Cultivation of Saline Tolerant Rice Varieties in the Coastal Area to Cope With Salinity in Protapkathi, Paikgacha, Khulna, Bangladesh

Summary of the Practice

Key words: Saline tolerant (submerged) rice varieties, livelihood options, sustainable development, popular and effective use, traditional/indigenous knowledge and practices.

Strategy: Promoting local/indigenous knowledge-based sustainable resource management

Environmental Areas: Rural environment

Critical Instruments: Awareness/capacity building, Organisational arrangements

Country: Bangladesh

Location: Protapkathi, Paikgacha, Khulna (Southern district), Bangladesh

Participants: Individual villagers and families, community dwellers

Duration: More than one hundred years

Funding: None

Background:

Bangladesh is a country of diverse geography with variations in water quality, topography of the land and structure of the soil.

The study area was the village of Protapkathi, in Paikgacha upazila in the Khulna district. It is situated in the southern part of Bangladesh. Since the village is adjacent to the coastal area, the water in the village is saline. Tidal fluctuations are common in the area.

\[\text{Study area}\]

In Bangladesh, coastal areas constitute about 2.5 million hectares which amount to about 25 percent of the total cropland of the country. Of this, nearly 0.84 million hectares are affected by varying intensities of salinity, resulting in very poor land utilization (Karim et al, 1990). Most of the southern districts of the country are under saline zones, which cover an area of 25-30 percent of the total arable land (Quazi et al, 1996). The average crop yield is very low in the region, which is obviously due to salinity problems, low soil fertility and drought in the dry season. The dominant crop in the coastal area is the local T-Aman rice. Although rice is the predominant crop of Bangladesh, modern rice cultivars tolerant to saline soils are few in number.

The people of that area have been cultivating saline tolerant rice varieties for more than 100 years. The farmers of the coastal region usually cultivate traditional varieties and harvest about 2.0-2.5t/ha/year. In 1965, the East Pakistan Water Development Board (EP-WDB) constructed an embankment on the outer side of the village of Protapkhal to protect the village from tidal fluctuations. The inner side of the embankment was used at that time for cultivating indigenous rice varieties. After the introduction of the HYV Aman varieties, they started to cultivate the HYV also. But in 1985, the influential people of the area constructed a sluice gate with the help of the Bangladesh Water Development Board for shrimp cultivation. This allowed saline water into the shrimp fields on the inner side of the embankment. Since then shrimp is replacing rice cultivation, and having a negative impact on rice cultivation because of the increased salinity, generally not suitable for rice. Since 1985, the number of shrimp farms, or shrimp
culture areas have been increasing and the whole area becomes submerged with saline water more or less year round. Though the number of shrimp farms is increasing day by day, the poor people of the Protapkathi village cannot become part of that economy because of the huge financial investment required. Hence they continue to cultivate rice. They cultivate 13 local varieties of rice in their fields, varieties which are saline tolerant and especially suited to the present circumstances to the area. These rice varieties include Jotabalam, Ashfall, ghunshi and Benapol. Other varieties are also cultivated in other fields away from the shrimp farms.

**Objectives:**

The main objectives of the people in the study area of Protapkathi under Paikgacha Upazila are to cultivate local/traditional rice varieties for production in the saline and submerged areas using their local knowledge and practice, without disrupting the existing shrimp farms.

**Description of the activity:**

The people of Protapkathi area have been cultivating saline tolerant T-Aman rice varieties for nearly 100 years. Though the yield of these local varieties is very poor, the people continue planting them because of their suitability to the area. In the early 1980’s the people of the area also started to cultivate the BRRI dhan40 and 41.

After the introduction of shrimp farming, the water in the village became extremely saline (>6dS/meter). The farms were water logged all year round. Perennial water logging due to inadequate drainage and faulty operation of sluice gate facilities restrict the possible land uses. In these areas, unauthorized digging of channels for intake of saline water for shrimp culture also creates many social conflicts.

