.

The MCC is working on similar activities among the landless, marginal and small farmers in some Char areas. In particular, they are targeting landless and destitute women. Due to lack of funds MCC has not yet begun work on off-shore islands. The MCC is also carrying out small scale research on house garden production.

CARE has started its Local Initiatives for Farmers Training (LIFT) programme in the coastal areas of Char Rangabali, Char Biswas, Galachipa and Patharghata under Patuakhali district. The main purposes of this programme are making compost, green manure and farm manure, conservation of soil moisture through mulching, preparation of nurseries for production of seeds and seedlings and raising multiple crops through crop rotation, fertilisation, irrigation, drainage and cultural pest management systems. Farmers involved in homestead gardening, at present, make their own nurseries and sell seeds, seedlings and samplings of vegetables and fruit trees. More than 50 per cent of women in the programme are engaged in gardening and agro-forestry. By means of household gardening, farmers have increased their household earnings from additional production of fruits and vegetables and from selling seeds and seedlings, produced in their homestead gardens.

Other, national and local, HEAD - Bangladesh, Proshika, Dip Unnayan Sangstha, and Hunger Project are working in Hatia Thana for homestead gardening, livestock rearing, nursery plantation and fish culture, in addition to other social activities.

The Service Civil International (SCI) is doing agricultural and fishing activities in Galachipa Thana. The Nigera Kari and Fight for Hunger NGOs are supporting home gardening activities in Sandwip. The DORP is assisting household plantation in Manpura.

5. POLICIES AND INSTITUTIONAL SETTING

5.1 Current policies for agricultural, livestock and homestead development in the estuary

In the Fifth Five Year Plan it is mentioned that economic development in Bangladesh is still synonymous with agricultural development. Agriculture is estimated to contribute almost 30 per cent of GDP in 1996-97, with high growth rates of livestock and fisheries subsectors estimated to be around eight per cent while growth rate for crops is estimated to be between five and six per cent and forestry only around four per cent.

Self-sufficiency in food grains at a national level is a major objective of the Plan. However, a more balanced diet of the population is also aspired to through an increase in the production of oilseeds, pulses, fruits and vegetables, fish, eggs, livestock, poultry and dairy products.

For development of coastal areas emphasis will be given to:

- development of appropriate housing for low income people
- building more multipurpose cyclone shelters
- developing intensive shrimp and pisciculture
- rehabilitation and raising embankments
- encouraging fish processing industries
- setting up export processing zones
- building efficient transportation and telecommunication links.

Development of the agriculture in the coastal area has not been given high priority in the past. According to Planning and Evaluation Division, the GoB has no plan specially to develop agriculture in char lands at present (personal communication). However, in relation to particular sector development some reference is given to production of agricultural crops.

Agricultural crops

The strategy to achieve the target of production of agricultural crops at national level will follow the line of earlier plans for agricultural development. It focuses largely on the use and development of high yielding varieties of rice and wheat, application and further development of irrigation as well as optimisation of the use of fertiliser.

However, for the MES area where irrigation cannot be developed much because of lack of fresh water, the system focused on the combination of HYV, irrigation and fertiliser is not a feasible option for agricultural development.

Particularly for the coastal farming it is mentioned that location specific research, extension and other programmes will be developed and provided for the purpose of exploiting the potential. Development of saline tolerant varieties of rice is mentioned as an option.

In the Plan, the importance of developing the agricultural extension service is recognised. Agricultural extension together with nutritional awareness programme will receive about eight per cent of the agricultural sector plan allocation.

Livestock

The Government has identified livestock sector as one of the most viable sectors for generation of employment and income for the more disadvantaged section of population, the landless, unemployed youths and destitute women.

No particular livestock policy for the coastal region is mentioned in the Fifth Five Year Plan.

At national level the Government envisages the increase of milk, meat and egg production and quality draft power availability. In the Fifth Five Year Plan there is an increased financial allocation for livestock development to be achieved through peoples' participation, NGOs' involvement and privatisation of input supply and commercialisation of veterinary vaccine production. The major programmes should include feeds and fodder development; animal health and disease control; genetic improvement of local chicken, ducks, goats, cattle and buffaloes; and training of DLS staff, NGO workers and participating farmers.

The government has already introduced a livestock development policy for implementation in which livestock production is considered as a means to reduce the protein gap for the fast growing population, draft power shortage, employment for women and contribution to alleviation of rural poverty. The government also acknowledges the role of NGOs and rural poverty alleviation projects.

Homestead production

The policies of the Fifth Five Year Plan do not have a specific focus on development of homestead production. However the Plan acknowledges that women play a crucial role in agriculture, especially in post-harvest operations, in homestead or home based activities, in resource conservation and in agricultural decision making. Any effort at poverty alleviation must address the needs of women as producers and income earners rather than merely as consumers of social services. Women will be increasingly involved in income generating projects like homestead horticulture, post-harvest processing and storage of agricultural produces, and in small scale agro-based industries.

5.2 The role of government

The institutional setting for development of the farming system in the offshore islands involves particularly Ministry of Agriculture and Ministry of Fisheries and Livestock. Most important are Department of Agricultural Extension (DAE) and Department of Livestock Services. Other relevant institutions are Department of Agricultural Marketing (DAM) as well as institutions involved in research. The following are descriptions of the respective Governmental departments and national institutions. There exists no particular institution or board who is responsible for coastal development or development of the estuary. The New Agricultural Extension Policy (NAEP) has adopted a farming system approach and this provides and important basis also for development in the offshore islands.

5.2.1 Department of Agricultural Extension

Structure from DAE to block level

The Department of Agricultural Extension (DAE) belongs under Ministry of Agriculture (MOA) and is headed by a Director General and comprises seven wings. Two of the Wings (Administration & Personnel and Planning & Evaluation) are headed by Additional Directors, the other five by Directors. The Field Services Wing has the primary responsibility for providing extension services to farmers. The other wings – Food Crops, Cash Crops, Training, and Plant protection – provide essential support and expertise, largely through their technical supervision of the Subject Matter Specialists (SMS) and the Subject Matter Officers (SMO) at district level and Thana level respectively.

Management and supervision of extension services is exercised at regional, district, Thana and block levels. Additional Directors at regional level support and monitor the work of the districts, ensuring that plan are drawn up on schedule and that the various district plans represent a co-ordinated and sustained programme for the region as a whole.

In each district, the extension service is headed by a Deputy Director DD/DAE with a staff of one Training Officer and two to five SMSs. The District Extension Programming Committee (DEPC), comprising the district staff, is responsible for planning extension activities in the district.

The Thana Agricultural Officer is responsible for extension services within each Thana. There are normally two SMOs, an Assistant Agricultural Extension Officer and a Junior Agricultural Extension Officer in each thana. These are responsible for giving technical support to, and supervising, the front line extension staff in two units, each comprising approximately half the thana.

At field level there are presently about 10,500 front line staff, the Block Supervisors (BS), in Bangladesh. Each BS is responsible for providing extension services to the farm families within a block. For planning and programming purposes, each block is divided into eight sub-blocks.

NAEP developed with assistance from ASSP

The New Agricultural Extension Policy (NAEP) has been developed with support from the Agricultural Support Services Project (ASSP). It outlines a new approach to agricultural extension, and it is based on the formulated overall objectives for the agricultural sector.

The objectives for the agricultural sector have been formulated (stated the Perspective Plan 1995 – 2010) and the immediate objectives of the sector are:

- to attain self-sufficiency in food grains and increase production of other nutritional crops
- to ensure sustainable agricultural growth through more efficient and balanced use of land, water and other resources

- to increase foreign exchange earnings through agricultural exports
- to increase per hectare rice output in order to release more land for other crops, especially legumes and fodder crops
- to introduce high value cash crops
- to improve the quality and availability of seeds
- to reduce environmental degradation
- to increase fish, livestock and forestry production
- to conserve and develop forest resources.

The goal of the NAEP is to *encourage the various partners and agencies within the national agricultural extension system to provide efficient and effective services which complement and reinforce each other, in an effort to increase the efficiency and productivity of agriculture in Bangladesh*. In order to achieve this goal the policy includes the following key components.

1. Extension support to all categories of farmers

The basic unit of production is the rural household and its farm, and it is realised that all members of the rural household contribute to agricultural activities. The extension programmes will therefore include specific programmes for: (1) female farmers and other women household members in support of homestead production and other activities; (2) young people who are the future farmers; (3) small and marginal farmers; (4) landless households, who have no farm land but may have homestead areas; and (5) medium and large farmers.

2. Efficient extension services

The efficiency of extension services will be improved through training, skill development, institutional strengthening and logistical support. The extension agencies of government, non-government organisations and private sector will continue to work within their own organisational structures and procedures, but the policy seeks to ensure that effective co-ordination is established to increase the efficiency of agricultural extension.

3. Decentralisation

The NAEP seeks the devolution of much of the responsibility, especially in the government sector, for key aspects of the planning and implementation of extension programmes. Such key aspects will include:

- identifying and responding to information needs: selecting information for farmers according to needs
- collecting information about local resources: basing extension programmes on a clear understanding of the availability of local resources, and the prevailing social and physical environment
- programme planning: details of work schedules and extension activities planned at local level, by field staff in consultation with their immediate supervisors
- training: farmer and extension personnel training plans drawn up at local level, to reflect local needs
- media: radio and television programmes, bulletins, leaflets, posters and folders produced locally (and nationally) to provide farmers with appropriate information.

4. Demand led extension

Extension programmes concentrate on meeting the information needs of farm households, in particular helping them solve the key problems they face in their farming activities. All extension activities and research priorities are to be based on the needs, problems and potentials identified at farm level. This may lead to involvement of extension agencies in local on-farm participatory research in order to identify appropriate solutions to farmers' problems.

5. Working with groups of all kinds

The NAEP endorses the principle that extension staff should work with groups of all kinds and not apply the formerly used T&V system. It recognises that a very wide range of mutual interest groups already exists in the field, some on very temporary basis and some on a permanent basis. These existing groups would be the focus of extension activities. New groups will be encouraged when there are none at present or where key target farmer categories are not included in the membership of the existing groups.

A group approach to extension offers the opportunity for more effective use of limited extension resources for problems identification and solution, sharing of information and cost-effective choice of extension methodology.

6. Strengthened extension - research linkage

Research institutes require information from extension about the problems farmers are facing, in order to conduct relevant research programmes both at research stations and on-farm with farmers. Extension requires the findings from research programmes, in order to provide farmers with the most appropriate advice.

