

# **Adaptation Strategies and Coping Mechanism Against Climate Change in Coastal Bangladesh**

**M. Shahe Alam**

**M.A.Islam**

**T. Paris**

**Amie Cueno**

# Outline of the presentation

- Background
- Objectives
- Methodology of the study
- Discussion of socioeconomic study results
- Conclusions

# Background

- Coastal and off-shore area in Bangladesh constitute 2.65 million ha.
- 0.85 million ha affected by varying degrees of salinity.
- Traditional aman(wet season) rice is the main crop followed by dry season rice.
- BRRI recently developed BRRI dhan47 for the salinity areas.



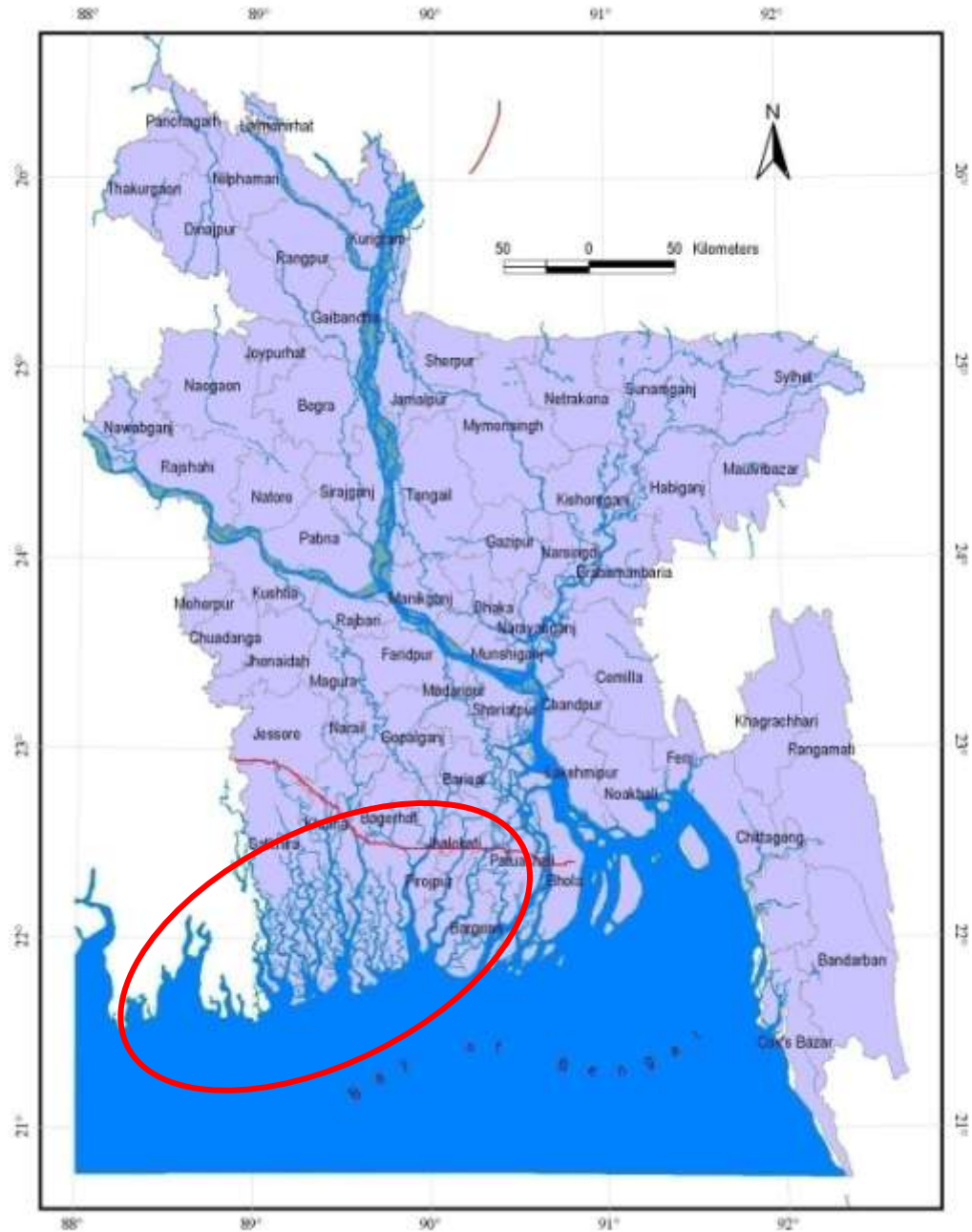
# Background



# Rice Economy of Bangladesh

<b>Net cropped area (mill. ha)</b>	<b>7.79</b>
<b>Total rice area (million ha)</b>	<b>11.27</b>
<b>Coastal and off-shore area (million ha)</b>	<b>2.65</b>
<b>Total area under salinity</b>	<b>0.85</b>
<b>Area going out of Agriculture (% /annum)</b>	<b>1.1</b>
<b>Total population (million)</b>	<b>150</b>
<b>Population growth rate (in %)</b>	<b>1.38</b>
<b>Additional demand for rice (million ton /yr)</b>	<b>0.60</b>
<b>Coverage of modern rice varieties ( %)</b>	<b>77</b>
<b>Coverage of irrigated rice (million ha)</b>	<b>4.8</b>
<b>Share of rice to the cereal consumption (%)</b>	<b>96</b>





