

# ACIAR SDIP Program



ACTIVITY REPORT AND DISCUSSION PAPER: CONSERVATION AGRICULTURE SEEDING OPTIONS  
FOR BANGLADESH



Australian Government  
Australian Centre for  
International Agricultural Research



**ACTIVITY REPORT AND DISCUSSION PAPER  
CA SEEDING OPTIONS FOR BANGLADESH:  
THE CURRENT STATE OF PLAY**



**ACIAR SDIP Workshop**

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# Contents

EXECUTIVE SUMMARY.....	5
Background .....	5
Briefing of senior government decision makers essential .....	5
Improving the CA mechanisation value chain is a sound investment for government .....	5
Building the capacity and sustainable business models for Local Service Providers (LSP) of CA .....	6
CA machinery development options and field efficiency .....	6
Introduction .....	8
Project Methodology.....	10
Step 1: CA Seeding Machinery Stocktake Assessment .....	10
Step 2: Workshop discussion paper: 'CA seeding machinery options for Bangladesh: the current state of play' .....	10
Step 3: Workshop: Sharing Experiences with CA-based Seeding Mechanisation in Bangladesh .....	10
Step 4: Final activity report and discussion paper update.....	11
Discussion Paper: CA seeding machinery options for Bangladesh .....	12
Key 'take-home' messages from the workshop .....	12
Key Questions for future consideration .....	12
Where to from here; priorities for immediate action .....	14
Influencing policy development for CA seeding systems in Bangladesh .....	15
Workshop Briefing Paper .....	17
Introduction .....	17
CA seeding machinery characteristics .....	18
Adoption of CA Seeding Systems.....	22
Priorities for enhancing extension activities in CA mechanisation adoption.....	23
Sustainable Business Models.....	25
Efficient CA Mechanisation value chains.....	29
Collaboration and communication .....	32
Appendix 1: CA Seeding Machinery Stocktake Assessment Survey .....	35

Appendix 2: Workshop briefing paper on CA seeding machinery options for Bangladesh: *the current state of play* .....43

Appendix 3: A summary of group exercises and discussion points from the workshop ..... 60

Appendix 4: Workshop Program .....70

Appendix 5: Workshop participants who attended the workshop..... 72

# 1 EXECUTIVE SUMMARY

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## Background

A workshop for sharing experiences with CA based seeding mechanisation in Bangladesh was conducted in Dhaka on October 12th, 2019, supported by the Australian Centre for International Agricultural Research's Sustainable Development Investment Portfolio (ACIAR SDIP). The workshop was attended by over 30 senior research and extension professionals and machinery manufacturing personnel from Bangladesh, who were considered to be actively engaged in leading and undertaking research into the development, promotion, adoption and out-scaling of CA based seeding machinery.

The workshop provided the opportunity to (1) address technical aspects relating to operational efficiencies of different CA seeding machinery equipment types; (2) discuss the merits associated with a range of business models for providing farmers with access to equipment; identify (3) strategies to support out scaling of equipment and (4) opportunities to assist in providing sound policy advice to government that would assist in accelerating the adoption and out scaling of CA seeding machinery in Bangladesh.

Key findings and recommendations from the workshop are presented.

### 1 Briefing of senior government decision makers essential

There is the opportunity (and need) to brief Government policy makers on the principles of CA sustainable intensification systems (CASI) (focused on CA seeding equipment), including the benefits and impacts and the associated complexities relating to adoption and farmer practice change. A briefing document, along with in-field visits and demonstrations of the CASI systems is recommended as an important step in raising awareness amongst policy makers. Arranging a meeting with the Standing Committee of Agriculture, as well as the Bangladesh Minister of Agriculture would be of significant value.

### 2 Improving the CA mechanisation value chain is a sound investment for government

The workshop identified a range of major constraints that are considered to be restricting the widespread adoption of CA mechanisation in Bangladesh. Key opportunities for government support and intervention should be about creating an 'enabling environment' that helps to (1) stimulate increased demand for the technology and (2) improve the quality of equipment that in the longer term allows the manufacturing industry to become self-reliant.

There is the need for government to shift from providing subsidies to providing incentives. Specific government supported interventions requiring further investigation include the following:

- 2.1 Tax relief on materials used in the manufacturing of equipment;
- 2.2 Access to credit for manufacturers to cover the purchase of raw materials (to assist in larger production runs and help achieve economies of scale);
- 2.3 Access to credit for local service providers for equipment purchase;
- 2.4 Support in the establishment of a CA Platform/Centre of Excellence for Bangladesh that brings together all stakeholders to work together in a collaborative manner sharing knowledge and experience;
- 2.5 Targeted investment in research and development across the machinery mechanisation value chain that addresses specific systems constraints relating to equipment design and quality, agronomic performance of equipment and business/entrepreneurial service provision models.

### 3 Building the capacity and sustainable business models for Local Service Providers (LSP) of CA

The workshop identified that the availability and reliability of the CA seeding equipment (including access to local service providers (LSPs) served as major barriers to adoption of such seeding systems. Further to this, there are a range of constraints in the field operation of equipment (poor operator skills) and timely access to CA seeding machinery by farmers difficult (largely influenced by the location of the local service provider), with some LSPs being poorly managed.

There is the need to build capacity in this sector through developing sound business management practices and building local entrepreneurial capacity in partnership with NGOs that can help stimulate the establishment of LSPs. Linked to this is the need to undertake and develop robust business models for LSPs that clearly determine field operational costs, service delivery charge out rates for different equipment configurations (including the use of higher capacity equipment such as four wheel tractors and seed drills (imported from India).

Opportunities to stimulate private sector investment in machinery manufacturing (representing a sustainable model for building the long-term capacity of the manufacturing sector) also needs to be explored.

### 4 CA machinery development options and field efficiency

The study identified that there are a number of machinery-operational constraints associated with the range of currently available designs. There is a need to address these through instigating a higher level of collaboration and cooperation between researchers and manufacturers. Additional efficiencies can be gained in the manufacturing process through higher levels of cooperation and the designing-sharing of common equipment components (requiring some rationalisation and agreement between manufacturers).

Collaboration and partnerships will assist in the sharing of information and knowledge in an effort to address common issues as associated with machinery design, field performance and quality. The establishment of a CA Platform/Centre of Excellence for Bangladesh would help address these issues (as mentioned in 2.4 above).

## 2 Introduction

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The workshop for sharing experiences with CA based seeding mechanisation in Bangladesh was conducted in Dhaka on October 12<sup>th</sup>, 2019, bringing together research and extension professionals and machinery manufacturing personnel who were considered to be actively engaged in leading and undertaking research into the development, promotion, adoption and out-scaling of CA based seeding machinery in Bangladesh (refer to Appendix 5 for a full list of participants).

The aims of the workshop were to:

1. Provide an open forum to consolidate experiences, exchange information, and identify the challenges and failures with regard to testing and scaling CA based crop seeding machinery (utilising a value chain approach to help engage of all relevant stakeholders along the chain).
2. Enhance linkages and develop an enhanced spirit of cooperation/common ground between projects, programs and organisations working with CA seeding machinery in Bangladesh.
3. Provide participants with the opportunity to develop an improved understanding of the merits associated with different machinery options, leading to increased adoption of CA in the longer term.

The workshop provided a focus on the following issues:

- Technical aspects relating to operational efficiencies of different equipment types such as the following examples (i) Minimum tillage seed drill (two-wheel tractor operated), (ii) Strip Planting (SP) using Versatile Multi-crop Planter (VMP) seed drill (two-wheel tractor operated) (iii) Zero-till drill (two-wheel tractor operated), (iv) Raised bed planter ((two-wheel tractor operated) (iv) Zero-Till seed drills (various) (four-wheel tractor).
- Identify and discuss the merits associated with a range of business models (that improve farmer access to machinery) relating to custom hiring, ownership and timely access to equipment, access to finance considerations and gender considerations.
- Identifying strategies to support out scaling, taking into consideration organisational capacity, adoption constraints, GESI considerations, promoting successful extension models (such as innovation platforms) and developing stronger relationships with the private sector. Sharing project experiences.
- Implications in relation to shaping and influencing government policy (a longer term outcome, the aim being to commence the dialogue)

Anticipated outputs from the workshop are described:

1. A stocktake of available CA seeding machinery  
Stocktake of appropriate to Bangladeshi needs (consolidated list of machines, their capabilities and current use taking into consideration the priorities for farmers, private sector and Govt support systems) and identification of the challenges associated with the scaling of each through adopting a value chain approach.

2. Providing guiding policy advocacy and recommendations for Government.

As a longer term output (initiated through this workshop) provide supporting information to assist in providing policy advice to the GoB in relation to supporting enabling environments for the outscaling and commercialisation of CA seeding machinery systems over the next 3-5 year period. Elements may also include supporting enhanced domestic manufacturing processes and capacity development for machinery, providing guidance for government support to different machines based on stocktake list.

### 3 Project Methodology

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This project involves a number of specific steps that are described as follows:

#### Step 1: CA Seeding Machinery Stocktake Assessment

Development of a template to capture the experiences in developing the specific CA machinery (positive and negative), the main machinery specifications, agronomic challenges and benefits, level of uptake and operational efficiency parameters, features, benefits, field applications (current 'domains of use'), the business model associated with each of the machinery types, access to finance, access to spare parts etc (linked to the value chain). The template was circulated to the intended participants of the workshop to complete well in advance of the workshop.

**Appendix 1: CA Seeding Machinery Stocktake Assessment template.**

#### Step 2: Workshop discussion paper: 'CA seeding machinery options for Bangladesh: the current state of play'

The discussion paper summarises the information provided from the CA Machinery Stocktake Assessment template (Step 1). The discussion paper was circulated to workshop attendees prior to the workshop, to ensure that participants were provided with a situational analysis of the current status of CA seeding machinery in Bangladesh. The discussion paper was presented as a 'strawman proposal' with the view of spending time discussing, debating and updating the content in the discussion paper as part of the planned and facilitated workshop.

**Appendix 2: Workshop discussion paper: 'CA seeding machinery options for Bangladesh: the current state of play'**

#### Step 3: Workshop: Sharing Experiences with CA-based Seeding Mechanisation in Bangladesh

The one-day workshop addressed the following elements:

- Specifically, what recommendations and findings have arisen from past and current projects across the region (BARI, DAE, ACIAR, USAID, NGO's and others) relating to R&D, out scaling.
- Current challenges and constraints along the value chain (manufacturing, imports, government subsidies, on-farm R&D, retail, maintenance and repairs, training and capacity building, custom hire centres, adoption constraints).

**Appendix 3: A summary of group exercises and discussion points from the workshop.**

#### Step 4: Final activity report and discussion paper update

(1) Activity report capturing workshop discussions and consensus and (2) updated workshop discussion paper: 'CA seeding machinery options for Bangladesh: the current state of play'.

**This output is presented as a summary briefing report highlighting the key findings and recommended future actions in the following pages.**

The overall methodology and approach (utilising the 'straw-man' technique) adopted in this project exercise was extremely successful in terms of the quality and depth of information obtained, and the ability to initiate detailed discussions amongst participants on the day of the workshop. Such an approach for similar activities in the future is to be highly recommended. The pre-workshop survey provided workshop participants with the opportunity to provide their honest opinions, that by and large were very well-considered and 'unrushed' as what may have bene the case if only collected on the day of the workshop. Participants were in the 'lead-up' to the workshop well-informed of the purpose of the workshop, and so were more 'mentally prepared' to participate in the program.

## 4 Discussion Paper: CA seeding machinery options for Bangladesh

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### 4.1 Key 'take-home' messages from the workshop

- Participants consider that it is a matter of time before the 'tipping point' is reached in relation to the technology being accepted and adopted, but there is still a significant amount of work that needs to be done to reach this turning point.
- As demand for CA builds in Bangladesh, it was considered that additional support would be required to help maintain any particular momentum that was generated.
- Any particular support from government would need to be fully justified, evidence based with specific benefits clearly identified (in terms of increased yield, profitability and scale of the benefits).
- There is an opportunity to improve the engineering skills (design and manufacturing) in the Bangladesh CA manufacturing industry. Skills could be enhanced through identifying opportunities to access such skills from the advanced manufacturing sector in India (such as through the advanced training of Bangladesh industry engineers and manufacturers).
- There is a need to provide long term practical 'hands on' training programs that target entrepreneurial youth. Selecting those who have left school (and are quite articulate) and develop career opportunities for them in CA machinery operation through providing intensive training would help build the overall skills and capabilities of operators, and raise the professionalism of the industry.
- There is the need to utilise existing networks, rather than trying to establish new ones for the promotion and out scaling of CA mechanised seeding technologies.
- The opportunity (and benefits) to be engaged in a Regional Conservation Agriculture Platform proposed for the Indo-Gangetic Plains (initiated by ACIAR, July 2018) was re-emphasised during group discussions.

### 4.2 Key Questions for future consideration

The following represent some key points of discussion and points that were raised during group discussion and activity feedback sessions.

#### 1. Where are the drivers and the incentives for adoption of the CA technology?

It appears that there are currently insufficient incentives for adoption to take place at all places along the CA mechanisation value chain. Therefore, adopting a planned and strategic approach would be of considerable benefit, to identify where any particular support can be best targeted and in turn supporting the specific 'drivers of change'.

#### 2. How best can we create demand for the technology?

There were a number of elements discussed, for example it was necessary to initially create awareness of the CA technology. It was considered that there was a need to establish a CA platform that would focus on demonstrating the technology and to provide a focus on out scaling of the technology. Those attending the workshop were aware of the benefits of CA

mechanisation, but there were no established pathways in relation to communicating and extending information to farmers and other stakeholders effectively.

### **3. How best can awareness of CA be raised as the first step towards adoption?**

The need to have farmer testimonials (for promotion of the technology) that illustrate the adoption processes that they have gone through would be a useful approach to begin with. It was considered that there is the need to develop an overall strategy to increase awareness of the technologies. Importantly, there was the need to identify who would be responsible for implementing an awareness raising exercise. This process could be led by a CA platform.