The main institutional mechanisms to ensure the above mentioned linkage are:

- a National Agricultural Technical Co-ordination Committee, comprising extension representatives from the government, non-government organisations, private sector, and representatives from research

- Agricultural Technical Committees, each covering a number of districts in similar agro-ecological zones and comprising local representatives of extension agencies and research institutes

- Research - extension review workshops between staff of the DAE and local research institutes.

7. Training of extension personnel

Training is a necessary feature of the new extension approach meaning that all providers of extension services need to be confident in their ability to solve farmers problems as well as information needs. Training will also be necessary to provide skills on how to deal with particular clients, such as women and landless households. Special attention will be required to encourage referral to other agencies or individuals better suited to deal with particular problems and opportunities, for example in livestock production, fisheries, forestry, farm management, credit and marketing.

8. Appropriate extension methodology

There is a wide range of extension methods which agencies can use in their work with farmers and rural households. No single method is for all purposes and occasions. Extension agencies and personnel will select appropriate methods in order to meet specific extension objectives with their various categories of farmers. The methods are likely to include farm visits, various media, farmers training, field demonstrations, fairs, and visits and motivational tours. The use of participatory methods is also considered to be appropriate extension methodology.

9. Integrated extension support to farmers

The policy of the government is to provide farmers with advice on all aspects of agriculture. Among the government organisations, DAE is the largest and provides services to farmers for

increasing production of crops, including vegetables, fruits and homestead crops and to develop the homestead agricultural activities. The department has extension agents, Block Supervisors (BS), at grass root level, with one BS responsible for approximately 500-1,000 families, as they cover 1,000 acres (400 ha).

Other departments, such as Livestock Services and Fisheries, have extension staff at Thana level, but with very limited outreach. The Department of Forestry has staff mainly at district level, although their extension services are mostly based on the nurseries established at Thana level. At present these departments have no grassroots extension agents. Until such services are developed, the DAE may offer appropriate information to farmers in the areas of livestock, fisheries and forestry, with the support of the other departments as decided in the Agricultural Technical Committee.

Appropriate advice, as requested, will be made available to non-government organisations from all these departments, to enable them to offer high quality integrated extension support.

10. Co-ordinated extension activities

The extension providers within the national agricultural extension system will be co-ordinated in order to optimise the use of the resources within the system. This implies the sharing of information expertise within the agencies involved, and participation where appropriate in each others extension activities.

The extension activities will be co-ordinated at five levels:

- Local level co-ordination will be enhanced through the participation of different extension agencies in the meetings of the Union Council, under the chairmanship of the Union Council Chairman. In addition non-formalised co-operation and exchange of information is expected among the various service providers and users.

- At Thana level through the Thana Agricultural Extension Co-ordination Committee (TAECC), which comprises representatives from government, non-government and private sectors, including women farmers and women representatives of these organisations.

- At district level through the DAE District Extension Planning Committee (DEPC) and the District Development Co-ordination Committee. The latter does not only include extension on its agenda, but generally all district level items, and all departments are represented.

- At regional level, through the Agricultural Technical Committee (ATC), where government and non-government organisation staff and research institute staff come together seasonally to discuss technical issues relating to extension programmes.

- At national level through the National Agricultural Technical Co-ordination Committee (NATCC). Representatives of the Committee are all government agencies, NGO apex bodies, and other such committees and bodies, and they discuss research co-operation and technical research issues related to extension work.

11. Integrated environmental impact

In an attempt to integrate sound environmental aspects into the extension system the following strategies are adopted:

- integrate the environment into the overall agricultural policy

- environmental impact assessment as an integral part of the development and testing of innovations by agricultural research institutes, universities, NGOs and the private sector

- promotion of environmentally sound agricultural practices, such as IPM, and the active discouragement of damaging and hazardous agricultural practices

- monitoring the impact of agricultural practices by environmental agencies.

The NAEP recognises that, inevitably, with increasing demand for higher agricultural output due to a rapidly increasing population there may be a negative effect upon the natural environment. However, the policy will support extension efforts aimed at balancing the demands for increasing production and environmental preservation. Part of this effort will be integrated extension support for the whole farm system.

5.2.2 Department of Livestock Services

The Department of Livestock Services (DLS) falls under the Ministry of Fisheries and Livestock and is headed by a Director General. DLS is responsible for the management, administration, research and extension services of livestock resources.

At the district level, the DLS has a District Livestock Officer, an Additional District Livestock Officer, a Field Assistant for artificial insemination and a Laboratory Attendant. The Thana set-up of DLS comprises a Thana Livestock Officer, an assistant Veterinary Surgeon, a Thana Livestock Inspector, a Thana Livestock Assistant, a Veterinary Field Assistant (artificial insemination), a Field Assistant (fodder cultivation), and a Compounder.

The DLS staffing at thana level is thus quite extensive, and specific knowledge on a variety of livestock aspects is most likely available. However, the department has not been very successful in its outreach to farmers and the impact of the department on the livestock sector has been limited. This is due to lack of operational funds, including transport, which has made the department inefficient when it had to rely on normal government funds only. Successful smallholder livestock development projects have been seen, e.g. one funded by IFAD/DANIDA and a similar ADB/DANIDA funded project is being initiated now. In these projects NGOs have played a significant role to ensure the outreach to farmers, but the DLS has played a role as provider of technical know-how through training, though this has not been optimal.

There seems to be an untapped potential in DLS, also at field level, but to realise this potential the department must be much more efficient in its operations. Furthermore, the modalities for co-operation between DLS, NGOs, the private sector and farmers have to be better developed as well. This may be worth considering as smallholder livestock development has a proven poverty alleviating effect demonstrated through donor funded projects as well as sector activities of some of the major NGOs in Bangladesh.

5.2.3 Bangladesh Rural Development Board

The Bangladesh Rural Development Board (BRDB) has over the years been the largest public agency working for rural development and poverty alleviation. Its roots go back to the successful Comilla model for rural development in the 1960s, which was the basis for the Integrated Rural Development Programme (IRDP) of 1972. The IRDP was made permanent in the form of BRDB in 1982. Institutionally it belongs under MLGRD&C and is headed by a Director General.

Through establishment of co-operatives, and in the 90s also informal group networks, the BRDB has sought to develop sustainable income generating opportunities among landless and marginal farmers through credit, training and marketing programmes. It has helped to form farmers' associations called Krishi Samabay Samities (KSS), organisation of assetless individuals in groups called Bittihin Samaby Samity (BSS), and poor women in Mahila Bittihin Samabay Samities (MBSS) and Mahila Samabay Samities (MSS). The organisations have a total membership of about 3.5 million, with over 75 per cent of the total represented by the KSS. There is a well defined set-up at both district and Thana level for supervision and control of the primary societies.

While a few of BRDB's programmes have performed well (e.g. RD-12 with both financing and technical assistance from CIDA), the overall performance of the BRDB organisations has been

abysmal and impact accordingly doubtful. The overall loan repayment has been unsatisfactory, only up to 80 per cent (but usually lower) for crop loans and down to as little as 20 per cent on equipment loan.

5.2.4 Department of Agricultural Marketing

The responsibilities of Department of Agricultural Marketing (DAM) are the following:

- Market Intelligence Service. Prices are regularly collected from primary, secondary and terminal markets. Upon request it provides certificates for different market products for hospitals, armed forces, FAO, Universities, etc.

- Market Regulation and Market System Development. Issuing of licenses for Government approved dealers like commission agents, wholesalers and traders that buy farm products at primary markets and trade them on secondary or terminal markets. The market has been regulated by the Agricultural Produce Market Regulation Act since 1964 (amended in 1975).

- Market Extension and Promotion Service. The Department provides information on marketing, storage and pricing via radio, T&V and leaflets. It also provides information and gives support to the formation of farmer groups to improve marketing of their products.

The larger districts have a District Marketing Officer, whereas smaller ones have Market Investigators. The Department is heavily constrained by lack of staff and funds for operations, communication and transport.

5.2.5 Agricultural Research

Bangladesh Agricultural Research Council

The Bangladesh Agricultural Research Council (BARC) falls under the MOA and is headed by an Executive Vice Chairman. Since its establishment in 1973 the overall role of BARC has been to set the priorities and co-ordinate the agricultural research institutes (ARIs), evaluate programmes and investments, and prepare staff development programmes and national research plans. BARC consists of a Governing Council and the Secretariat. The Governing Council is headed by the Minister for Agriculture, and the 28 members are selected from the Civil Service, Directors of Research Institutes, University vice-chancellors, and senior scientists.

Under its contract research programme BARC is also empowered to allocate funds to ARIs as well as to universities and NGO engaged in agricultural research.

Bangladesh Agricultural Research Institute

BARI is responsible for research and propagation of all important field crops such as wheat, oilseeds, potatoes, tobacco, vegetables and citrus fruits. The head office is located in Gazipur near Dhaka. It has four regional centres – one in Jamalpur – of which each has four sub-centres. The 800 staff at the head office and 300 at the centres are administered by a Director assisted by three Associate Directors.

The On-farm Research Development Division of BARI is most closely associated with the field implementation of farming systems research, which includes fodder production, field crops, horticultural crops and fuel wood trees. This type of research, apart from simple cropping systems research, is aimed at optimising production of agricultural systems through adaptive research trials to ensure that agricultural systems are adequately tailored to local conditions.

Bangladesh Rice Research Institute

BRRI is the institution, which has been responsible for rice research since its establishment in 1971. This institute, with a Board of Governors headed by the Minister of Agriculture, has about 200 scientists and eight regional stations. Aided by continuing technical support from the International Rice Research Institute and funding from external agencies, especially for training of personnel and developing on-station research facilities, BRRI is a fully viable institution that has made a significant contribution to development of Bangladesh's agriculture by developing and propagating quite a large number of high yielding varieties. BRRI high yielding varieties are now gradually replacing the local varieties, by now almost 80-90 per cent of the Boro rice area and 15-30 per cent of Aus and T. Aman is cultivated with HYV.

However, the increase in yield of new varieties of rice has not been significant over the past few years and it seems that the research efficiency and effectiveness has stagnated, probably due to under-funding and institutional deficiencies.

Bangladesh Livestock Research Institute

BLRI is entrusted to generate and adopt technologies to solve livestock problems at national an farm levels and to train scientist. The mandate is to take care of the livestock problems of smallholder farmers through multi- and inter-disciplinary and inter-institutional research. Over the last four years the institute has been able to generate and adopt a few appropriate technologies and strengthen farming systems research and establish extension-research linkage. The main area of research priorities are an on animal health, livestock production, poultry production and socio-economic aspects of livestock development.

The institute is governed by a Board of Governors chaired by the Minister, Ministry of Fisheries and Livestock and headed by a full time Director.