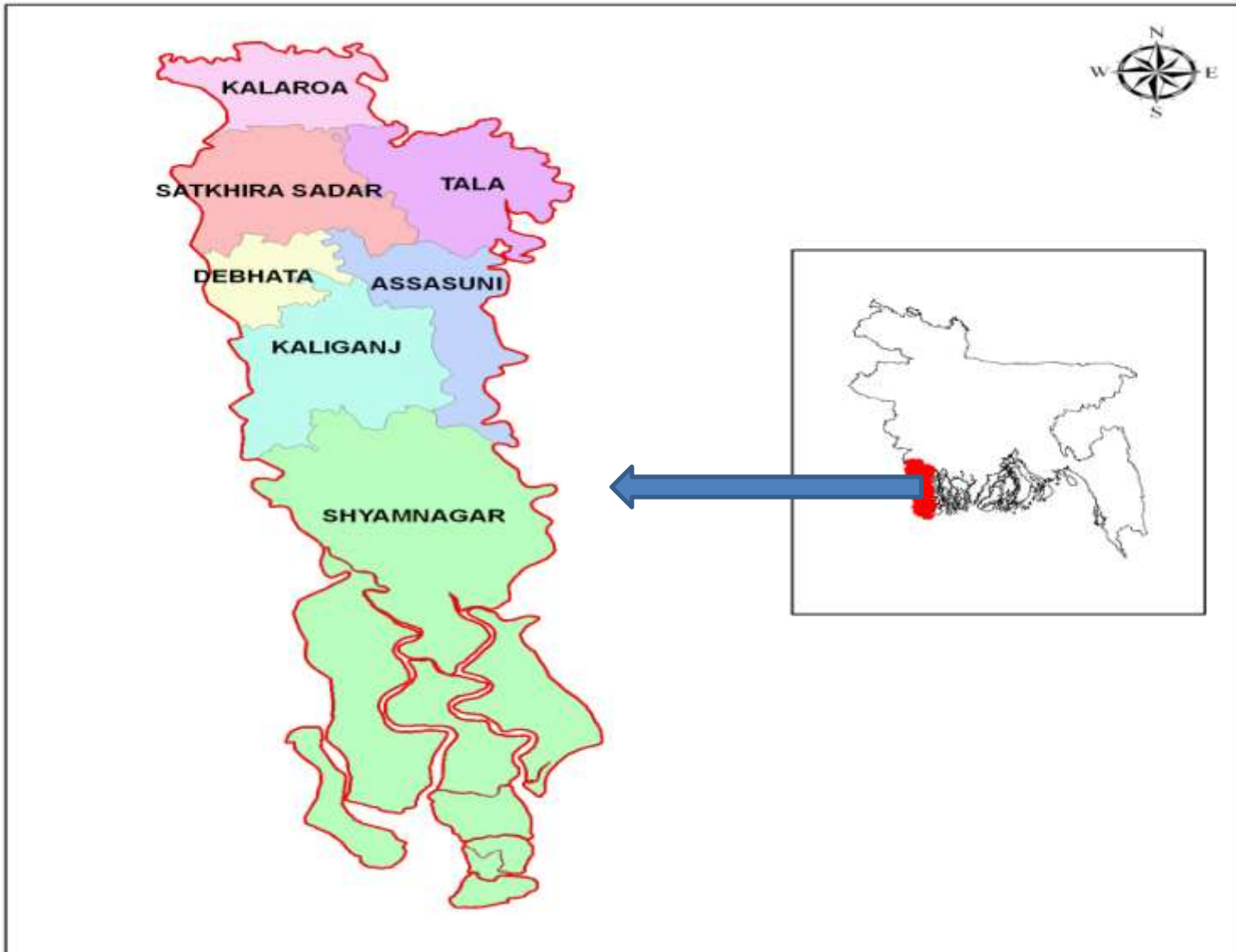
## **Specific objectives:**

- **Describe the biophysical characteristics of the sample farms under the study areas;**
- **Identify and document the process of diffusion of introduced technologies and assess the constraints to adoption of introduced technologies in coping with the climate change situation;**
- **Evaluate the impacts of introduced salt-tolerant varieties in the rice-based farming systems on livelihood changes of the farming households; and**
- **Derive some policy implications for further improvements under the climate change situations.**

# METHODOLOGY

- ❑ This study was conducted in the saline-prone region of Bangladesh covering seven sub-districts under Satkhira where salt tolerant rice variety was given by CPWF project activity.
- ❑ Fifty four participating farmers (i.e salt tolerant variety adopters) and fifty six non-participant farmers were taken under this study.
- ❑ Participant farmers were identified taking help from BRRI plant breeding division while the non-participating farmers were selected following random sampling technique.





**Figure 1: Map of Bangladesh showing the study areas**

# **Empirical findings**

**Table 1: Biophysical characteristics of the sample farms in the delta areas**

<b>Characteristics</b>	<b>Percent of area</b>	