### **4. How best could incentives be designed and targeted to maximise uptake of CA?**

There was quite a bit of discussion in this area, with no real consensus reached. For example, those engaged in the manufacturing felt that the government should provide financial support to help establish factories that could be set up for the purposes of undertaking large scale manufacturing of CA equipment.

### **5. What is the role of the private sector in supporting uptake of the technology?**

It was considered that there is an important role for the private sector to take on a significant role in driving up demand for the technology. In the manufacturing sector there was the need to think in large volumes of machinery output, to focus on producing quality products rather than short-run production that was often project based, with price being put ahead of machinery quality.

### **6. Should other options outside of local manufactured equipment be considered in Bangladesh?**

The workshop largely focused on identifying strategies relating to supporting the local CA seeding equipment manufacturing sector. Specific conversations focused on how best to create demand amongst farmers (linked to the need to significantly increase the scale of production in order to achieve economies of scale) which is strongly aligned to addressing constraints to the adoption of CA seeding mechanisation, issues surrounding manufacturer access to poor quality steel that is used in the manufacturing process (with much of the steel being sourced from the ship break up industry in Bangladesh), and the need to introduce quality assurance initiatives in the manufacturing process.

There was little dialogue during the workshop in relation to the importation of CA seeding machinery, with the exception of CA seed drills used with 4 wheel tractors sourced from India. Workshop discussion also focused on the opportunity to assess the role of 4 wheel tractors and CA ZT seed drills in Bangladesh from an efficiency perspective as an option to using 2 wheel tractor driven seeding equipment. There is the need therefore to explore further the opportunity and benefits that may be gained through the use of larger capacity seeding systems as is offered with equipment used with 4 wheel tractors.

### 4.3 Where to from here; priorities for immediate action

Participants identified a range of activities requiring few resources that when implemented in the short term would be capable of enhancing the adoption of CA mechanisation and related value chains in Bangladesh.

The following present specific action points that should be initiated as part of a ‘whole of industry approach’ to supporting the development of enabling government policy, improved manufacturing and quality performance of CA seeding machinery and adoption of CA mechanisation in Bangladesh (i.e. addressing all opportunities along the CA mechanisation value chain). There is the opportunity to give due consideration towards providing support in the further refinement of such an implementation strategy, and assistance in the initial establishment and facilitation of such processes in Bangladesh to help initial establishment and local capacity to take such initiatives forward.

#### **CA seeding machinery**

1. Conduct a survey to identify the opportunity of expanding CA systems in Bangladesh
2. Develop a knowledge bank on CA systems that can be shared amongst all stakeholders, to assist in the sharing of information, knowledge and experiences.
3. Explore CA mechanisation commercialisation, in terms of developing sustainable business models that integrate quality assurance of the end product.

#### **Adoption of CA Seeding Systems**

1. Organise an annual round table meeting/workshop of all stakeholders (to include agricultural ministry, secretary, policy makers, researchers, extension personnel, NGOs, private sectors, farmers, LSPs) at national and regional levels.
2. Organise training of LSPs and mechanics in districts and regional areas, through taking a coordinated approach, and engaging with all stakeholders and organisations (building on the network of participants in attendance at this workshop).
3. Organise CA demonstrations by cropping patterns at specific sites with the range of CA machines (this in turn would help to better understand and determine suitability of equipment, assess the best design features and integrate these into improved machinery design and manufacturing.)

#### **Sustainable Business Models**

1. Conduct a market assessment of the different business models.
2. Develop specific processes that help identify and support the development of entrepreneurs capable of establishing commercially sound service provider businesses (linked to the development of skills of the entrepreneurs and staff).
3. Identify and design improved approaches to post-sale services (machinery repairs and maintenance, servicing of equipment) and the ready availability of spare parts (key elements for establishing efficiency CA machinery value chains).

#### **Efficient CA Mechanisation value chains**

1. Explore the opportunity for establishing CA (innovation) platforms, that incorporate group demonstrations, the sharing and networking of information and experiences.

2. Strengthen relationships between the private sector and government through the establishment of MoU's with the Ministry of Agriculture and policy makers.
3. The development of a one-page briefing paper that describes the principles of CA and how it is applied to Bangladesh farming systems would be a step in the right direction towards educating and influencing policy makers.
4. Boost collaboration across the different production systems in Bangladesh, through better north-south cooperation, improved cooperation and networking with colleagues.
5. Strengthening public-private relationships, developing new and stronger partnerships.
6. Prepare a synthesis of what is already known about CA practice in different regions of Bangladesh and form the basis of a CA brain storming platform.
7. There should be a good empirical basis to argue for to CA mechanization in the context of currently practiced wetland cultivation of rice. Special emphasis is needed to demonstrate to farmers clearly that CA mechanization does not only provide benefits to the environment (soil, water savings which is rather remote for an individual farmer) but CA does significantly improve yield, cropping intensity, reduce weeds and labour costs etc (which is more of a direct farmer benefit).

#### **Collaboration and communication**

1. Capacity building of the whole value chain including policy and users (producers).
2. Remove support to rotovator and other soil structure destroying equipment so that subsidies are directed towards CA based equipment (where provision of subsidies may be directed).
3. Conduct further research to support the development of improved practise relating to rice production under minimal soil disturbance practices.
4. Prepare guidelines to manage residue management under combine harvesting systems (to avoid the risk of stubble residue burning and related consequences (air pollution and decline in soil fertility).
5. Update FAO's definition of CA to better reflect the practices and environment of South Asia (context).

Whilst it is recognised that many of the initiatives listed above have been conducted in the past, the need to adopt a coordinated approach and share the information amongst all stakeholders was considered a positive benefit that would arise from a higher level of cooperation and communication amongst those attending the workshop. The above action points can in fact be further prioritised in order to develop a 'staged action plan' for implementation by participants and others who attended the workshop. This initiative however needs to be driven by project team (ideally engaging with a sub-set of workshop participants), and would require project resources to help drive this process.

#### **4.4 Influencing policy development for CA seeding systems in Bangladesh**

Through the workshop discussions, it was identified that there is the need to identify how best policy makers can be informed and influenced by the high level of understanding and opportunities that are associated with the development of CA mechanisation seeding systems

in Bangladesh. This understanding relates to the wealth of knowledge and experience that has been developed by key stakeholders and organisations such as those that were represented at this specific workshop.

It was considered that a follow up meeting with the Standing Committee of Agriculture, as well as the Bangladesh Minister of Agriculture would be of significant value. What would be required to be presented would be clear and concise evidence based recommendations relating to the development of enabling policy supportive of strengthening CA seeding mechanisation value chains and increased on-farm adoption of associated technologies. A range of different scenarios accompanied by different outcomes (including the scale, potential benefits and net impacts) according to the design of interventions would be presented to, and discussed with policy makers. This activity would also serve as an opportunity to inform them of the need to prioritise support relating to CA machinery, as opposed to supporting the blanket subsidy of machinery that was in opposition to CA principles (rotovators for example). As a longer term outcome, ideally the opportunity to revise the Agricultural Policy relating to CA would be the ultimate goal.

## 5 Workshop Briefing Paper

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### 5.1 Introduction

The purpose of this workshop briefing paper is to provide a summary of the findings from the Conservation Agriculture CA Seeding Machinery workshop and stocktake assessment survey, with the view of providing a summary report highlighting the key findings and recommendations for future action.

There has been a significant level of investment in resources and scientific capability directed towards the development of CA seeding machinery over the past 20 years (or more) in Bangladesh. There have been a range of different mechanised seeding equipment configurations and models developed based on satisfying CA principles of one-pass sowing with minimal soil disturbance. Despite the advancements in design for smallholder farmers, adoption levels of CA seeding systems across Bangladesh remains at relatively low levels.

The purpose of this discussion paper is to gather the experiences of stakeholders actively engaged in the research, extension, manufacturing and supply of services associated with CA seeding machinery in Bangladesh, with a focus on identifying the constraints to adoption, possible pathways to maximise adoption amongst smallholder farmers, opportunities for improving the efficiency of the CA machinery value chains, and to identify how reform in policy may be able to create a far greater enabling environment.



Figure 1 Illustration of the mechanised seeding machine types being examined in this study and workshop.

This briefing paper focuses on five key areas that serves as the structure for the presentation and discussion of the findings and recommendations arising from the workshop and study, these being described as follows:

1. **CA seeding machinery characteristics:** Identifying advantages of CA machinery configurations (including integration into farming systems).
2. **Adoption CA Seeding Systems:** Enhancing the adoption of CA seeding systems through addressing systems constraints.
3. **Sustainable Business Models:** Building the capacity and sustainable business models for Local Service Providers (LSP).
4. **Efficient CA Mechanisation value chains:** Develop an enabling environment to improve CA mechanisation value chain efficiencies (including Govt policy).
5. **Collaboration and communication:** Collaboration and communication across the CA mechanisation value chain (including opportunities for forming an association), opportunities for developing Innovation Platforms.

## 5.2 CA seeding machinery characteristics

### Identifying the relative advantages of CA machinery configurations

- There is a need to have an open-minded approach to examining the relative efficiencies (and advantages) of the different CA seeding machinery designs (including 4WT CA seed drills).
- There needs to be an assessment of the relative advantages and disadvantages of the different machinery configurations.
- Questions arising from the study include what opportunities are there for further collaboration across the different organisations and machinery configurations?
- Linked to this is the need to identify and design specific business models designed for specific equipment types that are reflective of the scale and capacity of operation of the equipment.

The pre-workshop survey provided an indication of the relative constraints associated with the different machinery types, this was far more valuable (and quantitative in nature) in comparison to the workshop activities. Results are presented in **Table 1**.

**Table 1 Level of agreement to a range of CA seeding machinery adoption related constraints**

#	Specific adoption-related constraint	Average Score of respondents					
		1 = not important    2 = slightly important    3 = moderately important 4 = very important    5 = extremely important					
		A. Two wheel tractor operated strip till planter (Min till)	B. Strip Planting using Versatile Multi-crop Planter seed drill; 2WT	C. Zero-till drill; 2WT operated	D. Raised bed planter; 2WT operated	E. ZT seed drills; 4WT operated	F. Common to all
1	Unreliable machinery (frequent break-downs)	3 (n=4)	2.5 (n=6)	2.5 (n=2)	3 (n=2)	2 (n=2)	2.4 (n=5)
2	Machines difficult to service and repair	3.75 (n=4)	2.5 (n=6)	3 (n=2)	3 (n=2)	3 (n=2)	2.2 (n=5)
3	Machinery sows seed poorly (with poor crop emergence)	3.5 (n=4)	2.5 (n=6)	3 (n=2)	3 (n=2)	3 (n=2)	2.4 (n=5)
4	Difficulty in properly controlling weeds	2.75 (n=4)	2 (n=6)	2.5 (n=2)	3 (n=2)	3 (n=2)	3.5 (n=4)
5	CA machinery is physically too heavy for farmers to use	2.6 (n=5)	2.14 (n=6)	2.67 (n=3)	3.33 (n=3)	1.67 (n=3)	2.4 (n=5)
6	Machinery is too expensive for farmers to purchase	3.2 (n=5)	3.71 (n=7)	3 (n=3)	3 (n=3)	3.33 (n=2)	2.8 (n=5)
7	The seeding operation takes too long (poor field efficiency)	2.2 (n=5)	2.14 (n=7)	3 (n=3)	2 (n=3)	1.5 (n=2)	2.25 (n=4)
8	Machinery unable to sow some crop types very well	3 (n=5)	2.14 (n=7)	3 (n=3)	3 (n=3)	3 (n=3)	2.25 (n=4)
9	The ZT seed drill requires user to purchase costly 4WT	N/A	N/A	N/A	N/A	3.75 (n=4)	N/A

A summary of the identified machinery constraints (along with suggested approaches opportunities to address these) are provided in **Table 2**. Information provided is quite comprehensive and detailed in nature. Though addressing the specific constraints, there is the opportunity to improve CA machinery operational efficiencies, the agronomic performance (management of the seeding operation, weed control, seed placement and crop emergence) and importantly the quality of the machinery (largely the manufacturing process). These constraints were identified through the pre-workshop survey. There seemed to be a reluctance at the workshop for participants to be ‘up front’ about the specific shortcomings of the machinery.

