Sorjan Farming: A Sustainable Solution for Climate Resilience in Coastal Bangladesh

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The Sustainable Intensification of Mixed Farming Systems Initiative aims to provide equitable, transformative pathways for improved livelihoods of actors in mixed farming systems through sustainable intensification within target agroecologies and socio-economic settings.

Through action research and development partnerships, the Initiative will improve smallholder farmers' resilience to weather-induced shocks, provide a more stable income and significant benefits in welfare, and enhance social justice and inclusion for 13 million people by 2030.

Activities will be implemented in six focus countries globally representing diverse mixed farming systems as follows: Ghana (cereal–root crop mixed), Ethiopia (highland mixed), Malawi: (maize mixed), Bangladesh (rice mixed), Nepal (highland mixed), and Lao People's Democratic Republic (upland intensive mixed/ highland extensive mixed).

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Abbreviations and acronyms

BARI	Bangladesh Agricultural Research Institute
DAE	Department of Agricultural Extension
CIMMYT	International Maize and Wheat Improvement Center
ICARDA	International Center for Agricultural Research in the Dry Areas
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
NGO	Non-government Organization

Objectives

- To assess the effectiveness of *Sorjan* farming techniques in year-round vegetable production.
- Utilize the land through crop intensification and diversification.
- To cultivate vegetables and produce fish together in the same piece of land.
- To overcome the barrier of salinity problem in the dry season for vegetable production.

Background

The smallholder farmers of Bangladesh are facing huge challenges related to climate change. In coastal areas, especially southern Bangladesh, soil salinity in the dry season, and high-frequency rainfall in the wet season result in frequent flooding along with less irrigation water available during the dry season are the major agricultural constraints. The *sorjan* farming method is an effective way for farmers to cultivate year-round vegetables and produce fish together under these adverse ecological and climatic conditions.

Sorjan, characterized by raised beds, addresses soil salinity problems and deep sinks, improves soil drainage, and works as a water reservoir to address irrigation issues faced by coastal farmers in dry seasons. This system not only allows for improved crop yields but also fosters biodiversity, as diverse crops can be grown simultaneously, thereby supporting ecosystem balance.

The *sorjan* production system has emerged as an innovative agricultural practice in coastal Bangladesh, effectively addressing the challenges posed by climate change and environmental stressors. The *Sorjan* technique tackles various challenges encountered by farmers in coastal areas. It helps in preventing soil salinity issues and protects crops from flood damage and waterlogged roots during the monsoon season. This is achieved by elevating plants above flood levels and storing irrigation water in the channels between the beds during the dry winter months. Its versatile advantages and effective water management make *sorjan* farming an excellent example of climate-smart agriculture in coastal Bangladesh.

Status of the *Sorjan* farming system in Bangladesh

Adoption rates: The *Sorjan* production system has gained popularity among farmers in coastal regions of Bangladesh, especially in areas affected by saline intrusion and flooding. However, its adoption varies by region, with some areas showing strong uptake while others lag.

Government and NGO support: Various government agencies (DAE, BARI) non-governmental organizations (NGOs) like BRAC and other donor-funded NGOs, and a few private seed companies have currently been working to promote the *sorjan* systems adoption through training programs, workshops, and financial support. These efforts aim to enhance farmers' knowledge and skills in implementing and maintaining *sorjan* systems.

Community-based implementation: In some areas, farmers are involved in community-based approaches for sorjan farming where groups of farmers collaborate, share resources, and learn from each other. This collective effort helps them to reduce the production cost and proper utilization of their land.

Research and development: There has been little research conducted on sorjan production systems in Bangladesh.

Benefits of the *sorjan* farming system

Economic benefits: Allows for a more diverse source of income for farmers, as instead of just 1-2 low-yielding crops per year as in *sorjan* the same area becomes suitable to grow vegetables continuously and rear fish. Improved crop production can lead to higher incomes for farmers, strengthen local economies, and reduce poverty in coastal communities. Higher farm-income per land area unit with *sorjan* than with traditional paddy fields.

Increased food security and biodiversity: This system supports mixed cropping, allowing farmers to grow a variety of plants simultaneously. Increased biodiversity enhances soil health and promotes pest resilience. Increase of food security due to a higher diversity of locally grown food crops.

Enhanced soil drainage: The raised beds improve water management, preventing waterlogging and allowing for better drainage, which is crucial in areas prone to flooding.

Salinity management: Sorjan systems enable the cultivation of crops in saline environments by raising plant beds above high salinity levels, thereby reducing salt stress on crops.

Climate resilience: As Bangladesh continues to face the impacts of climate change, including rising sea levels and more severe weather events, the *sorjan* production system is increasingly found as a viable strategy for enhancing agricultural resilience. Farmers adopting *sorjan* systems report improved crop yields and better management of water and salinity. The adaptability of the *sorjan* system to changing climatic conditions helps farmers withstand extreme weather events and shifting growing seasons, making agriculture more resilient.

Carbon sequestration: Elevated beds and diverse plant species contribute to organic matter in the soil, enhancing carbon storage and promoting better soil health. Sorjan contributes to increasing the above-ground biomass due to crop intensification constituting a carbon sink.

Sustainable resource use: The system promotes efficient use of natural resources, especially irrigation water.

Erosion control: The structure of the Sorjan system helps to reduce soil erosion, maintaining soil integrity and fertility over time.

Improved crop yields: By optimizing water and nutrient availability and preventing the saline soil effect the *sorjan* system can lead to higher and more consistent crop yields, contributing to food security in the coastal areas.

Empowerment of local farmers: Through the implementation of *sorjan* systems, both male and female farmers can be involved in crop production year-round that supports their livelihoods.