	<b>Participant</b>	<b>Non-participant</b>
<b>Soil type</b>		
<b>Clay</b>	<b>54.6</b>	<b>52.5</b>
<b>Loamy</b>	<b>9.7</b>	<b>15.8</b>
<b>Clay-loam</b>	<b>29.6</b>	<b>26.2</b>
<b>Sandy-loam</b>	<b>5.9</b>	<b>3.6</b>
<b>Extent of sodicity</b>		
<b>Severe</b>	<b>10.7</b>	<b>13.2</b>
<b>Moderate</b>	<b>48.8</b>	<b>40.2</b>
<b>Low</b>	<b>34.5</b>	<b>31.5</b>
<b>Non-saline</b>	<b>5.0</b>	<b>8.6</b>

**Contd.. Table 1**

<b>Characteristics</b>	<b>Percent of area</b>	
	<b>Participant</b>	<b>Non-participant</b>
<b>Land type</b>		
High land	31.1	19.5
Medium land	65.9	77.9
Low land	3.0	2.6
<b>Sources of irrigation</b>		
Low-lift pump	3.1	-
Shallow tube well	40.9	30.6
Deep tube well	2.8	
Local irrigation system	37.7	45.0
Indigenous irrigation and STW	15.5	21.1

**Table: Changes in the level of salinity in the study areas over the years**

Level of salinity	Percent area	
	Participant	Non-participant
<b>15 years ago</b>		
Severe	<b>2</b>	<b>2</b>
Low	<b>70</b>	<b>61</b>
Not affected	<b>12</b>	<b>16</b>
<b>4 years ago</b>		
Severe	<b>6</b>	<b>18</b>
Low	<b>36</b>	<b>33</b>
Not affected	<b>10</b>	<b>12</b>
<b>1 year ago</b>		
Severe	<b>12</b>	<b>19</b>
Moderate	<b>42</b>	<b>30</b>
Low	<b>35</b>	<b>40</b>
Not affected	<b>11</b>	<b>12</b>