Due to high salinity levels, it is difficult to cultivate any HYVs, such as HYV aman and HYV aus. As a result, people continue to cultivate the local varieties because they perceive them to be not only saline tolerant, but they also have greater plant height, comparatively low planting costs, are tasty and above all are easily manageable. Since the introduction of shrimp farming and the subsequent reduction in areas under agriculture, there is a fodder shortage, the rice straw upon which the people depend entirely. The local rice varieties are categorized according to their different land types, such as for the shrimp farms and for other agricultural land. Jotabalam and Ghunshi varieties are selected for cultivation in the shrimp farms. Ashfall and Benapol varieties have the same qualities as the two above but they are destined for other agricultural farms. Jotabalam has the highest yield among them. The advantage of these varieties is that they require no irrigation and ploughing, because the shrimp farm ensures water for a long period of time and the soil becomes comparatively loose and muddy. In the Aman season people use different techniques for cultivating Aman rice within the shrimp farm. The shrimp farmers dig burrows to preserve the shrimp during the dry period, and therefore the rice cultivation does not harm the shrimp. After harvesting the rice, the people cultivate the other varieties in other fields rather than in the shrimp field. The people select the rice varieties by assessing the production, consumption, distribution and existing marketing facilities, while also taking into account the nutrient value of the produce.

**Critical Instruments**

**Overview**

Rice is grown on about 10.71 million hectares of land in Bangladesh (BBS 2000). Rice provides about 71 percent of the total calories and 51 percent of the protein intake of the people’s diet (BBS, 1998). The modern rice varieties cover about 62 percent of the total rice areas, which contribute to about 77 percent of the total rice production of the country. Area covered by modern varieties of rice is about 33, 48 and 98 percent for the Aus, Aman and Boro seasons, respectively. Thus it is clear that there is ample scope and need for expansion of the modern varieties particularly in the Aus and Aman seasons. In the coastal regions, about one million hectares of land are affected by soil salinity in varying degrees. Crop production in these areas is dominated by the traditional T-Aman rice with yields of about 2 t/ha. During
the monsoon, salinity levels usually remain low (2-6dS/m EC) and these varieties may eventually replace the traditional varieties.

Rice production is vital to Bangladesh’s economy, as it contributes about 50 percent of the total agricultural value and employs over 65 percent of the total agricultural labour force. Rice production continues to be one of the important sources of livelihood, accounting for 76 percent of the people’s average calorie intake (BBS, 1996). The experience of technological change has significantly contributed to the growth of rice production during the last couple of decades. In Bangladesh, people have been pursuing their livelihood by adopting their own beliefs and knowledge. This is actually the conventional practice which is feasible for their family and community lives. Their manner of coping with the saline water is one such good practice. They also practice shrimp and rice farming together because there are some problems related to cultivating the HYV. The HYV rice cultivation requires fresh water irrigation, but their irrigation system is not enough in the study area because the fresh water layer is about 1500 feet deep and it is costly to pump water. The existing salinity levels in the area are higher than can be tolerated by the HYVs. Normally, the soil where the salinity range is 4ds/meter or more is termed saline soil. In Bangladesh, there are 13 coastal districts and 833,000 hectares of land which are saline affected. Saline soils can be divided into different groups depending on their salinity levels, namely, low, medium, normal and high. Plant growth is generally lower in saline areas than in fertile land.

**Land area in the coastal region:**

<table>
<thead>
<tr>
<th>District</th>
<th>Saline area (thousand hectares)</th>
<th>District</th>
<th>Saline area (thousand hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satkhira</td>
<td>146</td>
<td>Vola</td>
<td>40</td>
</tr>
<tr>
<td>Khulna</td>
<td>120</td>
<td>Chittagong</td>
<td>46</td>
</tr>
<tr>
<td>Bagerhat</td>
<td>108</td>
<td>Cox’s bazaar</td>
<td>55</td>
</tr>
<tr>
<td>Barguna</td>
<td>103</td>
<td>Noakhali</td>
<td>50</td>
</tr>
<tr>
<td>Patuakhali</td>
<td>115</td>
<td>Laxmipur</td>
<td>19</td>
</tr>
<tr>
<td>Pirojpur</td>
<td>20</td>
<td>Feni</td>
<td>09</td>
</tr>
</tbody>
</table>

**Total**                                          833,000

**Source: Soil science division, BRRI, 2004**

The quality of nutrition in the soil fluctuates in the saline area. For that reason, the yields also fluctuate. Integrated fertilizer management recommends the application of chemical and organic fertilizer (manure) for better crop yields. The people of the area have been cultivating the local varieties following this system while also modifying their approach according to their knowledge and experience.

