

Draft

# Conservation Agriculture and Farm Mechanization in Bangladesh



## Key Points

- Conservation agriculture (CA) technologies are now developed for small farms in Bangladesh for a range of crops.
- Rice establishment in CA is now feasible.
- CA has water savings, labour savings, fuel savings and increases profitability of a range of crops.
- The commercialisation of CA is being led by private sector actors (local service providers and manufacturers/ importers).
- The enabling environment for CA spread can be developed by Government policies (R, D & E) and programmes (price support) and by the banking system (credit).

# Characteristics of Farming Systems in Bangladesh

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Aman rice is the anchor crop of most farm households in Bangladesh. At 350 kg of paddy consumed per person per year, the average family needs to grow 1750-2100 kg of paddy per year. Other cropping choices generally fit around this requirement for Aman rice, depending on the land type and the profitability of alternative crops.

Field sizes are generally small (~1,000 m<sup>2</sup>). Farms often comprise several dispersed small fields. About 85 % of primary tillage is provided by the

rotary tiller operated by two-wheel tractors (2WT).

Small farms with small dispersed fields are not conducive to mechanisation with four-wheel tractors (4WT).

The capital cost of mechanisation is often too high for small farmers. Consequently, many farm operations on small farms including tillage, pumping and threshing are mechanised by hiring local service providers to carry out the work on a fee-for-service basis.

## Intensive Cropping

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The national average for cropping intensity is 1.91. However, in many areas cropping intensity is close to 3. Not only are most fields growing 2-3 crops per year but considering whole farms and the changing profitability of crops over time, numerous crops may be grown over a number of years on each farm. Hence, each farmer needs the skill, capability and machinery to grow a variety of crops.

Costs of crop production are relatively high in Bangladesh reflecting inefficient use of inputs and labour. This makes crop production vulnerable to collapses in market prices and to low cost imports.

The intensity of cropping results in periods of high labour demand, particularly around harvesting of one crop and establishment of the next. Family labour is often insufficient to meet these demands in a timely fashion. Lack of timely sowing will decrease the yield potential of crops. Service provision has been adopted to overcome labour constraints for threshing and tillage but not yet for planting.

# Emerging Trends

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Labour shortages have emerged as a major constraint to farming operations limiting farmers' capacity to carry out transplanting, weeding, harvesting and threshing in a timely fashion.

The shortage of labour is reflected in the rising costs of day labour which has risen from 80 to 250 Taka per day.

New technologies like herbicides have spread rapidly in Bangladesh to deal with labour shortages.

Industry estimates and farmer surveys put the usage of herbicides in Boro rice at 80+ % of cropping area.

# Conservation Agriculture

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The form of cropping known as conservation agriculture (CA) involves minimum soil disturbance for placement of seed and fertiliser, retention of crop residues as a soil cover and diversifying crop rotations. Conservation agriculture is practiced on over 160 million hectares globally. There is still limited practice on small farms of CA especially in intensive crop rotations such as Bangladesh.

Since 2005, considerable research has been undertaken on developing CA for small farms in Bangladesh. Many research results confirm that for wheat, maize, pulses and oilseeds that sowing is feasible by mechanised planters with minimum soil disturbance. Even jute can be successfully established by machine sowing with minimum soil disturbance. Most of the planting has used strip planting where 3-5 cm width and similar depth of soil is disturbed to place seed and fertiliser while the remainder of the soil surface is undisturbed and crop residues are left standing.

The most problematic crop to produce under continuous CA is rice. The traditional puddling of soils for

transplanting destroys soil structure and reverses benefits obtained when zero tillage or strip planting are used for the non-rice crops in the rotation. Direct dry seeding (DSR) of rice is a possible CA technology, but significant weed control constraints remain in the Aman season rice due to the variable rainfall in the early wet season that hampers the efficacy of weed control. In Boro season, cold temperatures hamper successful crop establishment of the early DSR.

Non-puddled transplanting (NPT) is an alternative minimum soil disturbance technology for CA rice establishment in Aman, Aus and Boro seasons. Minimum tillage NPT (MTNPT) may be practiced following strip tillage or by zero tillage onto permanent beds or on flat land. In all cases, 18-24 hours flooding of soil needs to precede transplanting to soften soils.

Yields across a range of soils and seasons have shown that MTNPT with both manual and mechanised transplanting results in similar or higher rice yields than conventional puddling and transplanting.

# CA and Small Farm Machinery Development in Bangladesh

Many types of 2-wheel tractor-operated CA planters have been developed or imported. Some of them are commercially available and in use by the Local Service Providers and small farmers.