**Table 2 Household members' employment status by source of income and by gender.**

<b>Farm category</b>	<b>Percent</b>	
	<b>Male</b>	<b>Female</b>
<b>Participant</b>		
<b>Crop farming</b>	<b>51</b>	<b>14</b>
<b>Animal raising</b>	<b>17</b>	<b>80</b>
<b>Shrimp farming</b>	<b>23</b>	<b>5</b>
<b>Non farm work</b>	<b>5</b>	<b>2</b>
<b>Salaried work</b>	<b>6</b>	<b>0</b>
<b>Non-participant</b>		
<b>Crop farming</b>	<b>50</b>	<b>26</b>
<b>Animal raising</b>	<b>20</b>	<b>73</b>
<b>Shrimp farming</b>	<b>22</b>	<b>0</b>
<b>Non farm work</b>	<b>3</b>	<b>1</b>
<b>Salaried work</b>	<b>5</b>	<b>0</b>



**Table 3. Scenario of average annual income of the sample households by source**

<b>Sources</b>	<b>Share of total (%)</b>	
	<b>Participant</b>	<b>Non-participant</b>
<b>Rice income</b>	<b>51.8</b>	<b>53.89</b>
<b>Shrimp income</b>	<b>10.0</b>	<b>11.91</b>
<b>Other crops income</b>	<b>8.5</b>	<b>9.2</b>
<b>Livestock income</b>	<b>5.9</b>	<b>4.8</b>
<b>Renting-out land</b>	<b>7.31</b>	<b>3.9</b>
<b>Non farm income</b>	<b>4.2</b>	<b>6.4</b>
<b>Service income</b>	<b>8.2</b>	<b>6.2</b>

# Crop production

**Table 4. Area devotion to different crops during wet and dry seasons**

	Percent area	
	Participant	Non-participant
<b>Kharif/Wet (2007)</b>		
<b>Rice</b>	<b>55.7</b>	<b>58.3</b>
<b>Jute +other crops</b>	<b>1.6</b>	<b>1.4</b>
<b>Shrimp +other fish</b>	<b>20.0</b>	<b>29.7</b>
<b>Fallow</b>	<b>23.2</b>	<b>11.7</b>
<b>Rabi/Winter (2007)</b>		
<b>Rice</b>	<b>68.7</b>	<b>60.8</b>
<b>Jute + other crops</b>	<b>3.5</b>	<b>1.9</b>
<b>Shrimp +other fish</b>	<b>20.7</b>	<b>28.5</b>
<b>Fallow</b>	<b>7.3</b>	<b>8.8</b>
<b>Kharif (2008)</b>		
<b>Rice</b>	<b>54.7</b>	<b>57.3</b>
<b>Jute +other crop</b>	<b>1.1</b>	<b>1.9</b>
<b>Shrimp (+other fish)</b>	<b>20.9</b>	<b>27.9</b>
<b>Fallow</b>	<b>23.4</b>	<b>12.9</b>

**Table 5. Area devotion and average yield of different Local rice varieties: wet season: 2007**

	<b>Participant</b>		<b>Non participant</b>	
<b>Variety</b>	<b>Area (ha)</b>	<b>Average yield (t/ha)</b>	<b>Area (ha)</b>	<b>Average yield (t/ha)</b>
<b>Baral</b>	<b>0.82</b>	<b>3.01</b>	<b>-</b>	<b>-</b>
<b>Jatu Balam</b>	<b>4.50</b>	<b>3.00</b>	<b>1.61</b>	<b>2.89</b>
<b>Masuri</b>	<b>1.03</b>	<b>2.99</b>	<b>0.54</b>	<b>2.93</b>
<b>Sunflower</b>	<b>0.27</b>	<b>2.69</b>	<b>-</b>	<b>-</b>

**Table 5(a): Area devotion and average yield of different modern rice varieties, wet season: 2007**

MVs	Participants		Non participants	
	Area ( ha)	Average yield (t/ha)	Area ( ha)	Average yield (t/ha)
<b>BR10</b>	<b>19.35</b>	<b>3.77</b>	<b>12.27</b>	<b>4.11</b>
<b>BR11</b>	<b>8.18</b>	<b>4.17</b>	<b>6.32</b>	<b>3.97</b>
<b>BR22</b>	<b>1.07</b>	<b>3.33</b>	<b>1.21</b>	<b>2.86</b>
<b>BR23</b>	<b>2.15</b>	<b>3.59</b>	<b>3.83</b>	<b>3.91</b>
<b>BR30</b>	<b>8.95</b>	<b>3.67</b>	<b>7.59</b>	<b>4.00</b>
<b>BR41</b>	<b>3.89</b>	<b>4.28</b>	<b>2.00</b>	<b>4.61</b>
<b>Swarna</b>	<b>1.60</b>	<b>3.52</b>	<b>0.63</b>	<b>3.30</b>

