Conceptual framework for climate-smart agriculture in rice production (January 2017)

Overview of CSA Technologies & Practices:

<table>
<tr><th>Water smart</th><th>Carbon smart</th><th>Yield smart</th><th>Communication smart</th></tr>
<tr><td>1) Direct seeding</td><td>6) Preventing straw burning</td><td rowspan="3">10) Stress-tolerant varieties:
(i) droughts
(ii) floods
(iii) salinity
(iv) heat</td><td rowspan="3">12) Mobile phone technology:
(i) climate forecast
(ii) salinity warning</td></tr>
<tr><td>2) Laser leveling</td><td>7) Grains with low gelatinization temperature</td></tr>
<tr><td colspan="2">3) Improved irrigation techniques (alternate wetting and drying - AWD; mid-season drainage)</td></tr>
<tr><td colspan="2">4) Short-duration varieties</td><td rowspan="2">11) Hermetic storage of grains</td><td rowspan="2">13) Community-based seed systems for improved varieties</td></tr>
<tr><td colspan="2">5) Zero tillage</td></tr>
<tr><td rowspan="2"></td><td colspan="2">8) Site-specific nutrient management</td><td rowspan="2">14) Integrated Pest Management (adjusted to weather impacts)</td></tr>
<tr><td colspan="2">9) Deep placement urea</td></tr>
</table>

Characterization of CSA Technologies & Practices:

1) Direct seeding	**Water smart**
Adaptation mechanism	Better survival of seeds (as compared to transplanting) when rainy season delays
Mitigation mechanism	Unclear; lower CH4 emission rates (per area) due to reduced flooding -- but larger area needed (as compared to transplanting)
Target environments/ countries	(i) Rainfed rice in drought prone regions and (ii) regions with high competition for labor (North India; Central Thailand)

2) Laser leveling	**Water smart**
Adaptation mechanism	Allows more efficient water management (AWD) => reduced water needs under water scarcity
Mitigation mechanism	Allows more efficient water management (AWD) => shorter flooding periods reduce CH4 emission
Target environments/ countries	Regions with rapid mechanization trends (N India; S Vietnam)

3) Improved irrigation techniques (AWD; mid-season drainage)	**Water smart**	**Carbon smart**
Adaptation mechanism	Reduces water needs under water scarcity	
Mitigation mechanism	Shorter flooding periods in less CH4 emissions	
Target environments/ countries	Irrigated rice during dry season	

4) Short-duration varieties	Water smart	Carbon smart
Adaptation mechanism	Possible adjustment of cropping calendars	
Mitigation mechanism	Reduced flooding periods result in lower CH4 emissions	
Target environments/ countries	Countries with low adoption of improved varieties	

5) Zero-tillage	Water smart	Carbon smart
Adaptation mechanism	Lower water demand during field preparation	
Mitigation mechanism	Increases carbon pool in the soil	
Target environments/ countries	Regions with rapid mechanization trends, e.g. N India	

6) Preventing straw burning (e.g. through baling)	Carbon smart
Adaptation mechanism	-
Mitigation mechanism	Reduces CH4 emissions from burning with co-benefits for air quality; straw represents a valuable biomass for various purposes
Target environments/ countries	Regions with rapid mechanization trends (N India; S Vietnam)

7) Grains with low gelatinization temperature	Carbon smart
Adaptation mechanism	-
Mitigation mechanism	Reducing cooking temperatures and thus fossil fuel consumption
Target environments/ countries	Countries where consumers preferences allow changes in grain quality (amylopectin content) of local varieties, e.g. Myanmar

8) Site-specific Nutrient Management	Carbon smart	Yield smart
Adaptation mechanism	Balanced nutrient supply creates resilient systems	
Mitigation mechanism	Lower N supply reduces N2O emissions	
Target environments/ countries	Highly intensive systems (e.g. Philippines, Vietnam)	

9) Deep placement urea	Carbon smart	Yield smart
Adaptation mechanism	Balanced N supply creates resilient systems	
Mitigation mechanism	Slow release of N into the soils reduces N2O emissions	
Target environments/ countries	Countries with available experience from previous programs on deep placement urea (e.g. Bangladesh)	

10) Stress-tolerant varieties: (i) droughts, (ii) floods, (iii) salinity, (iv) heat	Yield smart
Adaptation mechanism	Higher resilience against climatic stresses
Mitigation mechanism	-
Target environments/ countries	Regions prone to climatic stresses: (i) droughts; (ii) floods; (iii) salinity; (iv) heat

11) Hermetic storage of grains	Yield smart
Adaptation mechanism	Protection of grains from extreme weather events
Mitigation mechanism	-
Target environments/ countries	Typhoon-prone countries (e.g. in the Philippines)

12) Mobile phone technology: (i) climate forecast, (ii) salinity warning	Communication smart
Adaptation mechanism	Allowing real-time adjustments in crop management
Mitigation mechanism	Balanced N supply reduces N2O emissions
Target environments/ countries	Wide range of environments, namely (i) rainfed rice experiencing erratic rainfall patterns and (ii) coastal rice prone to salinity intrusion

13) Community-based seed systems for improved varieties	**Communication smart**
Adaptation mechanism	Providing quality seeds for varieties higher resilience to climate stresses
Mitigation mechanism	-
Target environments/ countries	Countries with inefficient seed systems

14) Integrated Pest Management (adjusted to weather impacts)	**Communication smart**
Adaptation mechanism	Continuous monitoring and updating of pest management
Mitigation mechanism	-
Target environments/ countries	Environments with high pest infestation