Several Bangladeshi companies are manufacturing the small farm machinery.

The Bangladesh-developed Versatile Multi-crop Planter (VMP) and Versatile Strip Seed Drill (VSSD) have been exported to nine countries of Asia, Africa, and North America.

## Features of Available Planters

Planter type	Main features
PTOS	SPST and ST; Tk45,000; 150 kg
VMP	ST, BP, ZT, SPST; Tk60,000; 150 kg; vertical plate seed meter and fluted roller
VSSD	ST, and SPST; Tk80,000; 165 kg; vertical plate seed meter and fluted roller with fertilizer placement facility in single pass operation
BARI strip till	
BARI Zero Till drill	
BARI Bed planter	



# Benefits of CA using mechanised planters attached to 2-WT

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Annual potential gain from 10 % adoption of CA and mechanized planting is Tk. 11 billion (base year 2013-14)

- 94,010 tonne of aman rice grain + Tk. 2.42 billion for cost saving.
- 172,440 tonne of boro rice + Tk. 2.01 billion for cost saving.
- 8,600 tonne of wheat + Tk. 0.41 billion for cost saving.
- 19,530 tonne of maize + Tk. 0.20 billion for cost saving.

## Fuel savings:

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Due to single pass planting, fuel costs are reduced by 30-85 % in strip planting and zero tillage mechanised planting.

## Yield increases:

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Significant yield increases on crop yield e.g., 8% for boro rice, 6% wheat, 8% mungbean, 38% lentil, 36% jute, etc.

## Fertiliser

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Mechanised sowing places seed and fertiliser close together which can boost early growth of crops. However, in sandy soils, if the fertiliser rate is too high and too close to the seed,

toxicity may decrease plant emergence.

## Labour savings:

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Due to single pass planting and mechanized seeding, labour costs are reduced by 30-70 % in strip planting and zero tillage.

## Savings of time

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Single pass planting reduces the time taken for crop establishment enabling crops to be planted on-time to achieve high yield potential

## Weed control

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Residue retention, herbicides and timely hand weeding can be effectively used to control weeds. More R, D&E and training of farmers on the safe and effective use of herbicides is essential.

## Seed placement

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Mechanised sowing can place seed precisely at the best depth for germination. Hence 20 % decrease in seed rate is commonly acceptable for good crop establishment.

## Soil properties

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Bangladesh soils generally have low organic matter levels. Minimum soil disturbance and crop residue retention increases soil organic matter within 2-3 years.

## Sustainable intensification

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Unsustainable water use is evident in parts of Bangladesh where the rates of water extraction for irrigation exceed recharge rates to groundwater. In the Rajshahi Division, groundwater rates are reported to be declining rapidly and

progressively, threatening the Boro rice production.

Water use for crops can be decreased by CA practices. With wheat, research suggests that 36 % water savings are possible. With DSR, 50 % water saving is reported. Longer term changes in water balance under continuous CA practices need to be determined.

Increases in soil carbon within 2-3 years under continuous CA (minimum soil disturbance plus residue retention) improve soil health.

# Enabling Environment for CA and Mechanisation

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Commercialisation of the technology for adoption of CA is needed to spread the benefits to small farmers. The private sector is a key partner by supplying planters through dealer networks, by providing repairs and spare parts services and by continuously improving the suitability of planters for the market.

Local service providers are the key actor in enabling farmers to access mechanised minimum tillage planting with residue retention.

Policy initiatives from the Government related to machinery subsidies, fertiliser subsidies, herbicide registration, extension priorities and mechanisation can improve the spread of CA.

The Government of Bangladesh through its funded R, D & E programmes is well positioned to accelerate the spread of CA and its adaptation to the varied conditions across the nation.

Subsidies are available for a range of machinery but limited support is available for CA machinery. Carefully targeted and weighted price support can act as an incentive for LSP and farmers to take up mechanised CA planting, but care needs to be exercised in avoiding price distortions in the market.

Credit is needed for LSP to be able to invest in planters under terms that allow repayment over 2-3 years.

# Recommendations

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Bangladesh is poised to begin adopting CA across a range of cropping systems, including those incorporating rice.

Research and development is needed to further refine CA packages and adapt them to different regions.

Benefits from increased adoption of CA by farmers are primarily reduced

cost of crop production (input savings), more timely sowing and water savings.

Government policies to create an enabling environment will accelerate the adoption by farmers and create incentives for the private sector to take a lead role in commercialisation of CA through mechanisation.

# Partners of Conservation Agriculture Project in Bangladesh

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## Further reading

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