**Table 6. Area devotion and average yield of different rice varieties, winter season; 2007**

<b>Local Variety</b>	<b>Participant</b>		<b>Non participant</b>	
	<b>Area (ha)</b>	<b>Average yield (t/ha)</b>	<b>Total area (ha)</b>	<b>Average yield (t/ha)</b>
<b>Miniket</b>	<b>5.26</b>	<b>5.01</b>	<b>3.01</b>	<b>4.7</b>
<b>Moina</b>	<b>0.13</b>	<b>2.92</b>	<b>0.26</b>	<b>4.58</b>
<b>Ratna</b>	<b>-</b>	<b>-</b>	<b>0.13</b>	<b>4.62</b>
<b>ACI-2</b>	<b>0.34</b>	<b>5.77</b>	<b>1.46</b>	<b>5.89</b>
<b>Hira</b>	<b>2.64</b>	<b>5.18</b>	<b>-</b>	<b>-</b>
<b>Hira-6</b>	<b>0.46</b>	<b>5.89</b>	<b>0.47</b>	<b>5.46</b>
<b>Sonar Bangla 6</b>	<b>1.92</b>	<b>6.01</b>	<b>1.45</b>	<b>6.00</b>



**Table 6 (a): Area devotion and yield of different modern rice varieties, winter season; 2008**

<b>Variety</b>	<b>Participant</b>		<b>Non participant</b>	
	<b>Area (ha)</b>	<b>Av. Yield (t/ha)</b>	<b>Area (ha)</b>	<b>Av. Yield (t/ha)</b>
<b>Jamaibabu</b>	<b>1.34</b>	<b>3.17</b>	<b>1.1</b>	<b>3.04</b>
<b>BR28</b>	<b>35.99</b>	<b>5.00</b>	<b>24.53</b>	<b>5.11</b>
<b>BR29</b>	<b>0.33</b>	<b>5.11</b>	<b>0.2</b>	<b>4.92</b>
<b>New (BR 47)</b>	<b>10.61</b>	<b>5.84</b>	<b>3.98</b>	<b>5.1 4</b>

**Table 7. Area devotion and average yield of different rice varieties, wet season, 2008**

Variety	Participant		Non-participant	
	Total area (ha)	Average yield (t/ha)	Total area (ha)	Average yield (t/ha)
<b>Local</b>				
Baral	0.15	2.93		
Jatu Balam	4.52	3.27	1.76	2.72
<b>Modern</b>				
BR10	18.23	3.54	11.79	3.46
BR11	6.15	3.72	6.24	3.36
BR23	4.32	2.86	4.16	2.9
BR30	9.27	3.67	7.35	3.22
BR41	3.78	4.29	1.96	4.57
Swarna	2.22	3.68	0.90	3.28

**Table 8. Scenario of changes in the farming practices  
(Participant farms)**

<b>Item</b>	<b>Early Practice</b>	<b>% farms</b>	<b>Changed practice</b>	<b>% farms</b>
<b>Land preparation</b>	<b>Draft power (animals)</b>	<b>90</b>	<b>Power tiller</b>	<b>100</b>
<b>Rice variety adoption</b>				
<b>Boro</b>	<b>Local</b>	<b>65</b>	<b>Local and modern</b>	<b>13</b>
	<b>Modern</b>	<b>4</b>	<b>Local, modern and salt-tolerant</b>	<b>24</b>
			<b>Modern, salt-tolerant</b>	<b>48</b>
			<b>Salt tolerant</b>	<b>13</b>

**Table 9. Scenario of changes in the farming practices  
(Participant farms)**

<b>Item</b>	<b>Previous practice</b>	<b>Percent</b>	<b>Changed practice</b>	<b>Percent</b>
<b>T. Aman</b>	<b>Local</b>	<b>85</b>	<b>Local</b>	<b>4</b>
	<b>Local and modern</b>	<b>9</b>	<b>Local and modern</b>	<b>9</b>
	<b>Modern</b>	<b>2</b>	<b>Modern</b>	<b>69</b>
<b>Fertilizer application</b>				
<b>Urea</b>	<b>Apply</b>	<b>59</b>	<b>Apply</b>	<b>100</b>
	<b>Not apply</b>	<b>41</b>		
<b>TSP</b>	<b>Apply</b>	<b>65</b>	<b>Apply</b>	<b>100</b>
	<b>Not apply</b>	<b>35</b>		