How the *sorjan* farming system helps year-round production

The *sorjan* production system stands out in coastal Bangladesh for its ability to enable year-round agricultural production, a significant improvement over traditional farming practice. Here are several reasons why sorjan systems facilitate this continuous production cycle:

1. **Improved water management**: Sorjan systems are characterized by elevated beds and furrows, which enhance drainage and reduce waterlogging. This structural design allows for better control of water levels, making it possible to cultivate crops throughout the year, even during the monsoon season when traditional fields may become inundated.

2. **Salinity mitigation**: Coastal regions in Bangladesh often suffer from soil salinization, particularly during the dry season. The sorjan production method mitigates salinity by growing crops on raised beds, which keeps the root zones of plants above the saline water table. This adaptability enables the cultivation of both salt-tolerant and regular crops year-round.

3. **Crop diversification: T**he system supports mixed cropping and intercropping, allowing farmers to plant various crops simultaneously**.** This diversity maximizes land use and enables farmers to harvest different crops at varying times throughout the year, thus ensuring a continuous food supply. Sorjan allows cultivating year-round vegetables, spices and fruits on raised beds and creeper vegetables on bed edges making trellis on ditches and cultivation of fish in ditches during wet months in the water-logged/tidal surge areas.

4. **Reduced pest and disease pressure**: By diversifying crops and planting a rotation of varied species, the sorjan approach can reduce the prevalence of pests and diseases that typically target mono-cropped fields. This integrated pest management reduces crop losses and supports year-round production.

5. **Utilization of marginal lands**: In coastal Bangladesh, some areas may be unsuitable for traditional farming due to flooding or salinity. The raised beds in the *sorjan* system allow farmers to utilize these marginal lands effectively, extending the area available for cultivation. As the land is raised when it is normally submerged during the monsoon months it is still suitable for vegetable and fruit crops.

6. **Water retention in dry seasons**: The furrows in the *sorjan* system can help retain water in the soil during the dry season, enabling crops to thrive when water is scarce. Farmers can utilize stored water more effectively for irrigation. Meanwhile, several fish species including tilapia, carp, and cat fishes are suitable for farming in the accompanying furrows.

7. **Flexible planting schedules**: Traditional practices often require crops to be planted in specific seasons, restricting farmers. In contrast, the *sorjan* system allows for more flexible planting schedules, enabling farmers to sow and harvest crops based on market demand and climate conditions.

Updated status of *sorjan* farming under SI-MFS Initiative

The SI-MFS Patuakhali team in Bangladesh has recently started working on testing the feasibility and economics of some vegetables in the sorjan production systems. Initially, they established two fields for this production system. The cultivated area of the sorjan was 25 decimal each. Summer vegetables (Bitter gourd, Wax gourd, Sponge gourd, Okra, and Ridge gourd) were cultivated on these sorjan. Seed, fertilizers and technical support were provided by IRRI. Although heavy rainfall hampered the production there were profits in both sorjan. Farmers said that the profit would be higher if there were normal rainfall. The initial establishment cost as well as higher rainfall lowered the profits, but it is expecting higher profits in the next cycle of vegetable production. The summarized cost-benefit calculation of the two *sorjan*s are as follows:

Production Cost:

Input	**Sorjan-01**	**Sorjan-02**	**Remarks**
	Total cost (BDT)	**Total cost (BDT)**	
Seed	2,620	2620	
Fertilizer	2,985	2,985	
Labor (land/bed preparation, making net trellis etc.)	10,600	10,600	
Bamboo, net, rope etc.	3,100	3,100	The costs are considered for a single cropping season.
Total Cost	**19,305**	**19,305**	

Income:

Vegetable	**Sorjan-01**		**Sorjan-02**		**Remarks**
	Total sold (Kg)	**Total value (BDT)**	**Total sold (Kg)**	**Total value (BDT)**	
Bitter gourd	105	5,400	101	5,145	
Wax gourd	138	5,095	135	4,850	
Sponge gourd	178	7,785	194	8,325	
Ridge gourd	83	3,620	56	2,330	
Okra	Damaged	-	22	1,060	
Total sold value		**21,900**		**21,710**	

Net profits were BDT 2,595 and BDT 2,405 for sorjan-01 and 02 respectively. Although the profit is low for 25 decimals of land, farmers were happy to receive this profit in such a heavy rainfall situation.

Challenges of *Sorjan* farming system

Initial setup costs: Establishing *sorjan* systems may require a significant initial investment in infrastructure, which can be a barrier for smallholder farmers who have limited financial resources.

Challenges in scaling up: Despite its benefits, challenges remain that can hinder the widespread adoption of *sorjan* systems. These include high initial establishment costs, financial constraints, and lack of access to quality inputs. Sorjan allows limited use of farm machinery which is a challenge in scaling up.

Knowledge and training gaps: Farmers may lack awareness or training in implementing *sorjan* practices, limiting the technology's adoption. Effective extension services and education are crucial for successful implementation.

Maintenance requirements: Maintaining the raised beds and furrows requires ongoing effort, including regular repairing of the ridges, weeding and management of the water system. This can be labor-intensive and time-consuming.

Pest management: While increased biodiversity can enhance pest resilience, it can also attract new pests or diseases that farmers may not be prepared to manage effectively.

Soil fertility management: Maintaining soil fertility over time requires careful management and the use of organic amendments, which may not always be readily available to farmers.

Policy and support framework: A lack of supportive policies, funding, and resources from government and NGOs can limit the expansion and implementation of sorjan systems on a broader scale.

Photo 1: Sorjan farming system (Experimental fields)

Photo 2: Different sorjan farming system at Patuakhali site.

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