**Table 2 Summary of the advantages, constraints (and opportunities to address constraints) associated with the various CA seeding machine configurations, as provided by survey respondents.**

Machine advantages	Machine constraints	Opportunities to address constraints
<b>1. Two-wheel tractor 2WT operated strip till planter (Min till)</b>		
<ul style="list-style-type: none"> <li>Machine could be used for strip tillage, zero tillage and also for full tillage.</li> <li>Tilling soil and placing of seed and fertilizer could be done in one pass.</li> <li>This machine could be used as planter for large seed as well as seeder for medium to small seed.</li> </ul>	<ul style="list-style-type: none"> <li>Machine weight is high.</li> <li>Lack of training and demonstration.</li> <li>No uniform seeds are available.</li> </ul>	<ul style="list-style-type: none"> <li>Some part of the machine could be made by plastic to reduce the weight.</li> <li>Training should be given to the user.</li> <li>Seed should be graded.</li> </ul>
<ul style="list-style-type: none"> <li>Tillage operation cost low.</li> <li>Minimum irrigation requirements.</li> <li>less crop lodging.</li> </ul>	<ul style="list-style-type: none"> <li>High weed infestation.</li> <li>More technical knowledge required.</li> <li>Have knowledge on soil texture.</li> </ul>	<ul style="list-style-type: none"> <li>For refining constraints you have to Knowledge on engine and need. trained/skill operator as well as spare parts availability.</li> <li>Good knowledge on calibration (seed rate and depth of seeding), soil. condition, rice straw, seed size.</li> </ul>
<ul style="list-style-type: none"> <li>Saving time and quick sowing.</li> <li>Comparatively low production cost.</li> <li>Scope for utilization of stubble retention.</li> <li>Land topography (size) is factor to utilize this type of machine.</li> </ul>	<ul style="list-style-type: none"> <li>Machine &amp; spare parts are not available in community level.</li> <li>Scarcity of skilled operators.</li> <li>Farmer's faith on this machine is limiting factor.</li> <li>Accuracy and efficacy performance of the machine is low.</li> </ul>	<ul style="list-style-type: none"> <li>Sensitizing machine manufactures and importers.</li> <li>Trained up skill operator.</li> <li>Awareness amongst farmers.</li> <li>Govt. can take care their extension services in terms of CA machine.</li> </ul>
<ul style="list-style-type: none"> <li>This can be used as a multiple purpose machine with small adjustment and changing the configuration.</li> <li>One operation for sowing.</li> <li>Reduced time and cost of crop establishment.</li> </ul>	<ul style="list-style-type: none"> <li>Quality is big concern.</li> <li>Efficiency of machine is very low not suitable for business model and only provide small business as Bangladesh is rice based cropping systems (three crops in a year).</li> <li>Cost is very high considering efficiency of the machine.</li> </ul>	<ul style="list-style-type: none"> <li>Improved quality should be 1<sup>st</sup> priority.</li> <li>It must be taken by big manufacturing company for commercialization.</li> <li>Operational training and awareness</li> <li>Develop the micro-entrepreneurship at community level.</li> <li>Govt. should take ownership to implement the CA based mechanization.</li> <li>Do we really think that 2WT based planting is viable in</li> </ul>

		Bangladesh? We should revisit our strategy and approach.
Machine advantages	Machine constraints	Opportunities to address constraints
<b>2. Versatile Multi-crop Planter (VMP) seed drill (2WT operated)</b>		
<ul style="list-style-type: none"> <li>Multi-crop establishment ability in strip, bed, zero, single pass shallow, even conventional tillage.</li> <li>Row and plant spacing adjustment ability.</li> <li>Ability to sow continuous or spaced planting.</li> <li>Ability to prepare land, seed sowing, fertilizing and planking in single pass operation.</li> <li>Operator does not require to calibrate seed.</li> <li>Having seating arrangement for road transportation and bigger plot planting</li> </ul>	<ul style="list-style-type: none"> <li>In case of smaller plot, walking behind the planter.</li> <li>Difficult to handle if &gt;5.0 t/ha of fresh and wet and loose residue.</li> <li>Need 35-40 kg weight balance iron block placement in front of 2WT for weight balance.</li> </ul>	<ul style="list-style-type: none"> <li>In case of small plot, collective planting systems establishment.</li> <li>More training to operators for improvement of residue handling capacity of VMP.</li> <li>Mindset improvement of LSP on CA benefit to convince farmers in CA practice.</li> </ul>
<ul style="list-style-type: none"> <li>Strip or bed planting of several crops, land preparation, seed sowing and fertilization in a single pass operation.</li> <li>Continuous sowing or spaced planting.</li> </ul>	<ul style="list-style-type: none"> <li>It does work well when more than 30% residues are retained.</li> </ul>	
<b>3. Zero-till drill (2WT operated)</b>		
<ul style="list-style-type: none"> <li>This can be used as a multiple purpose machine with small adjustment and changing the configuration.</li> <li>One operation for sowing.</li> <li>Reduced time and cost of crop establishment.</li> </ul>	<ul style="list-style-type: none"> <li>Quality is big concern.</li> <li>Efficiency of machine is very low not suitable for business model and only provide small business as Bangladesh is rice based cropping systems (three crops in a year).</li> <li>Cost is very high considering efficiency of the machine.</li> </ul>	<ul style="list-style-type: none"> <li>Improved quality should be 1st priority.</li> <li>It must be taken by big manufacturing company for commercialization.</li> <li>Operational training and awareness</li> <li>Develop the micro-entrepreneurship at community level.</li> <li>Govt. should take ownership to implement the CA based mechanization.</li> <li>Do we really think that 2WT based planting is viable in Bangladesh? We should revisit our strategy and approach.</li> </ul>
<b>4. Bed planter (2WT operated)</b>		
<ul style="list-style-type: none"> <li>Tilling land, bed making and placing of seed in one pass.</li> </ul>	<ul style="list-style-type: none"> <li>Need training.</li> <li>Lack of permanent bed based cropping system.</li> </ul>	<ul style="list-style-type: none"> <li>Hands on training should be given to the users.</li> </ul>

<ul style="list-style-type: none"> <li>Machine could be used as bed former for planting of vegetables seedlings.</li> <li>Water saving (30%) technology.</li> </ul>	<ul style="list-style-type: none"> <li>Farmers are not quite aware of this machine.</li> </ul>	<ul style="list-style-type: none"> <li>Adoption program should be taken.</li> </ul>
<b>5. Zero-Till seed drills (various) (four-wheel tractor 4WT operated)</b>		
<ul style="list-style-type: none"> <li>Seeds can be sown without cultivation and at varying depths</li> <li>Fertilizers can be applied</li> </ul>	<ul style="list-style-type: none"> <li>Farmers lack experience in machine operation</li> </ul>	<ul style="list-style-type: none"> <li>Farmers need to be adequately trained to operate the machine</li> <li>Demonstration should be done at the ground level</li> </ul>

The workshop group activities identified a range of common issues that could be addressed through a collective effort between projects and developers of the different machinery type (**Table 3**).

**Table 3 Identification of common issues experienced by multiple CA seeding machinery types that could be addressed collectively.**

Common Issue	What needs to be done	Approach to be taken
1. Quality machine manufacturing	Improved workshop machine Technical training Soft loan for manufacturing	Private sector investment provides longer term sustainable model.  Government investment and support in R&D that is provided to both manufacturers and research institutes is also required.
2. Capacity building for machinery operator	Arrange training on CA systems	Hands-on training. Exposure visits.
3. Upscaling of CA technology	Large scale demos Experience sharing	Block demonstrations.
4. Collaborative approaches	R, D & E should be one (integrated) approach	Establishment of a CA centre.

### 5.3 Adoption of CA Seeding Systems

#### Enhancing the adoption of CA seeding systems through addressing systems constraints

- The perceived barriers to adoption of CA seeding systems by farmers is not so much related to the complexities of the technologies or the ability of farmers to recognise the potential yield benefits associated with the improved CA systems.
- Factors that are considered to serve as the major barriers to adoption include the cost of the equipment (thereby emphasising the importance of Local Service Providers (Team 3).
- There is the need to address constraints, identify training and capacity building opportunities, identify specific scaling considerations and strategies, develop adoption

pathways/roadmaps, and consider market segmentation approaches and Gender Equity Social Inclusion (GESI) integration principles.

The pre-workshop survey provided a valuable insight into the constraints to the adoption of CA seeding machinery. The highest rating constraints were as follows:

- CA seeding machinery operators have poor skills resulting in poor results in the field.
- Timely access to CA seeding machinery by farmers in the field is often difficult.
- CA seeding machinery is too expensive to purchase outright by the farmer.
- Custom hire centres do not exist in many districts where there is farmer demand.
- Poor sharing of CA seeding info between R, D & E and manufacturers/distributors.
- Custom hire centres are not well managed.
- Machinery subsidies do not provide sufficient incentive for adoption by farmers.

Those constraints considered to have least influence over adoption were:

- Farmers consider there is no yield advantage/benefit of the CA seeding technologies.
- CA seeding machinery technology concepts are too difficult for farmers to understand.

#### **Additional adoption-related constraints**

There were a wide range of additional constraints identified by survey respondents that collectively provide a valuable insight into the complexity of issues associated with the adoption process, including the following:

- Distribution of poor-quality planters (particularly those that are bulk purchased under projects) create a bad reputation for all planters, particularly those that are of high quality.
- There is a degree of unhealthy competition amongst researchers, manufacturers and projects. There is also a lack of coordination, consensus and communication across such parties.
- Selection of local service providers (LSP) is based on local and political interference rather than on the capability or potential to become LSP.

#### **5.4 Priorities for enhancing extension activities in CA mechanisation adoption**

Respondents to the pre-workshop survey identified a large number of extension related priorities for CA seeding mechanisation systems in Bangladesh. Many of these relate to enhanced communication and coordination, and so are presented in this section:

- There is a need to develop training modules and programs focusing on CA mechanisation, this needs to be systematic, and extension officers need to be amongst those targeted for the training.
- A policy dialogues is required, since there is a policy shift required away from subsidising machinery that is detrimental to soil health, that is clearly not CA based.

- Subsidies for CA seeding equipment needs to be reviewed, with incentives provided to farmers who adopt the technologies.
- Improved coordination through introducing a number of new initiatives, these include the opportunity to develop a CA Hub to serve farmers in extending the technologies, other options include a DAE farm machinery service centre.
- An opportunity to better engage and support the role that NGOs have in terms of the out scaling of the CA mechanisation technologies, giving the private sector a more significant role to play, including support for CASI technology service provision and capacity building.

A useful workshop exercise that was conducted set out to identify the major constraints to the adoption of CA seeding systems in Bangladesh, and is presented in **Table 4**. The most significant constraints identified by group participants were: (1) a lack of policy support on CA; (2) a lack of skilled operators and CA machinery mechanics and service providers; and (3) a lack of awareness amongst farmers, end-users and relevant stakeholders in relation to the technologies.

**Table 4 Identification of the major constraints to the adoption of CA seeding systems in Bangladesh (according to point of impact along the CA mechanisation value chain).**

Constraints	Machinery design & research	Manu- facturing	Service providers and access	Repairs and maintenance	Farmer extension and adoption	In-field operation	Govt policy
1. Lack of policy support on CA							X
2. Lack of skilled operators amongst LSPS			X	X	X	X	
3. Lack of awareness among farmers/end users			X		X	X	
4. Lack of knowledge of the practices and adopter profile					X		
5. The market of CA is small and segmented			X				
6. Low involvement of women in CA operations					X		
7. Lack of suitable seating in operation of equipment	X	X				X	

8. Low operational efficiency in the field	X	X				X	
9. Lack of subsidies							X
10. High weed pressures						X	

Solutions to addressing the most important constraints were then discussed and identified by workshop participants, and are presented in **Table 5**.

**Table 5 Potential solutions to identifying the most significant constraints (as identified and discussed by group participants).**

Constraint	What needs to be done	Approach to be taken
1. Lack of policy support on CA.	Policy dialogue required, and needs to be collectively driven by all stakeholders, not just government.  Advocacy by influential people. Written policy.	Organise a CA committee to inspire the viability and promote CA in Bangladesh.
2. Lack of skilled operators, mechanics and LSPs.	In-depth training on CA by the operators, mechanics and LSPs.  Ensure tools/spare parts are available.	Provision of practical training.  Develop training manuals/resources.  Require certification of operators.
3. Lack of understanding of CA by farmers.	Trained men and women farmers as operators.  Increasing farmer awareness through practical demonstrations.	Develop a CA mechanisation training centre.  Consider training men and women separately considering social, cultural & religious norms.

The group also identified a range of opportunities to enhance the integration of Gender Equity Social Inclusion (GESI) principles into CA mechanisation activities, these being;

1. Build the capacity and understanding of CA amongst women (including training).
2. Develop extension strategies factoring in social and cultural barriers to adoption (and also mobility, safety & women operators).
3. Develop 'women friendly' machines, supporting them in the use of such equipment.
4. Develop post-harvest enterprises and engage women (can be entrepreneurial business driven approaches).

## 5.5 Sustainable Business Models

### Building the capacity and sustainable business models for Local Service Providers (LSP)

- The survey identified that the availability and reliability of the CA seeding equipment served as major barriers to adoption of such seeding systems.
- Operator and business-related skills of the LSPs were also considered to be significant barriers. This was identified as a major need and opportunity.
- There were a number of excellent examples where such models had been successfully established, including the efforts of RDRS and the Conservation Agriculture Service Provider (CASP) network.
- The need to engage and link the finance/banking sector to LSPs was also identified as an urgent need.
- Other considerations include developing valid economic comparisons and business cases for investment (and enhance access to finance), issues relating to capacity building (including raining of operators, repairs and maintenance).
- Most CA planters do not qualify for government supported subsidies, with the government subsidising some planters that can't be categorised as being CA compatible (due to excessive soil disturbance).

A summary of the findings from the pre-workshop survey are presented in **Table 6**.