**Table 11. Scenario of changes in the farming practices in dry season (non-participant farms)**

<b>Item</b>	<b>Early practice</b>	<b>Percent</b>	<b>Changed practice</b>	<b>Percent</b>
<b>Rice varieties</b>				
<b>Boro</b>	<b>Local</b>	<b>66</b>	<b>Local</b>	<b>6</b>
	<b>Modern</b>	<b>4</b>	<b>Local and modern</b>	<b>29</b>
	<b>Local and modern</b>	<b>22</b>	<b>Modern</b>	<b>43</b>
			<b>Modern, salt-tolerant</b>	<b>16</b>
	<b>No response</b>	<b>8</b>	<b>Salt tolerant</b>	<b>5</b>

# **Constraints to the adoption**



**Table 12: Farm level constraints to the adoption of technology (new) as opined by the sample farmers.**

<b>Constraints</b>	<b>First response (%)</b>	<b>Multiple response (%)</b>
<b>Shattering problem</b>	<b>68</b>	<b>71</b>
<b>Low market price</b>	<b>12</b>	<b>15</b>
<b>Eating quality not good</b>	<b>10</b>	<b>11</b>
<b>Long duration variety</b>	<b>15</b>	<b>17</b>
<b>Coarse rice</b>	<b>8</b>	<b>7</b>
<b>Non-availability of seed</b>	<b>45</b>	<b>40</b>
<b>Growth remain stagnant in winter season</b>	<b>2</b>	<b>2.5</b>
<b>No response</b>	<b>0.2</b>	<b>2</b>

**Table 13. Changes in the agricultural activities occurred after project implementation**

<b>Item</b>	<b>Percent cases</b>		
	<b>Improve/ Increase</b>	<b>Deteriorate/ Decrease</b>	<b>Same</b>
<b>GENERAL</b>			
<b>Availability of rice supply</b>	<b>100</b>		
<b>AGRICULTURE</b>			
<b>Area for other crops</b>	<b>88</b>		<b>11</b>
<b>Area planted to new rice varieties</b>	<b>96</b>	<b>4</b>	
<b>Rice yield</b>	<b>98</b>		<b>2</b>
<b>Number of farmers adopting new technologies</b>	<b>100</b>		
<b>Fertilizer use</b>	<b>81</b>	<b>17</b>	<b>2</b>
<b>Value of land</b>	<b>100</b>		

**Table 14. Changes in the social and economic factors occurred after project implementation.**

Item	Improve /Increase	Same
<b>SOCIAL</b>		
Women's participation in project work	94	6
Information about new technologies	95	
Access to drinking water	83	15
<b>ECONOMIC</b>		
Rice selling	90	6
Use of irrigation facilities	96	4
<b>GENDER ISSUES</b>		
Participation of female hired labor in rice production	94	
Ability of women to be outspoken,	100	

# **Farmers' preferences towards technology**

**Table : 15. Farmers' preferences towards rice varieties as opined by the sample farms.**

	<b>Characteristics of existing varieties</b>	<b>Characteristics of demanded variety</b>
<b>Dry season/ Boro</b>		
<b>BRRI Dhan 28</b>	<ul style="list-style-type: none"> <li>-Moderately tolerant to salinity.</li> <li>-Moderate yield.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Salinity tolerant.</b></li> <li>-Varieties resistant to diseases.</li> <li>- Higher yield</li> </ul>

# Contd..table15

	<b>Characteristics of existing varieties</b>	<b>Characteristics of demanded variety</b>
<b>Wet season/ Aman</b>		
<b>BR23</b>	<b>-Susceptible to stem borer</b>	<b>-Taller plant height. - Resistant to pests</b>
<b>BRR I Dhan 30</b>	<b>-Susceptible to insects/pests</b>	<b>-Varieties resistant to diseases and salinity tolerant.</b>
<b>BRR I Dhan 40</b>	<b>-Moderate yielder</b>	<b>- Taller plant height - Higher yield</b>
<b>BRR I Dhan 41</b>	<b>-slightly tolerant Moderate yield</b>	<b>- Salinity tolerant - Higher yield.</b>