In line with the salinity the land could be divided into the following:
<table>
<thead>
<tr>
<th>Land classification (basis on salinity)</th>
<th>Salinity (ds/meter)</th>
<th>Saline area (thousand hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low saline</td>
<td>2-4</td>
<td>287</td>
</tr>
<tr>
<td>Medium saline</td>
<td>4-8</td>
<td>426</td>
</tr>
<tr>
<td>Normal saline</td>
<td>8-16</td>
<td>80</td>
</tr>
<tr>
<td>High saline</td>
<td>&gt;16</td>
<td>40</td>
</tr>
</tbody>
</table>

Source: Soil science division, BRRI, 2004

**Awareness/capacity building**

There is no official awareness and capacity building program to promote this practice. People do it as their own choice. Though this is a need-based activity, its sustainability requires awareness and some technical involvement to increase the yield. The people want to continue the practice by community arrangement and with the help of outside organizations.

**Organisational arrangements**

There exists some kind of organisational arrangement for practicing the combined shrimp/rice farming system. Sometimes the owners of the shrimp farm lease their land to the middle class and the marginal farmers for rice cultivation after the end of the shrimp season. There are some traditional rules and regulations for leasing. The owners lease the farm during the Aman season since the farm dries out at this time and is no longer suitable for shrimp farming. In return for use of the farm, the lessee has to give a certain proportion of the total rice yield to the shrimp farm owners. This is an oral agreement. The people in the study area have been practicing this system for a very long time.

The people of the village reported that the practice has a wide range of usefulness including socio-cultural and socio-economic benefits. The people believe that it helps to strengthen their social and communal harmony in the study area. Rice cultivation enhances the quality of the overall environment and the ecology of the area. The farmer community in the study area insisted that, if the government or other organisations helped them in their local rice cultivation, it would benefit them even more.

**Impacts**

The people of the area have been getting better results by cultivating the local rice varieties. The price of the local rice is always higher than the HYV because of its milling quality as well as its taste. It is also more environmentally sound because it requires less fertilizers and pesticides, thus also minimizing production costs. By practicing the Shrimp/Rice Farming System and selecting saline tolerant varieties, the people of the area have been getting more benefits from the same land by integrating local rice varieties with shrimp farming. It also has a positive impact on their society. The people become closer to each other by their activities of exchanging rice seeds and obtaining money when required.

**Lessons Learned**

The people of the study area have been practicing shrimp-rice-cultivation for generations using their own methods and community wisdom. They have modified and adapted the techniques as a coping strategy to deal with the problem of salinity. They are familiar with local varieties since these have many positive characteristics. The taste, price and milling value are better than that of the HYV varieties. A scientific
study also found that the local varieties have other appreciated qualities as listed in the appendix. These qualities have been assessed by analyzing the passport data and the physiochemical properties of local rice varieties.

**Potential for Application**

This practice is helpful in areas which face salinity problems, in fact in most parts of the country. It can also be useful for other countries where agriculture is practiced in areas having saline soils. The people in the study area have adopted these agriculture techniques by modifying and using their own local knowledge.

**Contact**

Sukanta Sen  
Director  
**BARCIK** - Bangladesh Resource Centre for Indigenous Knowledge  
3/7 Block-D, Lalmatia, Dhaka, Bangladesh  
Tel/Fax: +8802 9132 372  
E-mail: barcik@bdonline.com

**Case reviewer:** Md. Kamruzzaman; Senior Researcher, Md. Assaduzzaman; Research Fellow, **BARCIK**  
**Information date:** June 2004
APPENDIX
Physicochemical properties of some local rice varieties:

Table 1

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Ref No</th>
<th>Variety/Line</th>
<th>Milling outturn (%)</th>
<th>Head rice (%)</th>
<th>Chalkiness</th>
<th>Appearance</th>
<th>Length mm</th>
<th>Breadth mm</th>
<th>L/B ratio</th>
<th>Size &amp; Shape</th>
<th>Amylose (%)</th>
<th>Protein* (%)</th>
<th>Cooking time (min)</th>
<th>ER</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>Jota bala</td>
<td>67.0</td>
<td>57.0</td>
<td>Wb₁</td>
<td>Good</td>
<td>5.6</td>
<td>2.6</td>
<td>2.2</td>
<td>MB</td>
<td>28.8</td>
<td>8.0</td>
<td>17</td>
<td>1.6</td>
<td>3.4</td>
</tr>
<tr>
<td>2</td>
<td>43</td>
<td>Ghunshi</td>
<td>69.0</td>
<td>86.0</td>
<td>Wb₃</td>
<td>Good</td>
<td>4.5</td>
<td>2.7</td>
<td>1.7</td>
<td>SR</td>
<td>26.4</td>
<td>8.1</td>
<td>23</td>
<td>1.7</td>
<td>4.0</td>
</tr>
<tr>
<td>76</td>
<td>39</td>
<td>Ashfal</td>
<td>65.0</td>
<td>86.0</td>
<td>Wb₅</td>
<td>Good</td>
<td>5.4</td>
<td>2.3</td>
<td>2.3</td>
<td>MB</td>
<td>28.6</td>
<td>10.3</td>
<td>23</td>
<td>1.7</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Notes:
ER= Elongation ratio, IR= Imbibitions ratio