**Table 6 Strength of partnerships across the machinery value chain, as indicated by survey respondents.**

Partner type	Comments relating to interest in forming partnerships
1. CA machinery manufacturers (n=11)	Need strong partnerships with past and re-establish opportunity I didn't see much attraction of manufacturer on CA machinery in Bangladesh as commercialized way. I am sure they are not looking this sector as a potential large volume of business. Yes, I do agree lot of efforts made by Research, Development organization but on project targeted. This will require brainstorming.
2. CA machinery importers (n=10)	There are not much CA machineries exists for 2WT-based smallholders Need strong partnerships with past and re-establish opportunity Attempts to establish the partnership in Bangladesh to import the CA machineries was unsuccessful There is potential to explore the quality import machinery in better competitive price and also focussed on 4WT based machinery as well
3. CA machinery distributors/ retailers or suppliers (n=11)	Need strong partnerships with past and re-establish opportunity They are not looking this sector as a volume of business in Bangladesh It would be better to also capitalized the 4WT based machinery in Bangladesh
4. Custom Hire Centres / LSP (n=10)	Need strong partnerships with past and re-establish opportunity There is very strong network on custom hiring centre but need to provide capacity building through training and technical backstopping
5. Bangladesh National Research Org. (n=11)	Need strong partnerships with past and re-establish opportunity Strong research for development

6. Bangladesh National Extension Organisations (n=11)	Need strong partnerships with past and re-establish opportunity Need to put more emphasis and also require capacity building
7. Bangladesh Govt Policy Makers (officials) (n=10)	Need strong partnerships with past and re-establish opportunity Require immediate attention
8. CIMMYT (n=11)	We tried to establish partnership. However, CIMMYT did not show interest. We tried to establish partnership. However, CIMMYT inform us there is no scope to build collaboration to enhance CA promotion.
9. ACIAR funded projects relating to CA mechan. (n=9)	Need strong partnerships with past and re-establish opportunity Great efforts but need to think towards commercialization
10. Murdoch University (n=8)	Need strong partnerships with past and re-establish opportunity Working in isolation need to establish relations
11. ACIAR/SRFSI research/project staff (n=10)	We tried to establish partnership. However, SRFSI did not show interest. To promote CA mechanization in farmers field also like to get project support to accelerate adoption of CA mechanization; need strong partnerships with past and re-establish opportunity
12. Farmers org (CASPA CA Service Prov Org) (n=9)	To promote more CASI
13. Farmer Innovation Platform groups (linked to SRFSI project) (n=8)	To promote more CASI We are un-familiar with this system. Also, we have established farmers' organization like CASPA. Need strong partnerships with past and re-establish opportunity
14. Bangladesh Universities (n=11)	We worked with Murdoch University with ACIAR funded project which had partnership With Haque corporation. If we do continue any further research and extension activities it would need reestablishment of partnership with machine manufacturer. To include CASI in the university degree courses Need strong partnerships with past and re-establish opportunity Not much scope to involve universities but it was possible to engage through students
15. Finance/Banking (n=8)	Not worked, directly, but we tried to establish link between/among Credit/Finance agencies and LSPs (individually and/or in Group). Need strong partnerships with past and re-establish opportunity
16. Farm Input suppliers (fertilisers, pesticides) (n=7)	To promote more CASI Need strong partnerships with past and re-establish opportunity
17. NGOs engaged in out scaling of CA machinery; specify: (n=8)	Strip Till, Mechanical Rice Trans planter Need strong partnerships with past and re-establish opportunity There are only few NGOs explore but there is a huge potential to explore the possibilities of those who are working on climate resilient, agricultural development and rural development

18. NGOs supporting self-help groups: specify: (n=3)	RDRS
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**Table 7 Business models options for providing farmers with improved access to CA seeding machines.**

Specific Business model	General features and characteristics	Types of CA seeding machines can be used in this model
1. LSP	Field demonstrations	Strip Till 2WT
	Interest in machine	VMP
	Interest in the business	ZT 2WT
		Raised Bed planter
2. Farmers groups	Field demonstrations	Strip Till 2WT
	Entrepreneur selection	VMP
	Group decision making	ZT 2WT
		Raised Bed planter
3. Farmers Hub (federation)	Social enterprise	Strip Till 2WT
	Farmers become agri-entrepreneurs	VMP
	Group demonstrations at agri-centres	ZT 2WT
	Financial linkages (Bank of Asia, MFI)	Raised Bed planter

**Table 8 Strengths and weaknesses associated with each of the identified business models.**

Specific Business model	Strengths	Weaknesses
1. LSP	Individual business interest	Challenge of market entrance
	Choice of investment	Capital mobilisation
	Freedom of decision making	Market monopoly
2. Farmers groups	Better mobilisation of markets	Achieving consensus may not be easy
	Easy access to finance	Synchronisation of machine operations difficult
	Offer lower service cost	
	Secure capital mobilisation	Leadership conflict

3. Farmers Hub (federation)	Different pricing systems	Problems associated with decision making
	Offers multiple services	
	Captive market	

Participants identified the most important/desirable characteristic for the business models, these being;

- Skilled in machine operation and maintenance.
- Good business understanding.
- Provide multiple services (a 'one-stop' shop, whereby service providers provide an integrated multiple service package (seeds, fertilisers, tillage, seeding, crop protection, harvesting and marketing support).

### 5.6 Efficient CA Mechanisation value chains

Designing interventions for providing an enabling environment to improve CA mechanisation value chain efficiencies (including Government policy).

- There were a number of significant constraints facing the local manufacturing sector in Bangladesh. These included the access to quality building materials, and the issue of scale of manufacturing, farmer demand and the issue of cost of production.
- To make CA seeding equipment more affordable, there was an identified need to significantly increase volume of production, this was currently not possible.
- Identification of other interventions/support along the value chain needs to be explored, including subsidy dynamics, developing a policy guideline framework and report (from the workshop).

It is worth noting the particular constraints and challenges associated with the CA mechanisation value chains, as identified in the pre-workshop survey:

- Low market and seasonal demand.
- High cost of raw materials and import taxes on raw materials, spares for local manufactured CA planters.
- Difficulty in accessing high quality raw materials as well as availability of spare parts.
- Higher labour, manufacturing, marketing and establishment costs
- Lower demand and small market size of CA machine; hinders ability to minimise costs of production.
- Minimal scope to receive support from Govt and NGOs to support market promotion to private sector.
- There is the need to identify how production output can be significantly increased, to help drive up demand and in turn reduce the costs of production (and retail price of the equipment).

### Challenges faced in relation to the importation of CA machinery

- Small scale for local demand
- Exporters like to get bulk orders as well as their lack of organisational ability/presence
- Seasonal market
- Quality assurance
- High level custom and VAT charges

### Opportunities for improving the design/characteristics of manufactured/imported machinery

- Reduce weight.
- New seed meters for varied crops (VMP).
- Need proper training from abroad to maintain quality control and build manufacturer's skills.

### Most important benefits offered to farmers in relation to CA machinery

- A single machine that can provide precise planting, fertilizing and planking in single pass operation.
- Cost saving, time saving, labour saving, reduce turn-around-time, water savings, higher yield & profit.
- Price support to buyer (LSP/farmers) with 2WT for VMP promotion

### Opportunities for improving the approach to government subsidies

- Most of the cases, the direct subsidy by government seem non-effective.
- We are practicing the incentives to LSP based on CA planting area. The planting incentive are being practiced successfully by Murdoch University & Hoque Corporation for the out scaling of VMP.
- A separate fund should be provided to private sector for CA promotion & commercialization for demand creation, training, repair & maintenance, transportations of the machineries, after sale service, monitoring and follow-ups. The subsidised fund could be used effectively for this purpose

With this information in mind, workshop participants described what they considered to be the characteristics of efficient CA mechanisation value chains, and to identify to what degree such characteristics existed (and if it were possible to change the current situation). Results are presented in **Table 9**. Participants then identified the impediments to developing an efficient manufacturing base for CA machines in Bangladesh (**Table 10**).

**Table 9 Characteristics of an efficient CA mechanisation value chain**

Specific characteristic	Current existence of the characteristic 1=non-existent, 2=low level, 3=moderate, 4=high	Is it possible to change the situation?
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1. Importers and manufacturers	4	-
2. Dealerships – AZF credit, distribution, after sales service	2	Y
3. LSP	2	Y
4. Workshop, mechanics, operators, spare parts	2	Y
5. Training LSP, operators, mechanics, manufacturers, finance, public/projects	2	Y
6. Partnership development; development organisations, GDB, NGOs, others	2	Y
7. Demonstrations and extension activities, issues with lack of budgets	2	Y
8. Farmers associations and groups	2	Y
9. Manufacturers association and retailers	3	Y
10. ERD/planning commission – interconnection of Ministries	2	Y

**Table 10 Current impediments to an efficient local manufacturing base for CA machines in Bangladesh (along with what action is required to address such constraints).**

Major impediments	What needs to be done
1. Markets; knowledge and demand for machinery	Promotion, awareness raising, demonstrations
2. Policy – mechanisation needed, no support for the environment, taxes, import duties and subsidies skew and corrupt the market	Relationship building, training, linkage integration, awareness, discuss with GoB to reduce taxes and alter policies accordingly
3. Quality of inputs (such as steel for manufacturing, poor quality sourced from ship break-ups). No metal testing facilities (metallurgy labs)	Material testing to strengthen quality parameters, developing appropriate methodologies (no metallurgical testing exist in Bangladesh)
4. High cost of some machinery makes it unaffordable to many end-users.	Explore options for leasing of more expensive machinery, in addition to improved access to finance
5. Poor quality training and capacity building (these are not linked to what the industry needs) Private sector is driving training needs	Training and capacity building, upgrading of equipment, improved facilities, tools – private sector to invest in TVETS system
6. Integrating of parts/components and machinery manufacturing – no knowledge on what is needed by large manufacturers, no connectivity, not aware of BD’s comparative advantage to supply US/European manufacturers	Clustering, capacity building, networking, development of common components shared between manufacturers. Connect with OS companies especially those that have already established facilities in other developing nations.

The group identified opportunities for government policy to enhance the efficiency of the CA mechanisation value chains (**Table 11**), with the reasoning for this response also provided.

**Table 11 How can government policies can best enhance the efficiency of the CA mechanisation value chains.**

Policy initiatives	Why they would work (improving CA mechanisation value chains)
1. Shift subsidies to incentives – align with climate smart outcomes	Better management, more sustainable practices, less corruption (leakage in the system).
2. CA platform – centralising activities and funding – and demonstrations	Training, awareness, integrated approaches that also consider agronomy and crop husbandry practices as part of an integrated approach to cropping systems improvement (including non-rice crops outside of rice-based systems).
3. CDP – specific detail relating to benefits of CA – outcomes result framework and economics.	Greater understanding of the impact of CA
4. Machine, crop, geographic specific databases – selection of right machine for the cropping system	People select the best machines
5. Quality of extension staff, including improved recruitment processes. Generic staff are no longer adequate as we move into professionalising and modernising farming systems	More engineers, advanced education in CA
6. A single government window for business	Faster approval, efficient support

## 5.7 Collaboration and communication

Collaboration and communication across the CA mechanisation value chain including opportunities for forming an association.

- Issues were raised in relation to how best the various organisations that are representative of CA mechanisation value chain can develop enhanced working relationships, improved communication and sharing of information.
- Overall there is a willingness to build and strengthen such partnerships, but it appears that the mechanism to facilitate and support this is lacking.
- The question arises as to is there a need to form an association of partners for this specific purpose? Also, what opportunities are there to develop Innovation Platforms as a means of engagement and collaboration along the CA mechanisation value chain?

A detailed assessment of the status of relationships between the different organisations was provided by respondents to the pre-workshop survey. The challenges CA machinery manufacturers face is summarised;

- Low market and seasonal demand
- High cost of raw materials, higher import duty and VAT-Tax on raw materials, spares for locally manufactured CA planters.
- Difficulty in accessing high quality raw materials.

- Higher labour, manufacturing, marketing and establishment costs.
- Lower demand and small market size of CA machine; hinders ability to minimise costs of production.
- Minimal scope to receive support from Govt and NGOs to support market promotion to private sector.
- There is the need to identify how production output can be significantly increased, to help drive up demand and in turn reduce the costs of production (and retail price of the equipment).
- Low availability of spare parts.
- Poor market level.

Challenges faced in relation to the importation of CA machinery;

- Small scale for local demand.
- Exporters like to get bulk orders.
- Seasonal market.
- Quality assurance.
- High level custom and VAT charges.
- Importer's lack of organisational ability/presence.

Opportunities for improving the design/characteristics of manufactured/imported machinery;

- Reduce weight.
- New seed meters for varied crops (VMP).
- Need proper training from abroad to maintain quality control and build manufacturer's skills.

Most important benefits offered to farmers in relation to CA machinery;

- A single machine that can provide precise planting, fertilizing and planking in single pass operation.
- Cost saving, time saving, labour saving, reduce turn-around-time, water savings, higher yield & profit.
- Price support to buyer (LSP/farmers) with 2WT for VMP promotion

Opportunities for improving the approach to government subsidies;

- Most of the cases, the direct subsidy by government seem non-effective.
- We are practicing the incentives to LSP based on CA planting area. The planting incentive are being practiced successfully by Murdoch University & Hoque Corporation for the out scaling of VMP.
- A separate fund should be provided to private sector for CA promotion & commercialization for demand creation, training, repair & maintenance, transportations of the machineries, after sale service, monitoring and follow-ups. The subsidised fund could be used effectively for this purpose

Workshop participants identified the strengths and weaknesses in relation to the current level of collaboration amongst CA mechanisation stakeholders in Bangladesh (**Table 12**).

**Table 12 Current strengths and weaknesses in relation to the level of collaboration amongst stakeholders associated with CA mechanisation in Bangladesh**

Strengths	Weaknesses
1. Strong scientific consensus	1. Isolated research programs; silos inside of organisations as well as between organisations/institutions.
2. Evidence: research results : to convince stakeholders	2. CA not an identified priority of research institutions and government.
3. Some level of understanding now exists.	3. Communication and collaboration gap between middle level and top levels of management
4. Informal network of researchers and manufacturers now exists	4. CA import standards
5. Good basis of CA machines	5. Networks
6. Basic human capacity at least in research, manufacturing and farmers.	

Workshop participants then successfully identified opportunities to enhance collaboration ( **Table 13**), along with suggestions as to how best such opportunities could be implemented.

**Table 13 Opportunities available to improve collaboration amongst stakeholders.**

Specific opportunity	How can this be undertaken or initiated
1. Government commitment to: Ag mechanisation -> CA to be promoted	Through capacity building, including end users
2. Use existing infrastructure and networks (farmer groups, dealers, NGOs etc)	Bridge the gap between mid-level managers and policy makers
3. Link to climate change responses	Broaden discussion; carbon credits, future issues (straw).
4. Link to rural development and income generating activities	

Workshop participants considered that communication and the sharing of information could be improved through adopting the following practices;

1. Innovate communication messages and CA definitions
2. Media, branding
3. CA as part of the climate smart agenda
4. CA suitability mapping, according to cropping systems, land suitability (exists)
5. Cross boundaries lessons, learning, sharing experiences

## Appendix 1: CA Seeding Machinery Stocktake Assessment Survey

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### Purpose of this Survey

As part of the CA Seeding Machinery Dhaka workshop, we are seeking your feedback and experiences in relation to both the positive and negative aspects of the different CA seeding machines that are used for sowing field crops.