So far BLRI's research effort have concentrated on traditional problems in the mainland and given little attention to the specific problems in the estuarine areas where the inhabitants dependence on livestock and poultry production is assumed to be much higher than other parts of the country.

6. DEVELOPMENT POTENTIAL, STRATEGIES AND CONSIDERATIONS

6.1 Preconditions for development

It is important to note that the initiation of any sustainable development of the farming systems in the offshore islands depends on the establishment of institutional structures that support farmers in relation to:

- land titling, to secure the long term interest in improvements of the farm resources
- protection of the land and user rights, to break the power of big land owners and "land grabbers".

Such structures are fundamental for the protection of farmers' interests and to secure that farmers are able to benefit from their investments and various project interventions.

In the following sections it is assumed that land titling and protection of peoples user rights have been established in the area.

It is also assumed that an overall land use planning and resource assessment is carried out in relation to any development or project intervention. This is important for a farming systems analysis and resource assessment which should be the basis for planning of a sustainable development of the farming system.

6.2 Development potential in the offshore islands of MES

It is difficult to validate potential increase in yields of crops and livestock performance, as a result of different interventions and individual development components. There is no well-functioning polder in the offshore islands that can be used as a model for a 'project-situation'. Nor are there any coastal polders with similar conditions for cultivation where the drainage and protection system is fully in function and where improvements are documented.

It is a general perception that the natural resources of the MES area do not provide potential for a highly intensive farming system. The poor soil, the lack of water for irrigation and the capillary rise of saline water from the ground during the dry season indicate that there will always be limitations for the farm production. However with the present situation where damage and losses are frequent there is a potential for reasonable improvements. A less risk prone environment might enable the subsistence level farming to develop into a system where income generation and accumulation of resources take place.

There is between 90,000 – 100,000 ha of land more or less empoldered and 40,000 - 45,000 ha of land outside embankments which is used extensively for grazing and cultivation of Aman rice. Outside embankments in South Hatia and Nijhum Dwip cropping intensities of a maximum of 120 per cent (T. Aman - Rabi - fallow) and yields from the T. Aman crop in general between 600-800 kg/ha. Inside embankments at Hatia, although there are problems with flooding and the water management system has not been improved, the cropping intensity is, according to the thana office, as high as 195 per cent and the yield of T. Aman the double of the yield outside.

In Table 6.1 the primary constraints for development of the productivity both inside and outside embankments are listed. Development activities to target the different problems are also mentioned in the table. It is also noted in the table if it is a problem that occurs inside (I) or outside (O) the embankment.

Land protection and drainage systems, either construction or rehabilitation, are the kind of activity that targets most problems. Furthermore there are several components that, apart from on-station research and land use planning, more or less could be incorporated in an overall Farming Systems Research & Development Programme (FSR&D).

While there will be immediate benefits from physical constructions shortly after completion, a FSR&D programme needs a longer period of time to produce results, as development and testing of new or alternative crops/methods is part of the process.

Table 6.1: Primary constraints directly affecting the productivity of the farming system

Problem	Sub-Problem	Solutions	Development Activities
Soil salinity	Tidal flooding (O)	Protections of the land for desalinisation	Construction of embankments, establishment of drainage systems and improved water management systems
	Storm surges during cyclones (I/O)	Embankments	As above
	Capillary effect (I/O)	Improved water management Research mainly on improved soil structure	As above; On-station research (field testing integrated in FSR& D programme)
Soil fertility	Low natural content of organic matter (I/O)	Green manure, manure, mulching	Farming systems research and development programme (FSR&D)
	Farming practices deplete the organic matter content (I/O)	Improved use of on-farm and of-farm resources	FSR&D programme
	General low level of nutrients (I/O)	Manure and compost to be used in the field and for homestead crops. Increased fertiliser use	Community forestry programme in relation to mangrove forest, roadside plantation and embankment vegetation Fertiliser programme (integrated with FSD)
Crop losses due to flooding	Tidal inundation (O)	Land protection systems	Construction of embankments
	Storm surges (I/O)	Land protection systems	Construction of embankments
	Inadequate drainage (I)	Improved drainage systems	Rehabilitation of drainage and water management system
Crop losses due to pests	Pre-harvest (I/O)	Improved protection of crops	IPM-programme (integrated in an FSR&D approach)
	Post-harvest (I/O)	Improved storage facilities	Programme on homestead development (FSD)
Low livestock performance	Insufficient feeding (I/O)	Improved feeding Adequate areas for grazing	FSR&D Land use planning programme
	Diseases (I/O)	Improved health status	Animal health programme (FSD)
	Low performance of local breeds (I/O)	Improvement of local breeds	Research for better performing animals suitable for the coastal area
High livestock mortality	Diseases (I/O)	Improved control of diseases	Animal health programme (FSD)
	Low nutritional status of livestock (I/O)	Improved feeding	FSR&D
	Cyclones and flooding (I/O)	Improved protection	Construction of embankments and killahs

In Table 6.2 secondary constraints for development of the farming productivity as well as development activities are listed. According to the New Agricultural Extension Policy it is

decided that agricultural extension should take up a Farming Systems Research and Development approach. With a well-functioning extension system in the offshore islands a separate FSR&D programme would not be necessary. However, implementation of the NAEP have just started and has not yet reached the remote offshore islands. Support for the implementation of NAEP and strengthening co-operation between agricultural and livestock extension would be most important for continued development of the offshore islands and to keep up the level of achievements.

Table 6.2: Secondary constraints indirectly affecting the productivity of the farming system

Problem	Sub-Problem	Solutions	Development Activities
Inadequate extension service (I/O)	Lack of relevant research	Relevant research for saline areas	On-station research programme for food and fodder crops and animal husbandry
	Low level of training and implementation of NAEP	Improved extension service	Support to implementation of NAEP and strengthening of the extension service
	Lack of out-reach in the livestock extension service	Improved extension service	Support for strengthening the livestock extension service and increasing co-operation with agricultural extension service
	Lack of staff	Increase amount of trained staff	Support for implementation of NAEP and co-operation with livestock extension
Insufficient financial resources (I/O)	Inadequate credit facilities	Improved credit facilities	Micro-credit programme
	Low level resource accumulation in households	Improved income generation	FSD programme
	Indebtedness from earlier loans	Financial assistance	Debt relief programme
Inadequate supply of inputs (I/O)	Fertiliser, pesticides, seed, vaccines, feed	Improved access to inputs Improve credit facilities	Co-operative system programme Micro-credit programme
	Equipment	Organised purchase and use of equipment Improved credit facilities	Co-operative system programme Micro-credit programme
Limited access to markets (I/O)	Lack of farmer organisation	Improved farmer organisation	Co-operative system programme

There is a high need for proper credit facilities in the area. The high degree of indebtedness which has been reported in the area is partly a result of high interest rates in the informal money market, but also a result of the low or no income generation of the subsistence level farming activities. There might also be some potential in developing the markets and the marketing activities, maybe even to introduce small scale processing industries, particularly for preservation of food products. The relevance of such activities is, however, depending on intensification of the farming systems.

Livestock development in unprotected areas

Some areas are not yet suitable for empoldering and the land will have to be left unprotected by embankments. However there might be some potential in developing the livestock sector. Strengthening of the livestock extension with creation of a cadre of Livestock Field Workers and Women Poultry Workers who would undertake extension activities at grassroots level would be

expected to have an relatively large impact. Projects from other parts of Bangladesh have proven results in particular small livestock programmes. The approach has been participatory and on self help basis. As a result farmers have been motivated to bear the costs of inputs and service charge to the workers. Development of the livestock sector should, however, be combined with mangrove plantation and construction of Killahs for cyclone protection.

The development of the livestock sector, including cyclone protection, might also be a solution in case financial support is not adequate for the creation of land protection systems for an overall development of the farming system.

Research

On-station research on farming in saline areas, both on livestock and agricultural aspects, would also provide support to the development of the farming system. The NAEP emphasise a need for strengthening the extension-research linkage. However, on-station research is a programme in itself and should as such be independent and overall programme for farming in coastal and offshore islands.

6.2.1 Geographical differences of the planning units

The major constraints for development of the farming system are general for the offshore islands. There are, however, some differences:

- an increase in areas with saline soils from west towards east (Planning Unit A towards C)
- a shift from medium lowland to larger areas with medium highland from west towards east (Planning Unit A towards C)
- a total dependency on on-farm resources for fuel on Sandwip in the east (Planning Unit C) where there is no mangrove forest, whereas the forest resources are more abundant in the western part (Planning Unit A) and also on Hatia and Manpura (Planning Unit B), thus a decrease of forested areas from west towards east
- larger grazing areas in the central and western part than in the east (decreasing from Planning Unit A towards C)
- different marketing routes (direction Galachipa, Chandpur and Chittagong for the offshore islands of Planning Unit A, B and C, respectively).

The differences in natural resources are likely to have an impact on peoples priorities as well as it provides different options for development of the farming system.

According to the Thana offices of the five focal Thanas the cropping intensity is higher on Sandwip and Hatia. There might be a higher potential for increasing the cropping intensity in the western islands, but more reliable information is necessary for such predictions. The polders in Sandwip and Hatia were constructed in the sixties, while the rest of the polders have been completed within the past 10-15 years.

In general the available data is too limited to predict variations in potentials of the individual offshore islands. At present we have only very good indications of an overall need for protection of the land, and improved water management systems.

Further investigations on local needs should be part of local area planning and project designs.

6.3 Lessons learnt from CEP and CDSP

The existing polders in the offshore islands of MES have been constructed in relation to the Coastal Embankment Project (CEP). The empoldered areas are cultivated more intensively than

the areas outside the polders, but as the systems are not well-functioning the results in terms of yields are not always higher than outside the embankments.

The Coastal Embankment Project (CEP), which was launched in 1960, had originally the purpose to increase agricultural production by providing protection and drainage facilities. Before construction of the embankments, complete or almost complete crop failures due to saline inundation or monsoon flooding were reported in most areas once in every three years. It has been concluded that although no evaluation of the impact on agricultural production has been made it is apparent that the actual benefits have been far below expectations. Empoldering has however, increased the scale of production because of reduction in areas flooded and depth of flooding. The main reasons for the CEP achievements to be below expectations is lack of maintenance of sluice gates, damage of embankments, siltation of the drainage system, and changes in the river system, flooding and salinity, as these problems continuously inhibit the agricultural production (CARDMA, 1988).

Rehabilitation of the embankments has been carried out in relation to the Rehabilitation of the Coastal Embankment Project. However, at present the situation is still the same in most polders, sluice gates are damaged or missing, the drainage system is congested, and embankments not repaired when damaged deliberately or by cyclones or erosion.