**Size and Shape:** MB= Medium bold, SR= Short round, SB=Short bold, LS= Long slender, MS= Medium slender, LB= Long bold

**Chalkiness:** Wb= White belly, We= White center, Tr= Translucent
Table 2: Passport data of rice varieties

<table>
<thead>
<tr>
<th>Ref. No.</th>
<th>Variety name</th>
<th>No. of Utpazia reported</th>
<th>No. of samples collected</th>
<th>Environment</th>
<th>Area (%)</th>
<th>Land type</th>
<th>Season</th>
<th>Source of the seed</th>
<th>Plant ht (cm)</th>
<th>No. of Panicles/ hill</th>
<th>Maturity (days)</th>
<th>Husk color</th>
<th>Brown rice color</th>
<th>Brown rice length</th>
<th>Special feature</th>
<th>Special use (%)</th>
<th>Remarks and unique name of the variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jota balam</td>
<td>6</td>
<td>44</td>
<td>1,2,3, 4,5,6, 7</td>
<td>33</td>
<td>F1, F2, F2</td>
<td>T. Aman</td>
<td>Farmer’s home</td>
<td>132</td>
<td>18</td>
<td>166</td>
<td>Black</td>
<td>Dull white</td>
<td>Medium</td>
<td>Submergence</td>
<td>Pitha, Muri</td>
<td>Short panicle, Rice looks like matted hair</td>
</tr>
<tr>
<td>2</td>
<td>Gunshi</td>
<td>3</td>
<td>3</td>
<td>1,2,3, 4,5,6, 7</td>
<td>20</td>
<td>F1, F2</td>
<td>T. Aman</td>
<td>Direct from the Field</td>
<td>140</td>
<td>16</td>
<td>207</td>
<td>Straw</td>
<td>Red</td>
<td>Medium</td>
<td>Submergence</td>
<td>Pitha, Khoi</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ashfol</td>
<td>3</td>
<td>3</td>
<td>1,2,3, 4,5,6, 7</td>
<td>2</td>
<td>F1, F2</td>
<td>T. Aman</td>
<td>Farmer’s home</td>
<td>142</td>
<td>25</td>
<td>177</td>
<td>Straw</td>
<td>Red</td>
<td>Medium</td>
<td>Submergence, Saline tolerant</td>
<td>Khoi, Muri</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Benapole</td>
<td>3</td>
<td>13</td>
<td>1,2,3, 4,5,6, 7</td>
<td>14</td>
<td>F1, F1, F2</td>
<td>T. Aman</td>
<td>Farmer’s home</td>
<td>119</td>
<td>18</td>
<td>158</td>
<td>Dark brown</td>
<td>White</td>
<td>Medium</td>
<td>-</td>
<td>Pitha, Khoi, Muri</td>
<td>Nine farmers opined this rice like as Horibhog</td>
</tr>
</tbody>
</table>

Source: IRRI-PETRA Project, 2004

Notes:

N.B. Reference number indicates the number used by IARD in compilation of data from passport data collection form.

Environment: 1=Sweetwater, 2=Shrimp (Golda), 3= Water logged (Partial), 4= Shrimp (Bagda), 5= Saline+Bagda, 6= Semi saline, 7= Saline

Land type: F1= Highland, (30cm flooding), F2= Medium highland, (30-90 cm flooding), F3= Medium lowland (90-180 cm flooding), F4= Lowland, (180-300 c, flooding), F5= Very lowland, 300 cm flooding).

Grain length: For the dehulled grain, Long= (6.6 to 7.5 mm), Medium (5.51 to 6.6 mm), Short (5.5 mm or less)

    LB= Long and bold, LM= Long and medium, LS= Long and slender, SS= Short and slender, R= Round (IARD).