The information collected will be summarised into a discussion paper prior to the workshop, so your early response to the survey would be highly appreciated. Responses to be submitted by 26th September. The discussion paper will help to identify the 'key points' for workshop discussion.

The survey aims to capture the experiences from all participants associated across the CA seeding machinery 'value chain' (from research and development, design, manufacturing to custom hiring, farmer adoption and on-farm use) relating to the following elements;

1. The design and development of the specific CA machinery and machinery performance characteristics (including operational efficiency and effectiveness, agronomic challenges and benefits, and adoption characteristics).
2. Operational business models for the various equipment types, including custom hiring, local community ownership, access to finance and credit, machinery maintenance and spare parts availability.
3. Farmer experiences, constraints and incentives for adoption, gender equity and social inclusion considerations, agricultural extension initiatives and the role of government and supporting policy.
4. The experiences of manufacturing, importing, marketing, distribution of the machinery.

### A guide to completing the survey

It is recommended that you complete this survey where possible with input from your colleagues, (especially if they are also attending the workshop). This will firstly avoid duplication, and importantly help generate additional opinions and ideas. A list of workshop invitees is also provided for you reference.

It is OK to leave some sections blank if you are unsure of the specific information that is required.

**It is kindly requested that you please complete and return this survey to Dr Jay Cummins by Thursday 26th September. Surveys can be sent to the following email address: [jay@iafd.org](mailto:jay@iafd.org)**

Please email me if you have any questions.

Many thanks,

Dr Jay Cummins

[jay@iafd.org](mailto:jay@iafd.org)

Seeding machinery types referred to in this survey (*appearance may vary between manufacturers*)

1. Two wheel tractor 2WT operated strip till planter



2. Versatile Multi-crop Planter (VMP) seed drill (2WT operated)



3. Zero-Till seed drill (2WT operated)



4. Raised bed planter (2WT operated)



5. Zero-Till seed drills (various) (four-wheel tractor 4WT operated)



Photos Credit: *Israil Hossain, BWMRI and CIMMYT*

## SECTION 1: BACKGROUND

### 1.1. Please complete the following background information

1. Your name		
2. Your organisation		
3. List other persons also involved in completing this survey with you		

### 1.2. What role do you play in CA Seeding Mechanisation Value Chain (*tick all applicable boxes*)

#	Specific Role	Place 'X' in boxes below (more than one can be chosen)
1	Research: Machinery and seeding systems design	
2	Research: CA agronomy and farming systems	
3	Research: Extension including adoption, gender equity, out scaling design	
4	Extension and training services with farmers: CA systems, mechanisation	
5	Education: University lecturing and training students	
6	Manufacturing machinery	
7	Importation machinery	
8	Marketing, retail and distribution of machinery	
9	Repairs, maintenance and servicing of machinery	
10	Finance provision and business model development (access to credit)	
11	Custom hire service provision	
12	Government policy (Conservation Agriculture mechanisation related)	
13	Other (please specify)	

### 1.3. Which of the following CA machinery types have you worked with?

#	CA seeding Machinery type	Place 'X' in applicable boxes below	Model name and manufacturer of the machine	Years of experience you have working with machine
1	Two wheel tractor 2WT operated strip till planter (Min till)			
2	Strip Planting using Versatile Multi-crop Planter seed drill (2WT operated)			
3	Zero-Till drill (2WT operated)			
4	Raised bed planter (2WT operated)			
5	Zero-Till seed drills (various) (four-wheel tractor 4WT operated)			
6	Other (please specify)			

## SECTION 2: MACHINERY CHARACTERISTICS, SPECIFICATIONS AND ADOPTION)

To be completed by only those persons who have strong relevant experience and expertise. Please provide specific details for each machine type that you have first-hand experience working with.

If you work with more than one machine type, an additional template form is provided at the end of this survey.

Please Indicate which type of machine you are describing in this case study (place an 'X' in one box below)						
1. Two wheel tractor 2WT operated strip till planter (Min till)		3. Zero-till drill (2WT operated)		5. Zero-Till seed drills (various) (four-wheel tractor operated)		
2. Strip Planting using Versatile Multi-crop Planter seed drill (2WT operated)		4. Raised bed planter (2WT oper)		6. Other (please specify)		
	Characteristic		Your response			
1.	Specific model name					
3.	Manufacturer and location					
4.	year machine commercially available					
5.	Estimated cost of the machine					
6.	Details about number of machines in operation (by district) sown field grain crops area under use (per season)					
	District name		No. Machines:		Area sown (ha)	
7.	Ownership Distribution Indicate the % distribution of machine ownership across the different categories (total for all will add up to 100%)		Specific owner category	%	Specific owner category	%
			Custom hire centres		Extension/NARES projects	
			Farmer cooperatives		NGOs	
			Individual farmers		Others (specify)	
8.	Sowing width of the machine (cm)					
9.	Tine width placement (cm)			Number of sowing tines		
10.	Method of fertiliser placement			% soil disturbance machine causes		
10.	Method of fertiliser placement					
11.	Tractor HP requirement		12. Fuel consumption tractor (litres/hr)			
13.	Speed of operation (km/h)					
14.	Effective field capacity complete for either ha or Bigha		Ha/hr -->		OR Bigha/hr -->	
15.	Field efficiency: this is the % of time of the day the machine is actually operational in the farmer field. For example, if the machine is used for 6 hours in an 8 hour working day, the field efficiency is 6/8 = 75%					%
16.	Crop types sown	Y or N	Crop types Sown	Y or N	Crop types Sown	Y or N
	Wheat		Maize		Sugar cane	
	Rice		Mung Bean		Fodder (specify)	
	Pulse crops (specify)		Mustard		Other (specify)	
	Pulse crops (specify)		Cotton		Other (specify)	
17.	Please list the advantages of the machine					
18.	Please list the constraints of the machine.					
19.	How best can the machine operation and other constraints be improved?					
20.	Other comments					

### SECTION 3: WHO YOU WORK WITH:

#### IDENTIFYING STRENGTH OF PARTNERSHIPS ACROSS THE MACHINERY VALUE CHAIN

To help identify the strength of your relationships with other partners involved in the CA mechanisation value chain.

For each of PARTNER type listed (column 1) provide a Partner Score (in column 2) using the following ratings:

1. Partner type	2. Partner Score 1,2,3,4,5, or 6	Explaining your answer (1,2,3 or 4 only) If you answered 1, 2 or 3, provide reasons WHY you have not established a relationship If you answered 4, please explain why you would like to establish a new relationship
1. CA machinery manufacturers		
2. CA machinery importers		
3. CA machinery distributors/ retailers or suppliers		
4. Custom Hire Centres		
5. Bangladesh National Research Organisations		
6. Bangladesh National Extension Organisations		
7. Bangladesh Government Policy Makers (officials)		
8. CIMMYT		
9. ACIAR funded projects relating to CA mechanisation		
10. Murdoch University		
11. ACIAR/SRFSI research/project staff		
12. Farmers organization (CASPA CA Service Prov Org)		
13. Farmer Innovation Platform groups (linked to SRFSI project)		
14. Bangladesh Universities		
15. Finance/Banking		
16. Farm Input suppliers (fertilisers, pesticides)		
17. NGOs engaged in out scaling of CA machinery; specify:		
18. NGOs engaged in out scaling of CA machinery; specify:		
19. NGOs supporting self-help groups: specify:		
21. Other (please specify)		

3.2 Who do you consider is the most important partner or organisation that you work with in relation to CA mechanisation, and why?

## SECTION 4: CONSTRAINTS TO THE ADOPTION OF CA SEEDING MACHINERY

4.1 Below is a list of statements relating to possible constraints that may influence the adoption of CA mechanisation by farmers.

#	Specific adoption-related constraint	Level of Agreement Score (1 to 5) 1 = Strongly Disagree 2 = Disagree 3 = Neither Agree or Disagree 4 = Agree 5 = Strongly Agree
1	Timely access to CA seeding machinery by farmers in the field is often difficult	
2	CA seeding machinery is too expensive to purchase outright by the farmer	
3	Farmers have difficulty in accessing finance to purchase CA seeding machinery	
4	CA seeding machinery operators have poor skills resulting in poor results in the field	
5	Custom hire centres are not well managed	
6	Custom hire centres do not have the skills to run the business	
7	Custom hire centres do not exist in many districts where there is farmer demand	
8	Custom hire centres have difficulty in accessing finance to purchase machinery	
9	CA seeding machinery technology concepts too difficult for farmers to understand	
10	Farmers are not aware of CA seeding machinery technologies	
11	Extension Services either do not exist or are very ineffective	
12	Extension services do not cater for the needs of farming women	
13	There are social barriers that restrict farming women in using the technology	
14	Machinery subsidies do not provide sufficient incentive for adoption by farmers	
15	Farmers consider no yield advantage/benefit of the CA seeding technologies	
16	Poor sharing of CA seeding info between R,D&E and manufacturers/distributors	

### 4.2 Machinery-related constraints to adoption

Below is a list of specific CA SEEDING MACHINERY constraints, please provide a rating of 1 to 5 relating to how important each of the adoption constraints are.

#	Specific adoption-related constraint	Your score (1 to 5) 1 = not important    2 = slightly important    3 = moderately important 4 = very important    5 = extremely important					
		A. Two wheel tractor operated strip till planter (Min till)	B. Strip Planting using Versatile Multi-crop Planter seed drill; 2WT	C. Zero-till drill; 2WT operated	D. Raised bed planter; 2WT operated	E. ZT seed drills; 4WT operated	F. Common to all
1	Unreliable machinery (frequent break-downs)						
2	Machines difficult to service and repair						
3	Machinery sows seed poorly (with poor crop emergence)						
4	Difficult to control weeds						
5	CA machinery is physically too heavy for farmers to use						
6	Machinery is too expensive for farmers to purchase						
7	The seeding operation takes too long (poor field efficiency)						
8	Machinery unable to sow some crop types very well; Specify:						
9	The ZT seed drill requires user to purchase a costly 4 wheel tractor	N/A	N/A	N/A	N/A		N/A

4.3 Are there any other constraints to adoption that you can identify that are not listed on this page?  
(please list)


**SECTION 5: CA SEEDING MACHINERY RESEARCH AND EXTENSION PRIORITIES**

**Research Priorities**

5.1 For the questions listed in this Section 5, please indicate which CA machinery configuration/s your responses to this section apply to.

CA Machinery configuration	Please place an 'X' in the relevant box/es
1. Two wheel tractor 2WT operated strip till planter (Min till)	
2. Versatile Multi-crop Planter (VMP) seed drill (2WT operated)	
3. Zero-till drill (2WT operated)	
4. Bed planter (2WT operated)	
5. Zero-Till seed drills (various) (four-wheel tractor 4WT operated)	

5.2 What do you consider to be the greatest achievements made in relation to CA Seeding Mechanisation research in Bangladesh over the past 10 years?

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5.3 List any RESEARCH priorities relating to CA seeding mechanisation systems in Bangladesh that require further attention (list the most important issues first).

--

**CA Extension Priorities**

5.4 What do you consider to be the greatest achievements that have been made in relation to CA Seeding Mechanisation related Extension in Bangladesh over the past 10 years?

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5.5 List any EXTENSION priorities relating to CA seeding mechanisation systems in Bangladesh that require further attention (list the most important issues first).

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**ADDITIONAL COMMENTS** relating to your experiences with CA mechanisation

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**SECTION 6: MACHINERY MANUFACTURING AND IMPORT EXPERIENCES  
FOR MACHINERY MANUFACTURERS & IMPORTERS ONLY TO COMPLETE THIS SECTION**

**6.1 Which of the following types of CA seeding machinery do you manufacture or import?**

#	Specific CA seeding Machinery type	Place 'X' in applicable boxes below (more than one can be chosen)	
		MANUFACTURE	IMPORT
1	Two wheel tractor 2WT operated strip till planter (Min till)		
2	Versatile Multi-crop Planter (VMP) seed drill (2WT operated)		
3	Zero-till drill (2WT operated)		
4	Bed planter (2WT operated)		
5	Zero-Till seed drills (various) (4WT operated)		
6	Other (please specify)		

**6.2. What are the biggest challenges that you face in the manufacturing of CA Seeding machinery? Please list them (leave blank if you do not manufacture CA machinery)**

**6.3 What are the biggest challenges that you face in relating to the importation of CA Seeding machinery? Please list them. (leave blank if you do not import CA machinery)**

**6.4 Can you identify any improvements that are required in the design and/or manufacturing of the machinery that you either manufacture or import? Please list them.**

**6.5 What do you consider are the most important advantages/benefits offered to farmers in relation to the CA machinery that you manufacture/import? Please list them.**

**6.6 What is the level of government subsidies that apply to the equipment that you manufacture or import?**

Specific CA seeding Machinery type	% government subsidy (for each type) Place 'X' in applicable boxes below		
	SUBSIDY DIRECT TO MANUFACTURER	SUBSIDY ON PURCHASE OF LOCALLY MANUFACTURED EQUIPMENT	SUBSIDY ON PURCHASE OF IMPORTED EQUIPMENT
Two wheel tractor 2WT operated strip till pl			
Versatile Multi-crop Planter seed drill (2WT op)			
Zero-till drill (2WT operated)			
Bed planter (2WT operated)			
Zero-Till seed drills (various) (four-wheel tractor 4WT operated)			
Other (please specify)			

**6.7 How effective do you consider the provision of machine subsidies by government to be? Are there more effective ways in which the funds allocated for subsidies could be directed elsewhere in the industry? Please explain your answer.**

## Appendix 2: Workshop briefing paper on CA seeding machinery options for Bangladesh: *the current state of play*

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### 1. Introduction

The purpose of this workshop briefing paper is to provide workshop participants with a summary of the findings from the CA Seeding Machinery Stocktake Assessment survey that was completed by workshop participants prior to the workshop. This briefing paper will help to ensure that participants are provided with a situational analysis of the current status of CA seeding machinery in Bangladesh, allowing all to share a common level of knowledge and understanding of the issues and opportunities prior to the workshop. This in turn will allow us to ‘fast track’ to the real issues and concerns, and in doing so conduct a series of group workshop sessions where we can collectively develop practical solutions and a way forward to developing implementable solutions, whilst also influencing policy makers.