The Char Development and Settlement Project has been working in coastal Chars of Noakhali, where some of the problems constraining farming are the same as in the coastal islands. The soil is relatively saline, there is no water for irrigation, and the soil fertility is low. Protection of the land is being established at present but is not yet completed, as well as the drainage system is still being developed. CDSP is involved in Char development in an area already densely settled, while MES in the new chars will have a possibility of controlling the settlements by planting mangrove in the chars still too low for settlement. As the land develops a planning process with peoples' participation could take place. In this way the infrastructure of the char, like roads and drainage, can be planned together and provide a better basis for the well-functioning of the polder. Rehabilitation of the existing polders in the MES area is likely to face the same kind of problems as CDSP. An advantage for the work in the MES area is that the embankments have been established for some time and the farmers are aware that the problems relate to the malfunction of the polder system and therefore more willing to contribute to its rehabilitation.

CDSP has had a broad range of activities. Based on this experience one of the main general recommendations CDSP has given is to simplify project structure and activities and keep a focus on a few priority activities.

Within the farming system CDSP has concentrated their activities on field crops and homestead development. The project has followed a group approach for certain activities, but also a system of on-farm testing of crops and technologies similar to the T&V system. Demonstration farmers have tested several crops and methods including IPM. The practical experience of CDSP on field crops and homestead development can be very useful for a farming systems development programme in the offshore islands, when protection of the land has been established.

6.4 Strategy

The overall strategy for development of the farming system of the offshore islands of MES – what to do in the area - should be based on the following considerations:

- expected potential of the different development activities
- inter-dependency of interventions/development activities
- evaluation of impacts

- peoples participation.

The highest potential for development, as discussed above, lies within the elimination and minimisation of damage and losses. As the losses resulting from crop and animal diseases and pests are somewhat increased by flooding and poor health status of animals (and to a certain degree of the crop) the improved environment for farming created by the land protection might mitigate the severity of these constraints. A general reassessment of constraints during the implementation should be built into a strategy.

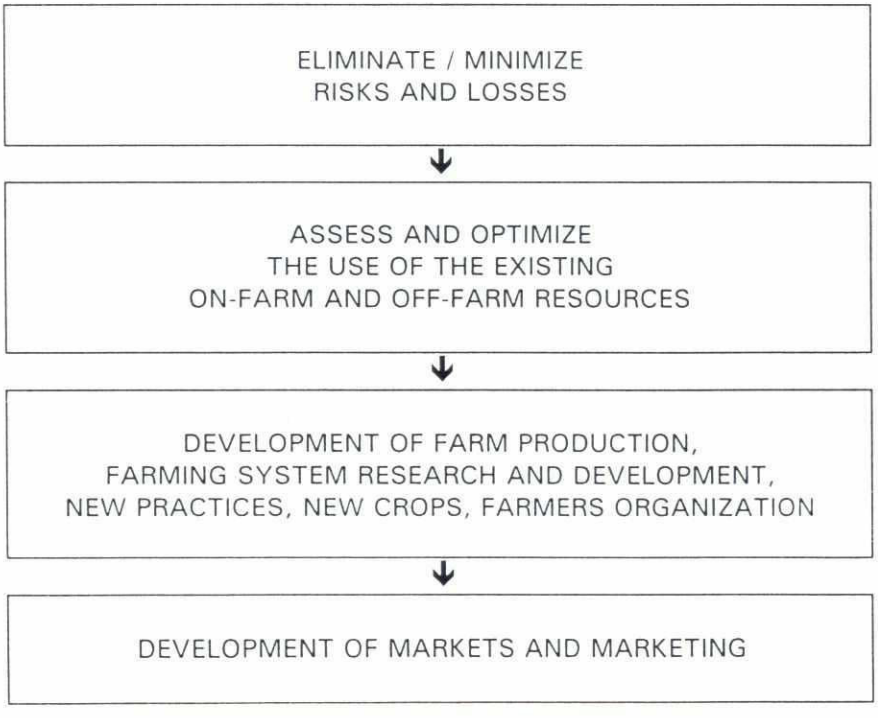
Results of the initial interventions should be evaluated and a participatory reassessment of farmers' needs should be carried out in relation to assessment of availability of on and off-farm resources (including forest and grazing areas). The result of such an assessment should feed in to the overall and continued land use master planning.

Based on the above assessment, the activities of FSR&D should be planned and implemented. As the need arises for improved access to farming inputs and marketing of products such activities should be added to the project.

A model for improvement of the farming situation and development of the farming system is shown in Figure 6.1. This model applies to overall planning for the offshore islands but also for smaller planning units

For sustainability of the development the strategy should assure people's participation from the beginning when the planning of the local area development takes places both for interventions outside and inside embankments. A group approach should be attempted for several reasons: user-groups are the basis for installation of, e.g., tube wells; groups of farmers are dependent on one section of the drainage system or polder section and will have to take decisions on the operation and maintenance as a group; the group approach for farming systems development will reach more farmers than the T&V system; furthermore the NAEP has adopted the group approach in the extension service.

Figure 6.1: A model for improvement of the farming system



6.5 Implementation of project activities

The development of the farm productivity and farming system is dependent on the creation of an improved environment for farming. At present the solution to this is protection of the land through creation of embankments, drainage and other works. However, the present status of the coastal area gives rise to serious concern.

There are a number of empoldered areas in the offshore islands and practically none of them provide full protection, well-functioning drainage or water management systems. There seems to be a fundamental lack of either planning or commitment for the operation and maintenance of the structures on a current basis. Some of the polders have been rehabilitated when donor assisted projects have taken on the task, but on a day-to-day basis there is a lack of institutional and financial support to allow the fundamental physical structures to provide the intended potential improvement of the farming environment.

CDSP has not yet developed a methodology for the institutionalisation of procedures for operation and maintenance of the land protection system, but this will be part of their activities in relation to the on-going completion of the polder in Char Majid.

Whether any other activities should be initiated before the land is properly protected must be considered as well as the expected impact. The recommendation from CDSP of keeping a focus on a few priority activities should be kept in mind. An integrated whole farm approach based on assessments of farmers' needs and resources as well as an assessment of the communal resources in the area is more likely to result in a sustainable development than implementation of individual components where conflicts in the use of resources are not taken into consideration. However an integrated approach requires much more effort and resources as well as planning and organisation. Therefore, if there is a need for prioritisation it would be advantageous to select individual components with high potential such as an animal health programme or a pest management programme.

6.5.1 Involvement of various sectors in development activities

Development activities for farming systems development fall into two categories:

- physical development
- farming development.

The two categories of activities can be implemented separately as different expertise is required. Both categories depend on an overall participatory land use planning at estuary level as well as at local level for co-ordination and sustainability of the development.

The physical development should have a strong emphasis on the institutional set-up for the operation and the maintenance of the polder system. Establishment procedures through peoples' participation are essential for a continued protection of the land and a sustainable improvement of the environment for farming. It is often seen that farmers are capable of getting benefits from such improvements without further assistance.

Proper micro-credit facilities would provide further improvement of the environment for farming and speed up the development process and should, therefore, be part of a Char development programme in relation to physical interventions.

6.5.2 Responsibility for farming development

The expertise for farming development lies within the Ministry of Agriculture and Ministry of Livestock and Fisheries. Any overall programme should be the responsibility of these ministries. As it has been mentioned earlier a few components could be implemented together with a programme on physical development, namely activities that has the same objective, to eliminate

or minimise damage and losses. This would be mainly animal health improvement and pest management programmes which could be implemented with the assistance of local NGOs.

The NAEP provide a perfect foundation for farming development as the principles of the extension service is a whole farm approach, based on farmers participation and a group oriented extension.

Special support to implementation of the NAEP in the offshore islands should be considered as a parallel programme to the physical development, as it is far too extensive to be a subprogramme.

6.5.3 Timing of activities for farm development

The timing for different development activities should be included in the overall co-ordination of development planning for the offshore islands. With a view to the discussion above on the institutional difficulties related to establishment of a well-functioning polder system it should, however, be considered if it is worthwhile to initiate any farm development activities (FSR&D) before the full system including operation and maintenance has been established.

Decisions on the timing of different activities will also depend on the resources which can be made available for activities and how well effort can be co-ordinated.

7. CONCLUSION

The offshore islands of MES south of Noakhali and south of Bhola are the focus for potential development of the farming system in the MES study. This area is where the majority of accretion takes place and this is also where the most extensive land masses are found. The northern border for this area is drawn where salinity of the river water in May reaches the level of two ds/m, which is the upper salinity level for the use of water for irrigation.

The basic condition for cultivation, climate, soil salinity, soil fertility, and availability of water for irrigation are relatively homogenous in the focus area for development of the farming. There are slight differences in soil salinity and land levels.

The total land area of the offshore islands is approximately 195,000 ha of which half is empoldered and half is outside embankments. Of the area outside embankments slightly more than half is forested with mangroves.

7.1 The physical and biophysical environment for farming

The area does not provide a huge potential for highly productive intensive farming system due to the persisting salinity problems during dry season, the low fertility and difficult structure of the silty soils, and the lack of water for irrigation. However there is some potential in increasing the productivity and develop the subsistence level outcome of the land to an income-generating farming system.

At present the main reasons for the low outcome of farming is the high amount of loss of crops and animals, damage to crops by flooding, soil salinity, pests and diseases, as well as animal parasites and diseases.

Physical interventions

Due to the low level of success in relation to land protection, the institutional set up for the management of such structures should be investigated further.

The highest potential for improving the farming conditions for the benefit of both agricultural, livestock and homestead production lies within the construction of land protection systems,

including embankments, drainage, sluice gates, canals for water reservoirs, etc. This kind of improvement is, however, not new to the area. There are at present 10 empoldered areas in the offshore islands of which the first was constructed in the beginning of the sixties. At present none of the polders are providing full protection against storm surges as parts of embankments are missing many places or has been damaged. Furthermore, sluice gates are missing and the drainage system is congested so the opportunity of improving the water management system does not exist. As sluice gates are mission tidal inundation at extreme tides still occur in lower areas. Procedure for operation and maintenance of the polder system does not exist, and in most polders there is virtually no system to operate (sluice gates are missing or do not function).

Given that it is possible to establish at well-functioning polder system, this would provide a fundamental improvement of the farming environment. An elimination or decrease of the damage caused by the physical environment is a major step for increased overall production.

Farming systems developments

Farming systems development as it is outlined in the NAEP should be implemented in the area under a special programme for the offshore islands.