# **Profitability assessment**

**Table 16. Cost and returns (Tk/ha) of rice production in rabi season, (Participants)**

Items	Without intervention		With intervention (Next year)
	Modern	Salt-tolerant	Salt-tolerant
<b>Gross returns</b>	<b>56,021</b>	<b>65276</b>	<b>110,567</b>
<b>Costs:</b>			
<b>Land preparation</b>	<b>2,715</b>	<b>2996</b>	<b>4,362</b>
<b>Material costs</b>	<b>14725</b>	<b>15607</b>	<b>19087</b>
<b>Land rent</b>	<b>9,518</b>	<b>8917</b>	<b>15,776</b>
<b>Labor cost</b>	<b>9,995</b>	<b>10074</b>	<b>14,514</b>
<b>Total Cost</b>	<b>36,980</b>	<b>37595</b>	<b>64,741</b>
<b>Net Returns</b>	<b>19,041</b>	<b>27681</b>	<b>45,826</b>



**Table 16 (a) Profitability in winter rice production in the saline prone areas (Participants)**

	<b>Without intervention (Tk./ha)</b>	<b>With intervention (Tk./ha) (Next year)</b>
	<b>MVs</b>	<b>Salt tolerant</b>
<b>Gross return</b>	<b>56021</b>	<b>110567</b>
<b>Total costs</b>	<b>36980</b>	<b>64741</b>
<b>Net return</b>	<b>19041</b>	<b>45826</b>
<b>BCR</b>	<b>1.51</b>	<b>1.70</b>

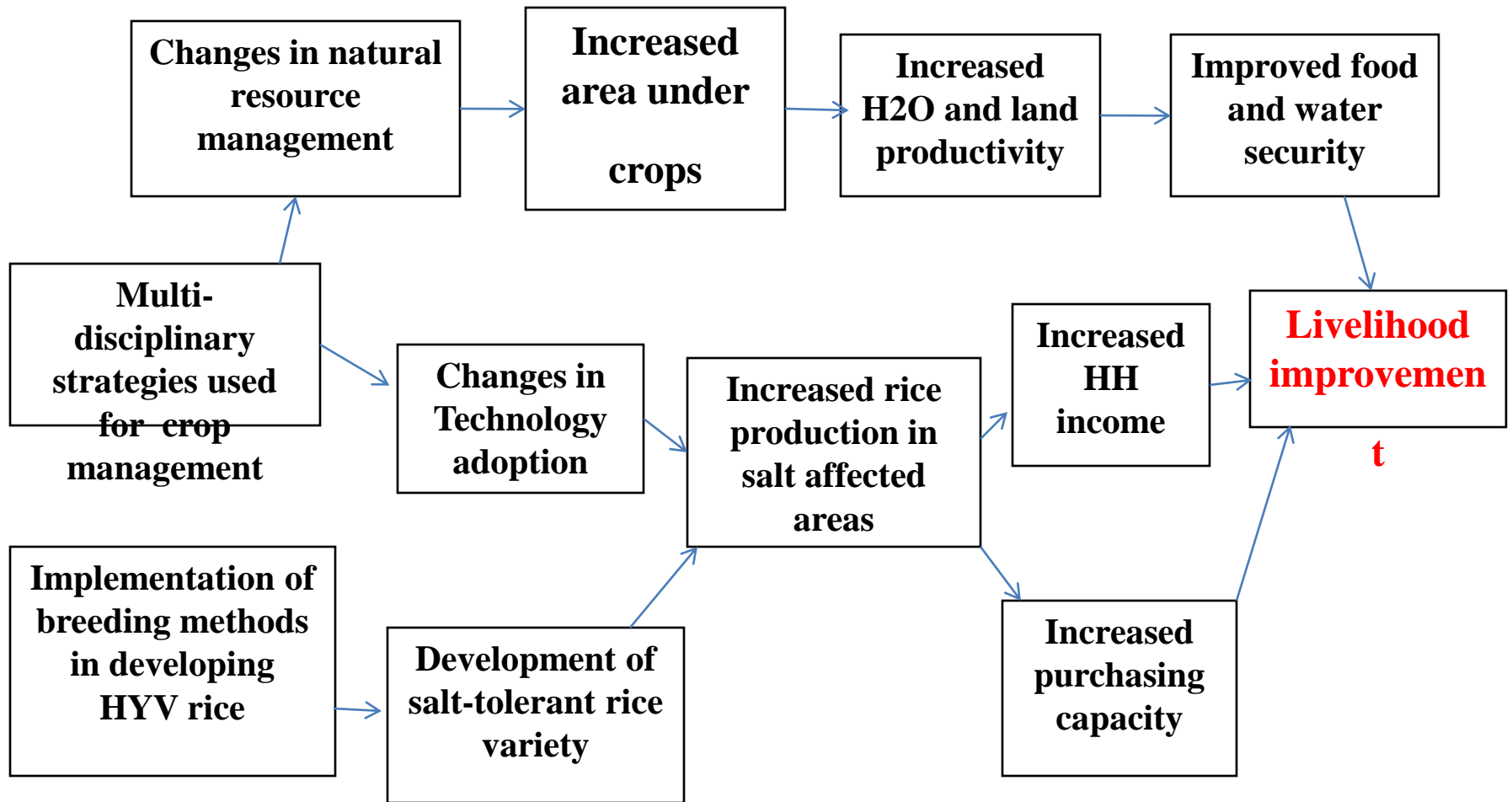
**Table 17. Cost and returns (Tk/ha) of rice production in rabi season, (Non-participant)**