The types of CA seeding machines that will be examined as part of the workshop process are presented in **Figure 1** (below), and comprise (1) Two wheel tractor 2WT operated strip till planter (Min till); (2) Strip Planting using Versatile Multi-crop Planter seed drill (2WT operated); (3) Zero-Till drill (2WT operated) (4) Raised bed planter (2WT operated) and (5) Zero-Till seed drills (various) (four-wheel tractor 4WT operated).

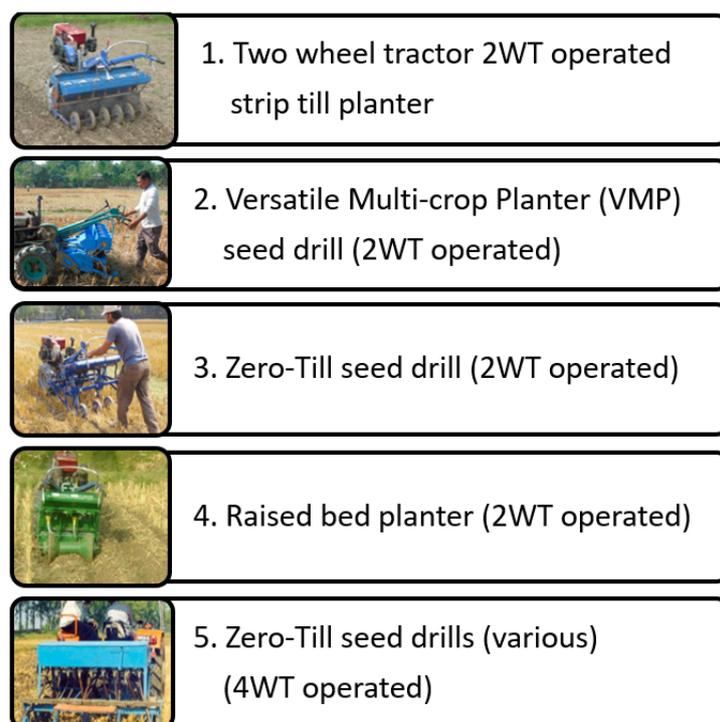


Figure 1 Illustration of the mechanised seeding machine types being examined in this study and workshop.

There has been a significant level of investment in resources and scientific capability that has been directed towards the development of CA seeding machinery of the past 20 years (or more) in

Bangladesh and across the Indo-Gangetic Plains. There have been a range of different mechanised seeding equipment configurations and models that has been developed.

This workshop focuses on seeding machinery that is described as being CA based, that is causes minimal seeding disturbance during the seeding operation. The machinery must be capable of 'one pass sowing', that is no prior cultivation or soil disturbance prior to the seeding operation taking place.

## 2. Workshop Theme Teams

The Dhaka workshop will be highly participatory in nature. The audience will be divided into 5 teams, based on a number of key workshop themes that have arisen from issues identified through the pre-workshop survey.

The specific 'theme teams' are as follows:

- **Team 1: CA Machinery**  
Identifying advantages of CA machinery configurations (including integration into farming systems)
- **Team 2: Adoption CA Seeding Systems**  
Enhancing the adoption of CA seeding systems through addressing systems constraints
- **Team 3: Sustainable Business Models**  
Building the capacity and sustainable business models for Local Service Providers (LSP)
- **Team 4: Efficient CA Mechanisation value chains**  
Develop an enabling environment to improve CA mechanisation value chain efficiencies (including Govt policy).
- **Team 5: Collaboration and communication**  
Collaboration and communication across the CA mechanisation value chain (including opportunities for forming an association), opportunities for developing Innovation Platforms.

## 3. Summary of survey findings (aligned to 'team themes')

### Team 1: CA Machinery

#### Identifying the relative advantages of CA machinery configurations

- There is a need to have an open-minded approach to examining the relative efficiencies (and advantages) of the different CA seeding machinery designs (including 4WT CA seed drills).
- There needs to be an assessment of the relative advantages and disadvantages of the different machinery configurations.
- Questions arising from the study include *what opportunities are there for further collaboration across the different organisations and machinery configurations?*
- Linked to this is the need to identify and design specific business models designed for specific equipment types that are reflective of the scale and capacity of operation of the equipment (Team 3 responsibilities).

### Team 2: Adoption CA Seeding Systems

#### Enhancing the adoption of CA seeding systems through addressing systems constraints

- The perceived barriers to adoption of CA seeding systems by farmers is not so much related to the complexities of the technologies or the ability of farmers to recognise the potential yield benefits associated with the improved CA systems.
- Factors that are considered to serve as the major barriers to adoption include the cost of the equipment (thereby emphasising the importance of Local Service Providers (Team 3)).
- There is the need to address constraints, identify training and capacity building opportunities, identify specific scaling considerations and strategies, develop adoption pathways/roadmaps, and consider market segmentation approaches and Gender Equity Social Inclusion (GESI) integration principles.

### **Team 3: Sustainable Business Models**

#### **Building the capacity and sustainable business models for Local Service Providers (LSP)**

- The survey identified that the availability and reliability of the CA seeding equipment served as major barriers to adoption of such seeding systems.
- Operator and business-related skills of the LSPs were also considered to be significant barriers. This was identified as a major need and opportunity.
- There were a number of excellent examples where such models had been successfully established, including the efforts of RDRS and the Conservation Agriculture Service Provider (CASP) network.
- The need to engage and link the finance/banking sector to LSPs was identified as an urgent need.
- Other considerations include developing valid economic comparisons and business cases for investment (and enhance access to finance), issues relating to capacity building (including training of operators, repairs and maintenance).

### **Team 4: Efficient CA Mechanisation value chains**

#### **Designing interventions for providing an enabling environment to improve CA mechanisation value chain efficiencies (including Government policy).**

- There were a number of significant constraints facing the local manufacturing sector in Bangladesh. These included the access to quality building materials, and the issue of scale of manufacturing, farmer demand and the issue of cost of production.
- To make CA seeding equipment more affordable, there was an identified need to significantly increase volume of production, this was currently not possible.
- Identification of other interventions or focused support along the value chain also needs to be explored, including considerations towards subsidy dynamics, developing a policy guideline framework and report (from the workshop).

### **Team 5: Collaboration and communication**

#### **Collaboration and communication across the CA mechanisation value chain including opportunities for forming an association.**

- Issues were raised in relation to how best the various organisations that are representative of CA mechanisation value chain can develop enhanced working relationships, improved communication and sharing of information.

- Overall there is a willingness to build and strengthen such partnerships, but it appears that the mechanism to facilitate and support this is lacking.
- The question arises as to *is there a need to form an association of partners for this specific purpose?* Also, *what opportunities are there to develop Innovation Platforms as a means of engagement and collaboration along the CA mechanisation value chain?*

### **The next steps: linking survey findings to workshop activities and actions**

This summary information provided above is expanded in further detail in the following text, where specific information gathered from the pre-workshop survey is expanded in further detail. It is recommended that you read all of this information, since it will provide a more detailed overview of the current situation. The information will be presented according to the specific themes. This will make it easier for the teams to reference survey information when they are undertaking their group activities as part of the workshop.

The information provided in this discussion paper will then be utilised in a series of group workshop activity tasks that each of the 5 identified teams will undertake during the workshop. The teams will have the opportunity to validate and expand on the information that has been provided. Teams will be expected to come up with evidence-based recommendations in terms of how particular constraints and barriers can be addressed through identifying workable solutions and actions for future cross team collaborations. Each workshop participant will be assigned to one of the five teams, according to the person's expertise and background experience in relation to CA mechanisation. This information is provided in Appendix I to this document.

### **Team Allocation for workshop participants**

- Team 1: CA Machinery (7 members)
- Team 2: Adoption CA Seeding Systems (6 members)
- Team 3: Sustainable Business Models (7 members)
- Team 4: Efficient CA Mechanisation value chains (7 members)
- Team 5: Collaboration and communication (5 members)

#### **Team 1: CA Machinery**

Identifying advantages of CA machinery configurations (including integration into farming systems)

##### ***What the survey discovered (results)***

##### **Machine-related constraints**

Survey respondents were asked to provide a response (in terms of their level of agreement) to a number of statements considered to be possible machinery related constraints to the adoption of CA seeding machinery. Using a scale of 1 to 5, the average score for each statement is presented in **Table 1** (below). A colour shading system was been overlaid to the respective cell scores in the table, to serve as an overall visual indicator to the relative advantage of each equipment type (green indicating a positive attribute, whilst brown negative).

**Table 1 Level of agreement to a range of CA seeding machinery adoption related constraints**

#	Specific adoption-related constraint	Average Score of respondents					
		1 = not important 2 = slightly important 3 = moderately important 4 = very important 5 = extremely important					
		A. Two wheel tractor operated strip till planter (Min till)	B. Strip Planting using Versatile Multi-crop Planter seed drill; 2WT	C. Zero-till drill; 2WT operated	D. Raised bed planter; 2WT operated	E. ZT seed drills; 4WT operated	F. Common to all
1	Unreliable machinery (frequent break-downs)	3 (n=4)	2.5 (n=6)	2.5 (n=2)	3 (n=2)	2 (n=2)	2.4 (n=5)
2	Machines difficult to service and repair	3.75 (n=4)	2.5 (n=6)	3 (n=2)	3 (n=2)	3 (n=2)	2.2 (n=5)
3	Machinery sows seed poorly (with poor crop emergence)	3.5 (n=4)	2.5 (n=6)	3 (n=2)	3 (n=2)	3 (n=2)	2.4 (n=5)
4	Difficulty in properly controlling weeds	2.75 (n=4)	2 (n=6)	2.5 (n=2)	3 (n=2)	3 (n=2)	3.5 (n=4)
5	CA machinery is physically too heavy for farmers to use	2.6 (n=5)	2.14 (n=6)	2.67 (n=3)	3.33 (n=3)	1.67 (n=3)	2.4 (n=5)
6	Machinery is too expensive for farmers to purchase	3.2 (n=5)	3.71 (n=7)	3 (n=3)	3 (n=3)	3.33 (n=2)	2.8 (n=5)
7	The seeding operation takes too long (poor field efficiency)	2.2 (n=5)	2.14 (n=7)	3 (n=3)	2 (n=3)	1.5 (n=2)	2.25 (n=4)
8	Machinery unable to sow some crop types very well	3 (n=5)	2.14 (n=7)	3 (n=3)	3 (n=3)	3 (n=3)	2.25 (n=4)
9	The ZT seed drill requires user to purchase costly 4WT	N/A	N/A	N/A	N/A	3.75 (n=4)	N/A

A summary of the identified machinery constraints along with suggested approaches (opportunities) to addressing these constraints are provided in the following table.

**Table 2 Summary of the advantages, constraints (and opportunities to address constraints) associated with the various CA seeding machine configurations, as provided by survey respondents.**

Machine advantages	Machine constraints	Opportunities to address constraints
<ul style="list-style-type: none"> <li>Machine could be used for strip tillage, zero tillage and also for full tillage.</li> <li>Tilling soil and placing of seed and fertilizer could be done in one pass.</li> <li>This machine could be used as planter for large seed as well as seeder for medium to small seed.</li> </ul>	<ul style="list-style-type: none"> <li>Machine weight is high.</li> <li>Lack of training and demonstration.</li> <li>No uniform seeds are available.</li> </ul>	<ul style="list-style-type: none"> <li>Some part of the machine could be made by plastic to reduce the weight.</li> <li>Training should be given to the user.</li> <li>Seed should be graded.</li> </ul>
<ul style="list-style-type: none"> <li>Tillage operation cost low.</li> <li>Minimum irrigation requirements.</li> <li>less crop lodging.</li> </ul>	<ul style="list-style-type: none"> <li>High weed infestation.</li> <li>More technical knowledge required.</li> <li>Have knowledge on soil texture.</li> </ul>	<ul style="list-style-type: none"> <li>For refining constraints you have to Knowledge on engine and need. trained/skill operator as well as spare parts availability.</li> <li>Good knowledge on calibration (seed rate and depth of seeding), soil. condition, rice straw, seed size.</li> </ul>
<ul style="list-style-type: none"> <li>Saving time and quick sowing.</li> <li>Comparatively low production cost.</li> <li>Scope for utilization of stubble retention.</li> <li>Land topography (size) is factor to utilize this type of machine.</li> </ul>	<ul style="list-style-type: none"> <li>Machine &amp; spare parts are not available in community level.</li> <li>Scarcity of skilled operators.</li> <li>Farmer's faith on this machine is limiting factor.</li> <li>Accuracy and efficacy performance of the machine is low.</li> </ul>	<ul style="list-style-type: none"> <li>Sensitizing machine manufactures and importers.</li> <li>Trained up skill operator.</li> <li>Awareness amongst farmers.</li> <li>Govt. can take care their extension services in terms of CA machine.</li> </ul>
<ul style="list-style-type: none"> <li>This can be used as a multiple-purpose seeder with small adjustment and changing the configuration.</li> <li>One operation for sowing.</li> <li>Reduced time and cost of crop establishment.</li> </ul>	<ul style="list-style-type: none"> <li>Quality is big concern.</li> <li>Efficiency of machine is very low not suitable for business model and only provide small business as Bangladesh is rice based cropping systems (three crops in a year).</li> <li>Cost is very high considering efficiency of the machine.</li> </ul>	<ul style="list-style-type: none"> <li>Improved quality should be 1<sup>st</sup> priority.</li> <li>It must be taken by big manufacturing company for commercialization.</li> <li>Operational training and awareness</li> <li>Develop the micro-entrepreneurship at community level.</li> <li>Govt. should take ownership to implement the CA based mechanization.</li> <li>Do we really think that 2WT based planting is viable in Bangladesh? We should revisit our strategy/approach.</li> </ul>
<ul style="list-style-type: none"> <li>Multi-crop establishment ability in strip, bed, zero, single pass shallow, even conventional tillage.</li> <li>Row and plant spacing adjustment ability.</li> <li>Ability to sow continuous/spaced planting.</li> <li>Ability to prepare land, seed sowing, fertilizing and planking in single pass operation.</li> <li>Operator doesn't require to calibrate seed.</li> <li>Having seating arrangement for road transportation and bigger plot planting</li> </ul>	<ul style="list-style-type: none"> <li>In case of smaller plot, walking behind the planter.</li> <li>Difficult to handle if &gt;5.0 t/ha of fresh and wet and loose residue.</li> <li>Need 35-40 kg weight balance iron block placement in front of 2WT for weight balance.</li> </ul>	<ul style="list-style-type: none"> <li>In case of small plot, collective planting systems establishment.</li> <li>More training to operators for improvement of residue handling capacity of VMP.</li> <li>Mindset improvement of LSP on CA benefit to convince farmers in CA practice.</li> </ul>