In case it is not found feasible to rehabilitate or establish polder systems, the main potential would be an optimisation of the use of the existing natural and human resources within an overall framework of land use planning. With a strong focus on the group approach as described in NAEP the organisation of the farmers would also be strengthened. A better organisation of the farmers could provide an important foundation for improving the small scale farmers' power towards large landowners, tradesmen, etc. Furthermore, organisation of the farmers in user-groups with stronger participatory skills might also provide a better foundation for participatory farmer maintenance of the polder system.

Livestock and poultry programmes with a primary focus on animal health, participatory integrated pest management programmes at farm level and women focused homestead production programmes at grassroots-level should be implemented immediately.

The potential results are at a minor scale compared to the potential of land protection systems; however, the results are likely to be of a permanent character and the development sustainable.

7.2 The socio-economic and human environment

Unless there is adequate commitment and provision for management, operation and maintenance of physical interventions no activities of that kind should be implemented.

The idea of establishing land protection systems for development of the farm production is not new to the area. It is mentioned above that around half of the land area of the offshore islands is somehow empoldered. It is, however, a cause of great concern that none of the polder systems are well-functioning despite the fact that rehabilitation has been carried out in several of the polders. The issue of management systems and resources for maintenance seems to have been neglected or not successfully implemented in the passed.

Activities to strengthen the rural development in terms of land titling systems, protection of land use rights, law enforcement, peoples participation should be implemented, if not before activities to develop the farming system, then at least parallel to a farming systems programme.

During the study it was found that although biophysical conditions have been emphasised as the immediate constraints for farmers, several other factors contribute to a large extent to the poverty of the farmers and the low potential for self-help development. These factors have only been mentioned in earlier in relation to preconditions for development, e.g., land titling, protection of land use rights, laws and procedures for settlement as well as law enforcement. The importance of such socio-economic and structural factors that secure the farmers' legal rights to their land as well as the day-to-day protection, must not be neglected as subsistence

farmers have very few means to protect his rights and land resources. It is not very likely that farmers will invest in or adopt practices that might provide a higher potential, but where the resources cannot be protected. Education and participatory training for a stronger organisation of the farmers could strengthen the structure of the society. These fundamental constraints are discussed further in the Rural Development volume of this report and should be kept in mind when discussing the potential for farming system development.

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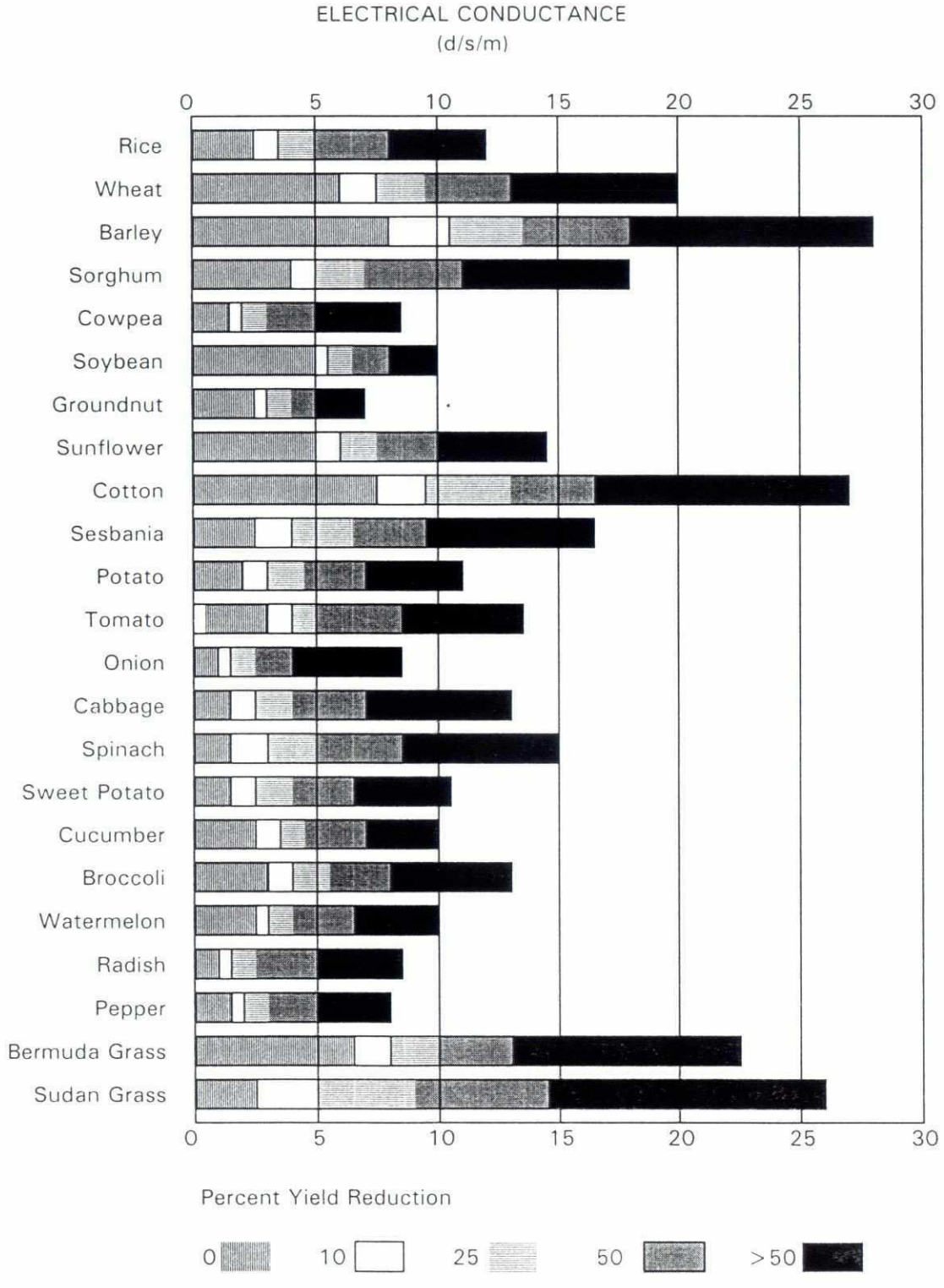
APPENDICES

Salinity tolerance of most commonly grown field and vegetable crop in Bangladesh, and some potential crops which could be cultivated in the saline zone (Ayers and Westcot, 1976)



Cultivated area, different cropped area, cropping intensity, total Aus, Aman, Boro Paddy and their tentative classes in various thanas inside the MES Area during 1982-83.

District	Thana	Cultivated area	Single crop area	Duble crop area	Triple crop area	Cropping Intensity	Total area			Crop intensity %				Boro area		
							Aus	Aman	Boro	<120	120-150	150-200	>200	1-50	50-100	>100
		000 ac	000 ac	000 ac	000 ac	%	00 ac	00 ac	00 ac					00 ac	00 ac	00 ac
Patuakhali	Galachipa	143	120	21	2	117	134	123	43	✓				✓		
Bhola	CharFasson	105	90	13	2	116	163	883	29	✓				✓		
	Manpura	16	14	2	-	112	28	57	-	✓						
Noakhali	Hatia	112	77	30	5	136	252	1045	-		✓					
Chittagong	Sandwip	37	17	17	3	162	346	319	2			✓		✓		
Chandpur	Haimchar	17	3	13	1	188	223	92	48			✓		✓		
Feni	Feni	38	10	21	7	192	137	388	67			✓			✓	

Note:
< 120 % = Low crop intensity
120 - 150 % = Moderately low crop intensity
150 - 200 % = Moderately high crop intensity
> 200 % = High crop intensity

Source :
Upazila Statistics
(1979-80 to 1982-83)
Volume - 2
BBS

Cultivated Areas, Cropped Areas and Cropping Intensity
in some coastal Thanas under the MES Area during 1995-96

(Hectares)

District	Thana	Cultivated area	Aus (L)	Aus (HYV)	Aman (L)	Aman (HYV)	Boro (L)	Boro (HYV)	Pulses	Oilseeds	Vegetable	Potato	Sweet Potato	Species*	TOTAL Crops	Crop Intensity (1995-96)	Crop Intensity (1982-83)
Chittagong	Sandwip	20450	5725	800	20100	550	-	-	-	15	-	-	-	83	27273	133	166
Noakhali	Hatia	50607	26980	6710	38663	4507	-	-	4835	15155	1012	-	-	856	98718	195	136
Bhola	Manpura	10263	850	250	9670	540	-	-	5970	70	500	-	-	500	18350	178	112
Bhola	Char Fasson	53441	4757	1943	15190	6356	162	1619	1010	399	182	34	231	587	32470	61	116
Patuakhali	Galachipa	65985	4225	824	48327	15818	2830	13	11594	749	105	43	2303	2302	89133	135	117
	TOTAL	200746	42537	10527	131950	27771	2992	1632	23409	16388	1799	77	2534	4328	265944		

* Includes Garlic, Onion, Chilly.

Sources : Estimates during 1995-96 were collected from the respective Thana Agricultural Officier
Estimates during 1982-83 were taken from the Upazila Statistics (1979-80 to 1982-83) Vol 1, published by BBS, 1985.