Items	Without intervention	With intervention	
	BR28	BR28	BR47
Gross returns	57,995	101,568	104,380
<b>Costs:</b>			
Land preparation	2,390	3,556	4,204
Material cost	13895	27839	28594
Land rent	8352	13,214	13,703
Labor cost	11083	14,824	14,457
Total Cost	37,029	59,550	61601
Net Returns	20,966	40,017	42,779

**Table 17 (a) Profitability in rice production in the saline prone areas ( **Non-participants** )**

	<b>Without intervention</b>	<b>With intervention</b>	
	<b>MV/BR28</b>	<b>BR28</b>	<b>Salt tlerant</b>
<b>Gross return</b>	<b>57,995</b>	<b>1,01568</b>	<b>104,380</b>
<b>Total costs</b>	<b>37,029</b>	<b>59,550</b>	<b>61601</b>
<b>Net return</b>	<b>20,966</b>	<b>42,017</b>	<b>42,779</b>
<b>BCR</b>	<b>1.56</b>	<b>1.70</b>	<b>1.67</b>

# Fig. Impact pathway



## Major findings and conclusions

- ❖ **The major proportion of lands under both participant and non-participant farms were devoted for rice production. Due to the supply of salt tolerant rice varieties, area devotion to rice was much higher in case of the participant farms Both in 2007 and 2008.**
- ❖ **Previously most of the farmers adopted local rice varieties. A contrasting picture appeared in the current practice; i.e. nearly 69% farmers grew modern varieties in the wet season. Previously only 37% farmers used irrigation water, but presently almost 90% farmers are adopting irrigation implying that after the intervention of new rice technologies there has been a radical change in farming practices in the saline affected areas.**

Contd.....

- ❖ **In dry season, the saline tolerant BRRIdhan 47 was adopted by 87% of the participant farmers and its yield was the highest among all MVs grown by both the participant and non-participant farmers.**
- ❖ **In general the household status and rice supply availability improved in 100% cases after the implementation of project activity. Area devotion to rice under sodic soil improved in 90% cases, while in 4% cases it remained same as before.**

## **Contd.....**

- ❖ Socioeconomic indicators such as access to school, rice income per hectare, purchasing ability etc, improved by nearly 100%. After project implementation, house holds' borrowing activity decreased in 22% cases and improved for about 57% cases.**
- ❖ There was substantial improvement in selling activity of rice and for other crops also, implying that the farming community had been able to make remarkable improvements in their livelihood through the adoption of introduced technologies as provided by the project activity.**



# Thank You





A photograph of a vast, lush green rice field under bright sunlight. The rice plants are tall and dense, with their leaves and panicles clearly visible. The field extends to the horizon. Overlaid on the center of the image is the text "Thank You" in a large, bold, red font with a white outline.

**Thank You**