<ul style="list-style-type: none"> <li>Strip or bed planting of several crops Land preparation, seed sowing and fertilization in a single pass operation.</li> <li>Continuous sowing or spaced planting.</li> </ul>	<ul style="list-style-type: none"> <li>It does work well when more than 30% residues are retained.</li> </ul>	
<ul style="list-style-type: none"> <li>This can be used as a multiple-purpose seeder with small adjustment and changing the configuration.</li> <li>One operation for sowing.</li> <li>Reduced time and cost of crop establishment.</li> </ul>	<ul style="list-style-type: none"> <li>Quality is big concern.</li> <li>Efficiency of machine is very low not suitable for business model and only provide small business as Bangladesh is rice based cropping systems (three crops in a year).</li> <li>Cost is very high considering efficiency of the machine.</li> </ul>	<ul style="list-style-type: none"> <li>Improved quality should be 1st priority.</li> <li>It must be taken by big manufacturing company for commercialization.</li> <li>Operational training and awareness</li> <li>Develop the micro-entrepreneurship at community level.</li> <li>Govt. should take ownership to implement the CA based mechanization.</li> <li>Do we really think that 2WT based planting is viable in Bangladesh? We should revisit our strategy and approach.</li> </ul>
<ul style="list-style-type: none"> <li>Tilling land, bed making and placing of seed in one pass.</li> <li>Machine could be used as bed. former for planting of vegetables seedlings.</li> <li>Water saving (30%) technology.</li> </ul>	<ul style="list-style-type: none"> <li>Need training.</li> <li>Lack of permanent bed based cropping system.</li> <li>Farmers are not quite aware of this machine.</li> </ul>	<ul style="list-style-type: none"> <li>Hands on training should be given to the users.</li> <li>Adoption program should be taken.</li> </ul>
<ul style="list-style-type: none"> <li>Seeds can be sown without cultivation and at varying depths</li> <li>Fertilizers can be applied</li> </ul>	<ul style="list-style-type: none"> <li>Farmers lack experience in machine operation</li> </ul>	<ul style="list-style-type: none"> <li>Farmers need to be adequately trained to operate the machine</li> <li>Demonstration should be done at the ground level</li> </ul>

## Team 2: Adoption CA Seeding Systems

Enhancing the adoption of CA seeding systems through addressing systems constraints

### *What the survey discovered (results)*

#### General constraints to the adoption of CA seeding machinery

Survey respondents were asked to provide a response (in terms of their level of agreement) to statements considered to act as constraints to CA seeding machinery adoption. Using a likert scale of 1 to 5, the average score for each statement is presented in Table 7.

**Table 3 Level of agreement to a range of general constraints to the adoption of CA seeding machinery**

#	Specific adoption-related constraint	AVERAGE SCORE FOR ALL RESPONDENTS
1	Timely access to CA seeding machinery by farmers in the field is often difficult	4 (n=11)
2	CA seeding machinery is too expensive to purchase outright by the farmer	4 (n=12)

3	Farmers have difficulty in accessing finance to purchase CA seeding machinery	3.33 (n=12)
4	CA seeding machinery operators have poor skills resulting in poor seeding results	4.5 (n=12)
5	Custom hire centres are not well managed	3.63 (n=11)
6	Custom hire centres (LSP) do not have the skills to run the business	3.54 (n=11)
7	Custom hire centres do not exist in many districts where there is farmer demand	3.72 (n=11)
8	Custom hire centres have difficulty in accessing finance to purchase machinery	3.36 (n=11)
9	CA seeding machinery technology concepts too difficult for farmers to understand	2.63 (n=11)
10	Farmers are not aware of CA seeding machinery technologies	3.5 (n=12)
11	Extension Services either do not exist or are very ineffective	3.2 (n=11)
12	Extension services do not cater for the needs of farming women	3 (n=11)
13	There are social barriers that restrict farming women in using the technology	3.18 (n=11)
14	Machinery subsidies do not provide sufficient incentive for adoption by farmers	3.63 (n=11)
15	Farmers consider there is no yield advantage/benefit of the CA seeding technologies	2.42 (n=12)
16	Poor sharing of CA seeding info between R,D&E and manufacturers/distributors	3.63 (n=11)

*Likert Scale: 1 = Strongly Disagree 2 = Disagree 3 = Neither Agree or Disagree 4 = Agree 5 = Strongly Agree*

The highest rating constraints were as follows:

- CA seeding machinery operators have poor skills resulting in poor results in the field.
- Timely access to CA seeding machinery by farmers in the field is often difficult.
- CA seeding machinery is too expensive to purchase outright by the farmer.
- Custom hire centres do not exist in many districts where there is farmer demand.
- Poor sharing of CA seeding info between R,D & E and manufacturers/distributors.
- Custom hire centres are not well managed.
- Machinery subsidies do not provide sufficient incentive for adoption by farmers.

Those constraints considered to have least influence over adoption were;

- Farmers consider there is no yield advantage/benefit of the CA seeding technologies.
- CA seeding machinery technology concepts are too difficult for farmers to understand.

### **Additional adoption-related constraints**

There were a wide range of additional constraints identified by survey respondents that collectively provide a valuable insight into the complexity of issues associated with the adoption process. These include the following:

- Distribution of poor-quality planters (particularly those that are bulk purchased under projects) create a bad reputation for all planters, particularly those that are of high quality.
- There is a degree of unhealthy competition amongst researchers, manufacturers and projects. There is also a lack of coordination, consensus and communication across such parties.
- Selection of local service providers (LSP) is based on local and political interference rather than on the capability or potential to become LSP.
- Most CA planters do not qualify for government supported subsidies, with the government subsidising some planters that can't be categorised as being CA compatible (due to excessive soil disturbance).

### **Research and Extension related achievements in CA mechanisation over the past 10 years**

There were a large number of achievements listed in relation to CA seeding mechanisation research in Bangladesh.

Research related achievements identified by respondents are summarised:

- The ability to develop, demonstrate and convince to farmers that CA based seeding systems work, and are a viable option for smallholder farmers.
- The design and development of CA seeding machinery that is suited specifically to the Bangladesh farming environment, including agronomic considerations (improved weed management systems).
- The benefits of the technology are numerous, including labour saving, improvements in soil health, improved irrigation efficiency, increased crop yields and economic benefits.
- The development of local service provider (LSP) business models, that are serving as viable business models for others to follow.
- Development of CA Service Providers Association, comprising 249 groups and 10,000 farmer members, together with the engagement of the banking sector to assist in providing access to finance.
- Development of human resource training packages for stakeholders involved in extension initiatives.

Extension related achievements identified by respondents are summarised:

- There has been a focus of demonstrating and 'proving the technology' to farmers in the field.
- Reliable and affordable machinery has been designed and produced.
- The characteristics of the technology (and associated benefits are generally well understood by researchers, extensionists, policy makers and the private sector.
- The local manufacturing sector has developed as a direct result of developing and designing the CA seeding equipment; there is now a good level of collaboration.
- Government policy is increasingly being influenced by the development of the equipment and technologies.
- Increasing number of farmers are now being reached/exposed to the technology.

### **Future research and extension related priorities**

Respondents identified a range of research priorities for CA seeding mechanisation systems. Responses are summarised:

- Important to adopt a value chain approach for ensuring that the effectiveness of the technology was linked to business development outcomes.
- Important to support the training capacity building needs of stakeholders associated with CA mechanisation, including the establishment of a network of CA practitioners for Bangladesh.
- Additional agronomic research (fertiliser and weed management) is required.
- Quality of machinery and specific features (for example operator seating) can be further developed.
- Opportunity to explore opportunities for 4WT based seeding machines for Bangladesh.

Respondents identified a large number of extension related priorities for CA seeding mechanisation systems in Bangladesh. Responses are summarised as follows:

- There is a need to develop training modules and programs focusing on CA mechanisation, this needs to be systematic, and extension officers need to be amongst those targeted for the training.
- A policy dialogues is required, since there is a policy shift required away from subsidising machinery that is detrimental to soil health, that is clearly not CA based.
- Subsidies for CA seeding equipment needs to be reviewed, with incentives provided to farmers who adopt the technologies.
- Improved coordination through introducing a number of new initiatives, these include the opportunity to develop a CA Hub to serve farmers in extending the technologies, other options include a DAE farm machinery service centre.
- An opportunity to better engage and support the role that NGOs have in terms of the out scaling of the CA mechanisation technologies, giving the private sector a more significant role to play, including support for CASI technology service provision and capacity building.

### **Team 3: Sustainable Business Models**

Building the capacity and sustainable business models for Local Service Providers (LSP)

#### ***What the survey discovered (results)***

Part of developing sustainable business models is the ability to form partnerships with different organisations associated with the CA mechanisation value chain. The following information from the survey provides some useful insights into the willingness (and reluctance) to form such partnerships.

Respondents were asked to indicate who they considered to be the most important partner to work with, in relation to CA mechanisation. Interestingly, the range of organisations identified represent the majority of organisations/stakeholders that are associated with the CA mechanisation value chain. This is quite a positive response, and reflects the important role that all organisations play, and the need to adopt a value chain approach to the development and successful promotion and out scaling of CA mechanisation in Bangladesh.

Respondents were also asked to indicate why the specific stakeholder/partner that they identified was so important. The responses provided a valuable insight into the value that the respective organisations bring to the overall CA mechanisation value chain. Those categories that received very little (if any mention) included CA machinery importers/distributors, custom hire centres/LSP, Bangladesh Government policy makers, SRFSI project farmer Innovation Platform groups.

**Table 4 Strength of partnerships across the machinery value chain, as indicated by survey respondents.**

Partner type	Comments relating to interest in forming partnerships
1. CA machinery manufacturers (n=11)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• I didn't see much attraction of manufacturer on CA machinery in Bangladesh as commercialized way.</li> <li>• I am sure they are not looking this sector as a potential large volume of business.</li> <li>• Yes, I do agree lot of efforts made by Research, Development organization but on project targeted. This will require brainstorming.</li> </ul>
2. CA machinery importers (n=10)	<ul style="list-style-type: none"> <li>• There are not much CA machineries exists for 2WT-based smallholders</li> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• There was a good attempted to establish the partnership in Bangladesh to import the CA machineries but it didn't work well.</li> <li>• There is potential to explore the quality import machinery in better competitive price and also focussed on 4WT based machinery as well</li> </ul>
3. CA machinery distributors/ retailers or suppliers (n=11)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• They are not looking this sector as a volume of business in Bangladesh</li> <li>• It would be better to also capitalized the 4WT based machinery in Bangladesh</li> </ul>
4. Custom Hire Centres / LSP (n=10)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• There is very strong network on custom hiring centre but need to provide capacity building through training and technical backstopping</li> </ul>
5. Bangladesh National Research Organisations (n=11)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• Strong research for development</li> </ul>
6. Bangladesh National Extension Organisations (n=11)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• Need to put more emphasis and also require capacity building</li> </ul>
7. Bangladesh Govt Policy Makers (officials) (n=10)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• Require immediate attention</li> </ul>
8. CIMMYT (n=11)	<ul style="list-style-type: none"> <li>• We tried to establish partnership. However, CIMMYT did not show interest.</li> <li>• We tried to establish partnership. However, CIMMYT inform us there is no scope to built collaboration to enhance CA promotion.</li> <li>• Need strong partnerships with past and re-establish opportunity</li> </ul>
9. ACIAR funded projects relating to CA mechanisation (n=9)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• Great efforts but need to think towards commercialization</li> </ul>
10. Murdoch University (n=8)	<ul style="list-style-type: none"> <li>• Need strong partnerships with past and re-establish opportunity</li> <li>• Working in isolation need to establish relations</li> </ul>
11. ACIAR/SRFSI research/project staff (n=10)	<ul style="list-style-type: none"> <li>• We tried to establish partnership. However, SRFSI did not show interest.</li> <li>• To promote CA mechanization in farmers field also like to get project support to accelerate the adoption of CA mechanization</li> <li>• Need strong partnerships with past and re-establish opportunity</li> </ul>
12. Farmers organization (CASPA CA Service Prov Org) (n=9)	<ul style="list-style-type: none"> <li>• To promote more CASI</li> </ul>

13. Farmer Innovation Platform groups (linked to SRFSI project) (n=8)	<ul style="list-style-type: none"> <li>To promote more CASI</li> <li>We are un-familiar with this system. Also, we have established farmers' organization like CASPA.</li> <li>Need strong partnerships with past and re-establish opportunity</li> </ul>
14. Bangladesh Universities (n=11)	<ul style="list-style-type: none"> <li>We worked with Murdoch University with ACIAR funded project which had partnership</li> <li>With Haque corporation. If we do continue any further research and extension activities</li> <li>it would need reestablishment of partnership with machine manufacturer.</li> <li>To include CASI in the university degree courses</li> <li>Need strong partnerships with past and re-establish opportunity</li> <li>Not much scope to involve universities but it was possible to engage through students</li> </ul>
15. Finance/Banking (n=8)	<ul style="list-style-type: none"> <li>Not worked, directly, but we tried to establish link between/among Credit/Finance agencies and LSPs (individually and/or in Group).</li> <li>Need strong partnerships with past and re-establish opportunity</li> </ul>
16. Farm Input suppliers (fertilisers, pesticides) (n=7)	<ul style="list-style-type: none"> <li>To promote more CASI</li> <li>Need strong partnerships with past and re-establish opportunity</li> </ul>
17. NGOs engaged in out scaling of CA machinery; (n=8)	<ul style="list-style-type: none"> <li>Strip Till, Mechanical Rice Trans planter</li> <li>Need strong partnerships with past and re-establish opportunity</li> <li>There are only few NGOs explore but there is a huge potential to explore the possibilities of those who are working on climate resilient, agricultural development and rural development</li> </ul>
18. NGOs supporting self-help groups: (n=3)	<ul style="list-style-type: none"> <li>RDRS</li> </ul>

There were also a range of additional comments made in survey relating to the importance and value of local service providers. It is recommended that all information be read since it will provide useful background briefing information to your team.