Yield of different crops in selected regions
(Source: Yearbook of Agricultural Statistics of Bangladesh 1995)

Yield of Local Aus rice by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	1236	1109	1257	1046	917	1113
Noakhali	910	730	815	675	738	774
Barisal	967	944	993	751	820	895
Patuakhali	879	835	1122	1020	934	958
4 regions	998	905	1047	873	852	935

Yield of Broadcast Aman rice by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	0	0	0	0	0	0
Noakhali	890	617	643	559	288	599
Barisal	1190	1298	1223	894	743	1070
Patuakhali	0	0	0	0	0	0
4 regions	1040	958	933	727	516	835

Yield of Local T. Aman rice by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	1443	1533	1518	1450	1495	1488
Noakhali	1014	1327	1369	1328	1308	1269
Barisal	1392	1247	1328	1299	1043	1262
Patuakhali	1058	1237	1247	1344	1059	1189
4 regions	1227	1336	1366	1355	1226	1302

Yield of HYV Aman rice by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	2238	2289	2415	2453	2649	2409
Noakhali	1720	1955	2010	2009	1787	1896
Barisal	1887	1885	1931	2043	1249	1799
Patuakhali	1509	1805	2012	1756	1590	1734
4 regions	1839	1984	2092	2065	1819	1960

Yield of Pajam Aman rice (HYV x local Aman) by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	1998	2193	2187	2142	2239	2152
Noakhali	1223	1459	1532	1770	1578	1512
Barisal	1710	1743	1921	1647	1084	1621
Patuakhali	1296	1381	1451	1528	1257	1383
4 regions	1557	1694	1773	1772	1540	1667

Yield of Local Boro rice by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	2058	2350	2254	2047	2170	2176
Noakhali	1230	1528	1280	1500	709	1249
Barisal	1349	1464	1384	1314	982	1299
Patuakhali	1083	979	1025	1024	1055	1033
4 regions	1430	1580	1486	1471	1229	1439

Yield of Khesari by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	824	780	761	766	758	778
Noakhali	773	773	798	812	669	765
Barisal	716	781	729	731	716	735
Patuakhali	605	662	684	692	721	673
4 regions	730	749	743	750	716	738

Yield of Mung by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	1096	922	951	761	667	879
Noakhali	654	721	709	467	727	656
Barisal	370	454	378	314	319	367
Patuakhali	506	543	620	776	709	631
4 regions	657	660	665	580	606	633

Yield of Rape and Mustard by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	692	706	711	756	767	726
Noakhali	521	478	499	519	537	511
Barisal	472	445	429	431	415	438
Patuakhali	312	305	314	323	321	315
4 regions	499	484	488	507	510	498

Yield of Groundnut (Rabi and Kharif) by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	1220	1359	1389	1520	1576	1413
Noakhali	857	892	892	946	1055	928
Barisal	814	850	843	835	801	829
Patuakhali	857	881	862	1003	284	777
4 regions	937	996	997	1076	929	987

Yield of Rabi Chilli by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	964	1005	993	987	976	985
Noakhali	739	753	778	766	741	755
Barisal	625	618	622	635	630	626
Patuakhali	578	519	494	469	427	497
4 regions	727	724	722	714	694	716

Yield of Onion by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	3649	3414	3293	3162	3178	3339
Noakhali	3277	3165	3030	3083	2623	3036
Barisal	2235	2129	2167	2210	2238	2196
Patuakhali	2308	2304	2574	2935	3009	2626
4 regions	2867	2753	2766	2848	2762	2799

Yield of Garlic by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	2646	2276	2561	2237	2515	2447
Noakhali	2414	2319	2285	2297	2237	2310
Barisal	2250	2172	2214	2221	2160	2203
Patuakhali	2094	2081	2232	2276	2343	2205
4 regions	2351	2212	2323	2258	2314	2292

Yield of Sweet Potato by region, Kg/Ha						
Region	1990-91	1991-92	1992-93	1993-94	1994-95	1990-95
Chittagong	5920	5460	6058	5897	14204(?)	5834
Noakhali	8902	8082	8218	8354	7542	8220
Barisal	7582	7701	7269	7269	9117	7788
Patuakhali	7694	7405	7566	7583	7896	7629
4 regions	7525	7162	7278	7276	8185	7485

The 1994-95 figure is omitted

Total Cropped areas, Productions and Yields of paddy in different thanas of the MES Project during 1982-83 and 1995-96

(Area and Production in hundred)

District	Thana	1982-83												1995-96											
		Cropped Area (ha)				Production (ton)				Ton/ha				Cropped Area (ha)				Production (ton)				Ton/ha			
		Aus	Aman	Boro	Total	Aus	Aman	Boro	Total	Aus	Aman	Boro	Total	Aus	Aman	Boro	Total	Aus	Aman	Boro	Total	Aus	Aman	Boro	Total
Chittagong	Sandwip	140	129	0.8	269.8	155	142	2	299	1.1	1	2.5	1.1	65	206	-	271	70	170	-	240	1.1	0.8	-	0.9
Noakhali	Hatia	102	423	-	525	154	397	-	551	1.5	0.9	-	1.0	337	432	-	769	638	754	-	1392	1.9	1.7	-	1.8
Patuakhali	Galachipa	54	50	17	121	59	75	41	175	1.1	1.5	2.4	1.4	50	641	28	719	113	1035	40	1188	2.3	1.6	1.4	1.7
Bhola	Char Fasson	66	357	12	435	72	405	18	495	1.1	1.1	1.5	1.1	67	215	18	300	158	489	92	739	2.4	2.3	5.1	2.5
Bhola	Manpura	11	24	-	35	8	24	-	32	0.7	1	-	0.9	11	75	-	86	30	199	-	229	2.7	2.7	-	2.7
TOTAL		373	983	30	1385.8	448	1043	61	1552	1.2	1.1	2.0	1.1	530	1569	46	2145	1009	2647	132	3788	1.9	1.7	2.9	1.8

Note: The data of 1982-83 were collected from the Upazila Statistics, Vol.-2 (Major Crops and Agricultural Input), Published by BBS in September, 1985.
The data of 1995-96 were collected by the Junior Specialists of the MES Project from different thanas during April to June, 1997.

Crop areas, crop productions, per acre yield, per hectare yield

Areas	Crops	Area covered (acre)	Production obtaned (kg)	Yield/acre (kg)	Yield/ha (kg)
1	2	3	4	5	6
Char Osman	Razasail	94.38	24402	258	637
Bandartila	Razasail	3.00	125	41	101
Char Hare	Razasail	18.26	7160	392	968
Char Macpherson	Razasail	72.46	27340	377	931
Char Osman	Kazalsail	13.15	200	15	77
Char Hare	Kazalsail	43.62	10040	230	568
Char Hare	BR -8	0.22	360	1636(?)	4040(?)
Char Hare	BR - 11	1.22	640	524	1294
Bandartila	Haida (Aus)	0.58	35	60	148
Char Hare	Haida (Aus)	24.44	8270	338	835
Char Osman	Ground nut	0.60	280	466	1151
Char Hare	Ground nut	12.70	4700	370	914
Char Macpherson	Ground nut	9.08	3560	392	968
Char Osman	Sweet potato	3.00	3200	1066	2634
Char Hare	Sweet potato	2.34	2500	1068	2633
Char Macpherson	Sweet potato	3.30	3800	1151	2843
Char Osman	Khesari	16.82	1380	82	203
Char Hare	Khesari	0.80	80	100	247
Char Mcpherson	Khesari	2.80	440	157	388
Char Osman	Pepper	3.31	445	134	331
Bandartila	Pepper	0.20	10	50	124
Char Hare	Pepper	3.72	240	64	168
Char Macpherson	Pepper	2.84	600	211	521
Char Osman	Linseed	8.36	660	78	193
Char Hare	Linseed	1.60	120	75	185
Char Hare	Mung	10.90	1050	96	237
Char Macpherson	Mung	2.00	120	60	148
Char Osman	Garlic	0.39	68	174	430
Bandartila	Garlic	0.20	160	800	1976(?)

Summary result of farm household survey in different chars in MES area

Farmer in char land	Homestead area (acre)	Cultivated area (acre)	Crop area & production: Crop	Area (acre)	Yield obtained: Paddy/Rabi (md)	Yield obtained: Paddy Kg/ha	Annual shortage of rice: mds	Annual shortage of rice: Tk.	Gross annual income: Agri Tk.	Livestock Tk.	Home garden Tk.	Fishing: River/sea Tk.	Fishing: Pond Tk.	Labour Tk.	Other inocme Tk.	No. of livestock: Cattle	Goat	Poultry	Fertiliser used: Urea Kg.	TSP Kg.	SSP Kg.	MP Kg.	Pesticide Pkt	Cowdung used as: Manure (M)	Fuel (F)	Credit: Recd. Tk.	Paid Tk.
Char Montaz																											
Sahera Banu	0.5	3.15 (L)	LHT Aman	3.75	56	1475	10	5000	7350	4500		15000				5	4	32	10		10		2		F	9000	-
		0.50 (K	Rabi	2.2	82																					RIDP	-
Abdul Jalil Farazi	0.18	0.6	LT Aman	0.6	5.6	922	18	9000		1200		3600		6000 (son)		3	3	19	8						F		
Pancham Ali	0.06	0.45	LT Aman	1.95	21	1064	S N E					4800				1		5							F		
		0.50 (K	Rabi	0.3	3.5																						
Nuru Howlader	Nil *	0.6 .50 (S)	LT Aman	3.1	16	510	12	6000	1300			5000				4		9							F		
Sahela Begum	0.22 (K)	1.8	LT Aman	1.8	40	2106	18	9000	2000			25000	680			2	3	28	20						F	6000	3000
			Rabi	0.3	3																					RIDP	
A. Sattar Howlader	0.02 (L)	nil										29000				2		15								10000 RIDP	5000
Chari Biswas																											
Nur Mohd. Sarkar	0.16	2	LT Aman	2	5	247	25	21600		300				7200 (son)				11						M			
			Rabi	0.66																							
Gazi Mosharraf	Nil *	Nil												10000													
A. Barek Holader	1	4	LT Aman	2	4	192	14	5000				2400							65				3		F	6000 AB	
Sanu Miah	0.2	10	LT Aman	10	50	494	35	17500								2			150				3		F		
			Rabi	5	20																						
Rangabali																											
Forkan Miah	0.15	0.6	LT Aman	3	10	329	20	10000				8000				4		13	100				3		F	5000	
		2.5 (L)																									
Ratan Ali	0.15	1.66	LT Aman	1.66	6	357	8	4000										7								2000	
Mohammed Ali	0.25	5	LT Aman	5	50	988																			F	6000	
			Rabi	0.63	3		7	3500								4			30							AB	
Azizur Rahma	0.15	2	LT Aman	2	30	1482							4000		11400 **	1	4	23							F	10000	
			Rabi	1.05	4		12	6000			900																
Majibul Hqu	0.45	20	LT Aman	20	240	1186										12	5	15							F		
			Rabi	2.5	21		Nil		17100																		
Badsha Miah	1	2	LT Aman	2	25	1235	18	9000			5500		5000					3							F		
Mohammad Fariduddin	0.33	3.06	LT Aman	3.06	51	1647	Nil									4	12	8						M			

Note: * = Living in in-law's house, RIDP = NGO, LT Aman = Local varieties of T. Aman, L = Lease, K = Khas, S = Share cropper, AB = Agriculture Bank, LHT Aamn = Local and High Yielding varieties of T. Aman
SNE = Shortage, but not estimated, 1 md = 40 kg paddy = 25-27 kg rice, ** = Salary as primary school techer + coaching fee.
Survey conducted by M. A. Sattar, Agronomist during 5.12.97 to 9.12.97

Total number of livestock in selected Thanas of MES 1991-92 to 1995-96

(Figures in hundred)

District	Thana	Total number of Livestock																									Total	
		Bullock					Buffalo					Milk-Cow					Goat					Sheep					Cattle	Go + Sh
		1991-9	1992-9	1993-9	1994-95	1995-96	1991-92	1992-93	1993-94	1994-9	1995-9	1991-9	1992-9	1993-9	1994-9	1995-9	1991-9	1992-9	1993-9	1994-9	1995-9	1991-9	1992-9	1993-9	1994-9	1995-9	94-95	94-95
Chittagon	Sandwip*				449.8					89.5										154.4					105.5		539	259.9
Noakhali	Hatia	186.4	184.4	187.5	193.1	221.1	163.5	168.8	172.4	206.7	234.6	66.1	73.1	84.2	78							304.7	326.2	341.1	359.2	362.2	478	359.2
Bhola	Char Fasson	343.5	344.8	345.1	345.5	345.7	164.9	164.5	164.2	164.7	164.9	248.5	248.8	248.6	248.9	249.1	121.9	122.5	122.7	123	123.2	83.7	83.9	84.3	84.7	85.1	759	207.7
Bhola	Manpura	42.2	57.8	65.6	73.5	83.7	84.7	103.4	114.7	120.4	127.6	42	51.5	57.2	62.1	68.3	30.1	54.1	62.2	76.8	83.2	10.8	12.3	14.8	17.5	18.1	256	94.3
Patuakhal	Galachipa	467.8	468.5	468.6	469.1	469.5	236.5	236.9	237.6	237.8	238.3	265.9	265.6	265.4	265.3	265.5	169.9	169.8	169.9	170.1	170.5	105	105.3	105.8	105.9	106	972	276
																										Total	3004	1197

* Number of Bullock includes bullock + milch-cow

The above data were collected by the Junior Specialists from different thanas of the MES Project during April to June, 1997.
The Char Montaz and Rangabali moujas of Galachipa thana have high number of buffaloes.

Average number of livestock pr. total amount of household (

Thana																										Cattle	Go + Sh
Sandwip*	0.00	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.23	0.00	1.16	0.56
Hatia	0.41	0.40	0.40	0.40	0.45	0.36	0.36	0.37	0.43	0.48	0.15	0.16	0.18	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.71	0.72	0.75	0.74	0.99	0.75
Char Fasson	0.54	0.53	0.52	0.51	0.50	0.26	0.25	0.25	0.24	0.24	0.39	0.38	0.38	0.37	0.36	0.19	0.19	0.19	0.18	0.18	0.13	0.13	0.13	0.13	0.12	1.13	0.31
Manpura	0.47	0.62	0.67	0.72	0.79	0.95	1.11	1.18	1.18	1.20	0.47	0.55	0.59	0.61	0.64	0.34	0.58	0.64	0.76	0.78	0.12	0.13	0.15	0.17	0.17	2.52	0.93
Galachipa	0.94	0.92	0.90	0.89	0.87	0.47	0.47	0.46	0.45	0.44	0.53	0.52	0.51	0.50	0.49	0.34	0.33	0.33	0.32	0.32	0.21	0.21	0.20	0.20	0.20	1.84	0.52

Overall average for 1994-95 (300400/224943) 1.34
Overall average for 1994-95 (119710/224943) 0.53

Number of households in selected Thanas

	Y 1991	Y1992	Y1993	Y1994	Y1995	
Sandwip	45970	46108	46246	46385	46524	Sandwip 0,3%
Hatia	45389	46259	47142	48036	48943	Adjusted
Char Fasson	63740	64962	66201	67457	68731	Adjusted
Manpura	8959	9345	9748	10168	10606	Manpura 4,31%
Galachipa	49982	50940	51912	52897	53896	Adjusted
	214040	217614	221249	224943	228700	

Note: 1991 figure is from BBS, 1992-1995 has been adjusted according to the population growth in the area. Total population growth rate of the estuary has been estimated by MES to 1.67%. For Sandwip Thana 0.3% and for Manpura Thana 4.31%. The individual growth rate for Sandwip and Manpura has been used in the calculation and for the other Thanas the total growth adjusted accordingly.

Crop Losses in Different Thanas by Natural Calamities during 1991-96

(Area in acres)

District	Thana	1991-92					1992-93					1993-94					1994-95					1995-96				
		Aus	Aman	Boro	Rabi	TOTAL	Aus	Aman	Boro	Rabi	TOTAL	Aus	Aman	Boro	Rabi	TOTAL	Aus	Aman	Boro	Rabi	TOTAL	Aus	Aman	Boro	Rabi	TOTAL
Patuakhali	Galachipa	850	8792	50	12	**9704**	160				**160**	175	3947	142		**4264**	350	1300			**1650**	430		230		**660**
Bhola	Char Fasson	861	538	195		**1594**	175	538	39		**752**	253	813	63		**1129**	320	1012	76		**1408**					**0**
Bhola	Manpura	520	9515		2851	**12886**	1350	9595		3561	**14506**	1000	10225		6455	**17680**	900	10220		7325	**18445**	1100	10210		7040	**18350**
Chittagong	Sandwip	8168				**8168**	8377	18500			**26877**	7100	20500	20	915	**28535**	6225	20450	15	1724	**28414**	6525	20650		98	**27273**
Noakhali	Hatia					**1259**					**31257**					**31282**					**38099**					**17563**
TOTAL		**10399**	**18845**	**245**	**2863**	**33611**	**10062**	**28633**	**39**	**3561**	**73552**	**8528**	**35485**	**225**	**7370**	**82890**	**7795**	**32982**	**91**	**9049**	**88016**	**8055**	**30860**	**230**	**7138**	**63846**

Note : The HYV and local varieties of Aus, T.Aman paddy and Rabi crops like Boropaddy, vegetables and pulses were lost by flood, cyclone, salinity and pest attack. These losses have not been segregated according to individual factors. Figures were collected by the MES field staff from thanas during April to June, 1997

	1991 - 96 (excl. Hatia)			
	Area (acres)	Damaged (acres)	%	
Total Aus	250927	44839	17.9	mainly due to soil and water salinity and lack of rain/irrigation
Total Aman	1405275	146805	10.4	mainly due to water-logging and pest attack
Total Boro	56716	830	1.5	mainly due to lack of rain/irrigation and soil salinity
Total Rabi	312002	29981	9.6	mainly due to soil salinity, and pest attack and lack of irrigation
	2024920	222455	11.0	
Total Hatia	1083290	119460	11.0	
Total area	3108210	341915	11.0	

Crop areas in different thanas during 1991-92 to 1995 -1996

(Area in acres)

District	Thana	1991-1992					1992-93					1993-94					1994-95					1995-1996				
		Aus	Aman	Boro	Rabi	Total	Aus	Aman	Boro	Rabi	Total	Aus	Aman	Boro	Rabi	Total	Aus	Aman	Boro	Rabi	Total	Aus	Aman	Boro	Rabi	Total
Patuakhali	Galachipa	4577	175844	7500	37163	225084	16363	158411	7148	41341	223263	17685	158414	7100	41783	224982	12858	164426	7022	42288	226594	12473	158438	7024	42226	220161
Bhola	Char Fasson	17221	53852	3906	6092	81071	17536	53803	3985	6086	81410	16890	54205	4218	6022	81335	16776	53898	4327	6145	81146	16550	53220	4400	6037	80207
Bhola	Manpura	1284	23502		7042	31828	3334	23699		8795	35828	2470	25255		15944	43669	2223	25243		18093	45559	2717	25219		17389	45325
Chittagong	Sandwip	20249				20249	20691	45695			66386	17537	50635	49	5019	73240	15376	50511	37	4295	70219	16117	51005		242	67364
Noakhali	Hatia	53478	111199		41570	206247	62997	112550		26999	202546	43595	110903		41575	196073	79040	111422		44129	234591	83214	106630		53989	243833
	Total	96809	364397	11406	91867	564479	120921	394158	11133	83221	609433	98177	399412	11367	110343	619299	126273	405500	11386	114950	658109	131071	394512	11424	119883	656890

Source: Estimates were collected by the MES field staff from thanas during April - June, 1997

Common Insect Pests of Rice in Bangladesh

Insect pest	Bengali name	Pest affected countries	Severely pest-affected greater districts	Pest firstly detected	Crops mainly affected	Crops less affected	Other crops affected	Crop injury	Pest major/ minor	Period of infestation	Commonly used insecticides	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13
Rice stem borer	Majra Poka	Thailand, Nepal, Pakistan, India	Barisal, Chittagong, Dhaka, Faridpur, Khulna, Noakhali, Mymenshingh	India-1992 BD-1974	T. Aman, Aus	Boro	DW Aman, Sugercane, Sorghum, Maize, Millet	Larvae feed on leaf sheath and bore into rice stem, causing dead heart and whitehead.	Major-1	Sept-Nov May-June	Diazinon Azodrin, Furaden, Dimecron, Endin, Parathion, Sevin, Sumithion	In saline soils T. Aman is affected in Oct-Nov
Rice green leaf hopper	Sabuj Pata Foring	Thailand, Nepal, Pakistan, India	Mymenshingh, Bogra	Pabna & Dhaka-1908, Noakhali-1914	T. Aman, Aus	Boro	Grasses, weeds, water hyacinths	Insect mainly feeds leaf and leaf sheath, thus reducing vigor of the plant and decrease no. of tillers.	Major-2	Apr-Oct	Dimecron, Sevin, Melathion, Lebaycid, Diazinon, Folithion, Sumithion, Imidin, Ambithion,	-
Ear cutting caterpillar	Siskata, Leda Poka	Russia, Far East, Australia, Newzeland, Japan, Manchuria, South & Southeast Asia.	Comilla, Barisal, Noakhali, Mymenshingh, Dhaka, Sylhet, Chittagong, Rajshahi, Faridpur, Pabna.	India-1914 Mymenshingh & Chittagong-1919	T. Aman B. Aman	-	Sorghum, Gram-Maize, Wheat, Grass	Insect causes damage of the young crop at the time of heading. 2 plants are destroyed by 1 insect in a night.	Major	Aug-Nov	Melathion, Sevin, Bidrin, Lebaycid, Chlordane, BHC Aldrin, DDVP	Severe infestation in water-logged areas, serious outbreaks occured several times in coastal and offshore islands in Oct & Nov.
Rice Hispa	Pamri Poka	Philippines, Indonesia, India, Pakistan	Barisal, Sylhet, Noakhali	Barisal-1906 Sylhet-1912 Noakhali-1913	Aus	Boro, T.Aman, DW Aman	Grass	Insect feeds leaf tissues, causing white streaks with sun-burnt apperance. Damage starts from top to bottom of the leaf of young plants, thereby stunting and weakening of the crop.	Major	Feb-Aug (Max: May-June)	Bidrin, Lebaycid, Thiodan, Folithion, Sumathion.	--

Insect pest	Bengali name	Pest affected countries	Severely pest-affected greater districts	Pest firstly detected	Crops mainly affected	Crops less affected	Other crops affected	Crop injury	Pest major/ minor	Period of infestation	Commonly used insecticides	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13
Rice leaf folder/ roller	Pata Morano Poka	South and South-east Asia, Japan, Madagascar, India	Sporadic attack in some areas	Eastern India-1917, BD-1957	Aus	T.Aman		Leave attack leaf blade, make leaf roller, produce large white area with no chlorophyll, causing the leaf to dry down.	Minor	May-Oct (Max: Jul-Aug)	Bidrin, Dimecran, Lebaycid, Thiodan, Folithion, Sumathion, Diazion, Carbicron.	
Rice swarming caterpillar	Leda Poka	South-east Asia, Sikkim, Japan, China, Hawai, Austrilia, W. Africa, Tanjania, Madagaskar, Bahrein, Mauritania	Sporadic attack in some areas		Aus	Boro, T. Aman		Insect feeds on leaf. After finishing the crop in the field, it moves to the other field.	Major	Apr-Oct (Max: Jun-Aug)	Endrin, BHC, Melathion, Sevin, Bidrin, Lebaycid	Seedbeds are seriously damaged.
Rice case worm	Chungi Poka	W. Africa, Congo, Rawanda, Burundi, Mozambique, Malawi, Madagascar, Indonesia, Philippines, Brazil, India, N.Australia, Uruguay, Venezuela.	Spordic attack throughout the country	Eastern India-1917	T. Aman, B.aman			Insect cuts leaves, forms tubes or cases & remain inside & feed on foliage. The insect with its case is detached from the rice plant, floats on water and moves from plant to plant. Leaves are preforated and plants become weak and die.	Minor	July-Oct (Max: Sept - Oct)	Lebaycid, Follithion, Bidrin, Dimecron.	Young plants are attacked in wet seedbed and newly T.Aman fields.
Rice mealy bug	Chatrak Poka	India, Nepal, Pakistan, Burma, Malaysia, Thailand, Philippines, Cuba.	Comilla, Chittagong, Mymenshingh, Tangail, Rangpur.	Estern India-late 19th century. Comilla, Chittagong-1957	Aus			Insect attacks stemes & sucks the plant sap, thereby making leaves yellow & stunted and plants become weak.	Major	Apr-Aug (Max: Jun-Aug)	Melathion, Diazinon, Dimecron, Lebaycid, Polythion.	Prolonged drought with moderately high temp. cause out-break of the insect.

Insect pest	Bengali name	Pest affected countries	Severely pest-affected greater districts	Pest firstly detected	Crops mainly affected	Crops less affected	Other crops affected	Crop injury	Pest major/ minor	Period of infestation	Commonly used insecticides	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13
Rice bug	Gandhi Poka	South and South-east Asia, Estern Pacific Region, inc N. Australia and Fiji	Rangpur, Dhaka Comilla, Mymenshingh, Chittagong, Noakhali	India-1912 Rangpur, Dhaka, Comilla & Mymenshingh-1919	Aus	Aman, Boro	Millets Grasses	Damages rice crop by sucking the milky dough from developing grains, thus preventing grain formation.	Major	Apr-Oct (Max: May - June)	Bidrin, Lebaycid Sevin, Melathion, Sumithion, Imidan, Folithion, Accothion.	
Rice gall midge	Gall Machi	South and south-east Asia, Several Asian countries	Chittagong, Noakhali, Comilla, Sylhet, Dhaka, Mymenshingh, Rajshahi, Jessore.	India-1880 Bengal-1917	Aus, T. Aman	Boro	Grasses	The hollow out-growth by larva from an affected stem does not produce an ear and do not produce heads. After emergence of the midge, the gall gradually dries up and decays	Major	Apr-Oct (Max: Jun-Sept.)	Dieldrin, Diazinon, Lebaycid, Bidrin, Dimecron, Carbicron,	Local varieties of rice are resistrant to the insect attack, HYV crops are severely attacked due to long duration. Plants in water severly attacked than in dry land.

Source: Literature Review of Insect Pests and Diseases of Rice in Bangladesh - published by Bangladesh Rice Research Institute, Joydepur, Dhaka in November 1977.

Rice Disease in Bangladesh

Causal agent		Disease	Severely affected greater districts	Affected parts of plants	Crops mainly susceptible	Period of infestation	Main symptom	Chemicals to used	Remarks
1.	Virus	Tungro	Comilla, Chittagong, Bogra, Dhaka, Dinajpur, Mymenshingh, Rajshahi	Whole plant	Most Aus crops, IR-5, IR-8, BR-2, China	Apr-Dec	Yellow or orange-yellow color of leaves, growth stunted, leaves slightly rolled upwords, root length reduced & rotten in extereme case, flowering delayed, no grain formation.	Diazinon, Dimecron, Sevin	Green leaf hopper a vector insect. Virus not trainsmitted through seed, soil or by mechnical means except proper vector. Low temp. develops symptom.
		Yellow dwarf	Sporadic in different districts	Whole plant	Most Aus crops affected, Ratoon crops mostly affected.	Apr-Dec	Chlorosis (pale yellow) of mostly new leaves, plants severely stunted. No grain in affected crops.	Same as above	Green leaf hopper a vector insect. Not known if virus transmitted through seed, soil or by mechanical means.
2.	Becterial	Bacterial leaf blight	All districts except northern and coastal districts.	Leaf and sometimes whole plant	Aus and T.Aman	Mar-Nov	Bacteria enters through roots, leaves and tissues, blocks transpiration, and causes wilting.	Celdion, Benlate, New Sankel	Boro unaffected by cold weather, B.Aman unaffected by low soil moisture. HYV rice highly susceptible to disease.
		Bacterial leaf streak	Sporadic all - over country.	Leaf and grain	Most HYV Aus (BR-1, BR-2)	Mar-Nov	Appear yellowish or orange streaks on leaves, light visible through affected leaves.	Celdion	Most local Aus varieties resistant. Severity decreases as plants grow older. Heavy rain and storm greatly increase incidence.
3.	Fungus	Sheath blight	Sporadic throughout the country	Leaf sheath and leaf.	HYV Aman	Jun-Nov (Max: Jun-Aug).	Attacks leaf & grain are attacked. Bluish-grey spots on leaf sheath, finally a cobra skin appeared. In sever case panicles fail to emerge.	Validamycin	Many tall local varieties of three rice crops more resistant than dwarf & high tillering varieties. Water hyacinth a host for this disease.
		Brown spot	Northern districts	Leaf, leaf sheath and grain	All Aman varieties (Aus varieties less susceptible)	Apr-Dec	Infection starts from seed or soil. Brown spots appear on leaves, leaf sheaths.	Granosan M, Agronan, Dithane.	Continuous heavy rainfall, soil temp, below 26°C, high relative humidity above 90%, 7 or hours of cloudy sky develop disease. Cultural meaures like, stubble burning, furtilizer application, irrigation & use of healthy seed prevent disease.
		Foot rot (bakanea)	Sporadic throughout the country	Mainly stem base, whole plant and grain.	Aus, Aman and Boro	Apr-Dec	Infected seedbeds and seedlings elongated, pale, green and sickly by bakanae infected plants usually not survive. Foot rot affects nodes and internodes and plant within 1 week damaged.	Agrosan GN /M, Uspulun, Homai, Vitavax-Thiram	First detected in BD in 1953. Seed borne fungus affects seedlings. Fungus survive in soil for more than 3 months. HYV crops severely attacked. Symptom develops below 20°C.

	Causal agent	Disease	Severely affected greater districts	Affected parts of plants	Crops mainly susceptible	Period of infestation	Main symptom	Chemicals to used	Remarks
3.	Fungus	Blast	Sporadic outbreak all over Bangladesh.	Leaf, leaf sheath, node, panicle	Aus, Aman, (Boro, DW Aman)	Apr-Dec	Blush-green spotted leaves die. Nodes become black and rotten, causing plants to die. Neck blast stops filling grains and reduces yields.	Granosan-M, Balsticidin S, Kasumin, Copper oxychloride.	In 1913 blast detected in Bangal. Boro & Aus crops during Apr-May affected if scanty rain and high humidity prevail. Disease prevalent in Aman season if heavy dews drop and soil is dry. More N-fertiliser application develops disease. During drought in Aus & Aman incidence higher. Leaf infection during seedling stage severely damages plant. Blast disease a serious problem in Japan, Philippines and other rice-growing countries.
		Leaf scald	Same as above	Leaf and leaf sheath	Aman, Aus (Boro)	June-Dec.	Attack leaves of seedlings and mature leaves. Lesions usually appear on leaf tips. Lesions become olive-coloured. Sometimes middle of the leaf dries out. Affected sheath assumes brownish color. Finally whole plant dies.	Same as above	Disease first found in BD in 1972. Steadily increasing throughout the counrty.
		Stem rot	Same as above	Leaf sheath and stem	Aman (Aus & Boro)	Oct-Dec	Sheaths & stems rotten at lower internodes. Affect many tillers. Affected grains & ears become light in weight.	Same as above	The disease first detected in Italy in 1876, in Noakhali dist. in 1973. Stagnant water in Aman field develops disease. Excess N and lack of K encourage infection.
		Sheath rot	Same as above	Sheath enclosing emerging ears	Mostly HYV crops in all seasons	Apr-Dec	Lesions on leaf sheath start enlarging & showing brown margin, sometimes covering the whole sheath. Prevents panicle iniciation, grains discolored. Whitish color often found in affected sheath.	Same as above	At first detected in BD in 1973.
4.	Neamatode	Ufra	Barisal, Comilla, Dhaka, Faridpur, Jessore, Khulna, Noakhali, Patuakhali, Sylhet.	Sheath & ear	Mostly in DW Aman	Aug-Dec	Yellowish or reddish-brown dots on affected leaves, sheaths, panicles. Grains completly empty and wrinkled.	Furadan, Benlate.	First detected in Bangladesh 1923. Nematode cannot survive if stubbles uprooted and field submerged for several months.
		Root knot		Root	DW Aman and Boro	Aug-Dec.		Same as above	First detected in BD in 1960.
		White tip		Leaftip	DW Aman and Boro	Aug-Dec.	Root discolored reddish brown and growth stunted.	Same as above	Flooding may control disease.

Source: Literature Review of Insect Pests and Diseases of Rice in Bangladesh - published by Bangladesh Rice Research Institute, Joydepur, Dhaka in November 1977.