#### **Team 4: Efficient CA Mechanisation value chains (VC)**

Developing an enabling environment to improve CA mechanisation VC efficiency (including Govt policy).

##### ***What the survey discovered (results)***

##### **Challenges facing machinery manufacturers/importers.**

A series of questions were designed as a means of identifying the challenges that machinery manufacturers/importers faced. A summary of responses to the range of questions are provided below. These provide a range of worthwhile recommendations in terms of how the manufacturing sector can be better supported. A key challenge relates to scale of production. There is the need to identify how best demand can be increased, to allow greater numbers of equipment to be manufactured (to reduce the overall price per manufactured unit).

Challenges faced in relation to the manufacturing of CA machinery

- Low market and seasonal demand
- High cost of raw materials, higher import duty and VAT-Tax on raw materials, spares for locally manufactured CA planters.
- Difficulty in accessing high quality raw materials.
- Higher labour, manufacturing, marketing and establishment cost s
- Lower demand and small market size of CA machine; hinders ability to minimise costs of production.

- Minimal scope to receive support from Govt and NGOs to support market promotion to private sector.
- There is the need to identify how production output can be significantly increased, to help drive up demand and in turn reduce the costs of production (and retail price of the equipment).
- Low availability of spare parts

Challenges faced in relation to the importation of CA machinery

- Small scale for local demand
- Exporters like to get bulk orders
- Seasonal market
- Quality assurance
- High level custom and VAT charges
- Importer's lack of organisational ability/presence

Opportunities for improving the design/characteristics of manufactured/imported machinery

- Reduce weight.
- New seed meters for varied crops (VMP).
- Need proper training from abroad to maintain quality control and build manufacturer's skills.

Most important benefits offered to farmers in relation to CA machinery

- A single machine that can provide precise planting, fertilizing and planking in single pass operation.
- Cost saving, time saving, labour saving, reduce turn-around-time, water savings, higher yield & profit.
- Price support to buyer (LSP/farmers) with 2WT for VMP promotion

Opportunities for improving the approach to government subsidies

- Most of the cases, the direct subsidy by government seem non-effective.
- We are practicing the incentives to LSP based on CA planting area. The planting incentive are being practiced successfully by Murdoch University & Hoque Corporation for the out scaling of VMP.
- A separate fund should be provided to private sector for CA promotion & commercialization for demand creation, training, repair & maintenance, transportations of the machineries, after sale service, monitoring and follow-ups. The subsidised fund could be used effectively for this purpose

### **Team 5: Collaboration and communication**

Collaboration and communication across the CA mechanisation value chain (including opportunities for forming an association), opportunities for developing Innovation Platforms.

#### ***What the survey discovered (results)***

**Strength of partnerships between different organisations and stakeholders engaged in CA mechanisation**

Respondents were asked to indicate the relative strengths of partnerships that their respective organisations held towards a range of stakeholders associated with the CA mechanisation value chain. There were six categories of possible responses, these were;

- 1 = no partnership at present, no desire to partner
- 2 = past partnership, no desire to re-establish
- 3 = past partnership, opportunity to re-establish
- 4 = no partnership currently, opportunity to build one
- 5 = partnership exists, opportunity to strengthen it
- 6 = strong partnership exists and will continue

The survey results are summarised.

Partnerships in existence, but an opportunity to strengthen the relationships (a rating of '5')

- CA Machinery importers (n=4)
- CA machinery distributors/wholesalers or suppliers (n=6)
- LSP (custom hire centres) (n=5)
- Bangladesh National Research Organisations (n=5)
- Bangladesh National Extension Organisations (n=5)
- Bangladesh National Policy makers (officials) (n=5)
- ACIAR funded projects relating to CA mechanisation (n=4)
- Farmers organization (CASPA CA Service Provider Organisation) (n=6)
- Bangladesh Universities (n=5)
- Finance/Banking sector (n=6)
- NGOs engaged in out scaling of CA machinery (n=6)

Strong partnerships that were likely to continue (a rating of '6') were held with the following stakeholders;

- CA machinery manufacturers (n=6)
- Bangladesh National Research Organisations (n=4)
- CIMMYT (n=7)
- Murdoch University (n=4)
- ACIAR/SRFSI research/project staff (n=4)

Those organisations who prominently scored either (3) past partnership, opportunity to re-establish and/or (4) no partnership currently, opportunity to build one were as follows;

- CA machinery distributors/ retailers or suppliers (n=3)
- Custom Hire Centres / LSP (n=3)
- CIMMYT (n=3)
- ACIAR funded projects relating to CA mechanisation (n=3)
- Murdoch University (n=3)
- ACIAR/SRFSI research/project staff (n=4)
- Farmer Innovation Platform groups (linked to SRFSI project) (n=3)
- Bangladesh Universities (n=4)

There appeared to be a reluctance to form/develop partnerships with farm input suppliers (fertilisers, pesticides) amongst the survey respondents. This is unfortunate, given the potential opportunity to build relationships with a sector that does have influence over agronomy related farmer decision making practices.

Respondents provided comments on how partnerships and relationships can be enhanced between stakeholders, where there were either no current or very weak relationships.

- CA Machinery manufacturers; strong partnerships have existed in the past and there is an opportunity to re-establish them; there is the opportunity to expand the manufacturing capacity significantly amongst local manufacturers of CA seeding machinery.
- CA machinery importers; there is the opportunity to strengthen partnerships with this sector, noting that previous attempts did not work well; there is the potential to import machinery at better competitive pricing, whilst also exploring 4WT based machinery.
- CA machinery distributors/ retailers or suppliers; opportunity to re-establish partnerships, and to explore importation of 4WT CA machinery.
- Custom Hire Centres / LSP; there is very strong network on custom hiring centre but need to provide capacity building through training and technical backstopping
- Bangladesh National Research Organisations; strong research for development capacity.
- Bangladesh National Extension Organisations; need to explore opportunities to provide more support for capacity building.
- Bangladesh Govt Policy Makers; requires immediate attention; opportunities to strengthen relationships.
- CIMMYT; an opportunity to strengthen relationships, there has been some attempts to build such relationships but there has not necessarily been any interest shown.
- ACIAR funded projects relating to CA mechanisation; great efforts, but need to also have a focus on the commercialisation (of technology).
- Murdoch University; opportunity to strengthen relationships, they have been working in isolation.
- ACIAR/SRFSI research/project staff; have attempted to establish relationships but no interest has been shown; have had a focus on developing mechanisation in the farmer field – also need to have a focus on accelerating the adoption of CA mechanisation.
- Farmers organization (CASPA CA Service Prov Org); opportunity for them to have a greater role in the promotion of conservation agriculture sustainable intensification (CASI).
- Farmer Innovation Platform (IP) groups (linked to SRFSI project); they have a role in promoting CASI, many are unfamiliar with the IP approach.
- Bangladesh Universities; opportunities to strengthen partnerships between manufacturers and the universities; important to introduce CASI technologies into course curriculum, and engage more with students.
- Finance/Banking; opportunities to establish and strengthen linkages between farmer groups/associations and credit providers.
- Farm Input suppliers (fertilisers, pesticides); an opportunity for this sector to actively promote CASI technologies, partnerships need to be established to achieve this.
- NGOs engaged in out scaling of CA machinery; There are only few NGOs but there is a huge potential to explore the possibilities of those who are working on climate resilient, ag development and rural development.

Respondents were asked to indicate who they considered to be the most important partner to work with, in relation to CA mechanisation. There were a wide range of organisations that were identified as being the most important to work with. Results are presented in **Table 5** below.

**Table 5 Comments provided by respondents in relation to the characteristics associated with ‘the most important partner to work with’ in relation to CA mechanisation**

CIMMYT: One of important international research organisation working for CA
DAE: Important agency for technology dissemination
Donor Agency and DAE is the major partner as without funding we cannot proceed to do research and extension.
Research, Development/Extension and value chain or market development oriented organizations, because they have key roles to play for CA based mechanization. However, as being a researcher more research is still needed in Bangladesh context around CA based mechanization to make the machines more efficient and user friendly.
Hoque Corporation; having long, practical field experience in commercialization of CA machinery (e.g., VMP). They have successfully commercialised 169 units of VMP in Bangladesh since 2015; exported 42 units to 9 countries.
CASPA (Conservation Agriculture Service Providers’ Association) = Farmer led organization having around 10,000 member farmers. CASPA is playing the key role to identify Local Service Providers (LSP) of VMP; out scaling CA and mechanization among the farmers community.
Financial Organization (National Bank Ltd., First Security Islami Bank Ltd., Islami Bank Bangladesh Ltd. = To expand loan support for purchasing VMP along with 2WTwith low interest rate.
Solidaridad; RDA Bogra; BMDA = Organize and motivate farmers to promote CA and mechanization.
Murdoch University; long, practical field experience on the development, out scaling of CA machinery (e.g., VMP).
CASPA (Conservation Agriculture Service Providers’ Association) = Farmer led organization having around 5,000 member farmers. Out scaling CA and mechanization among the farmers community.
Dept of Ag Extension (DAE); have strong grass root extension services to promote new CA and farm machinery.
Agricultural Research Organizations including Agricultural Universities= Conducting various agronomy, soils, and machinery related works that helps to improve CA and machinery.
Financial Organization (National Bank Ltd., First Security Islami Bank Ltd., Islami Bank Bangladesh Ltd. = To enhance loan support for purchasing VMP along with 2WTwith low interest rate.
Solidaridad Network Asia; RDA, Bogra; BMDA=Organize and motivate farmers to promote CA and mechanization.
CIMMYT Bangladesh is important partner. We work with CIMMYT Bangladesh for CA machinery mechanisation.
iDE Bangladesh is important partner. We work with iDE Bangladesh for CA machinery mechanisation.
Union federation is important partner to mechanize CA as it is community base farmers’ organization; It has resources and legal validation, own constitution; It has strategy for engaging farmers to implement their activity
CIMMYT, ACIAR, Cornell University, USA and Murdoch, Australia are committed to help CA among our farmers
Department of Agricultural Extension (DAE)
Agricultural Research Organizations (BRRI, BARI, BINA)
Agricultural Universities (Khulna University, Patuakhali Science & Technology University)
Private sector engagement, NGOs and INGOs for CA promotion, International organizations including CGIAR
Research organization (BARI, BRRI, BWMRI, Universities etc), Extension development agencies (DAE and NGOs) also development organizations, Ministry etc
Finance agencies, Bank and donors

Interestingly, the range of organisations identified represent the wide range of organisations/stakeholders that are associated with the CA mechanisation value chain. This is quite a positive response, and reflects the important role that all organisations play, and indeed the need to adopt a value chain approach to the development and successful promotion and out scaling of CA mechanisation in Bangladesh.

Respondents were also asked to indicate why the specific stakeholder/partner that they identified was so important. The responses provided a valuable insight into the value that the respective organisations bring to the overall CA mechanisation value chain. Those categories that received very little (if any mention) included CA machinery importers/distributors, custom hire centres/LSP, Bangladesh

Government policy makers, SRFSI project farmer Innovation Platform groups. Those stakeholders recognised as being extremely valuable are summarised in Table 6 below.

**Table 6 Summary of specific organisations who were considered to be amongst the most valuable partners involved in CA mechanisation in Bangladesh.**

Stakeholder category	Why they are an important partner
CA machinery manufacturers	Long and practical field experience in the design and manufacturing of machines
National Research Organisations	Critical to providing research into mechanisation and agronomy aspects of CA
Bangladesh National Extension Organisations	DAE has good grass roots links and practical expertise Assistance in the provision of resources for out scaling of CA mechanisation
CIMMYT	A well-recognised and reputable international research organisation
ACIAR funded projects relating to CA mechanisation	Require access to expertise and a funding base for research Committed to helping in the introduction of CA mechanisation to Bangladesh farmers
Murdoch University	Committed to helping in the introduction of CA mechanisation to Bangladesh farmers
Farmers organization (CASPA CA Service Prov Org)	CASPA is recognised as being a valuable farmer led organisation with in excess of 10,000 members
Bangladesh Universities	Actively engaged in undertaking agronomy and mechanisation research
Finance/Banking	Working with financial organisations critical to provide finance access for equipment purchase
NGOs engaged in out scaling	Critical for expanding mechanisation out to farmers, to help in the motivation of farmers

Respondents identified a large number of extension related priorities for CA seeding mechanisation systems in Bangladesh. Many of these relate to enhanced communication and coordination, and so are presented in this section;

- There is a need to develop training modules and programs focusing on CA mechanisation, this needs to be systematic, and extension officers need to be amongst those targeted for the training.
- A policy dialogues is required, since there is a policy shift required away from subsidising machinery that is detrimental to soil health, that is clearly not CA based.
- Subsidies for CA seeding equipment needs to be reviewed, with incentives provided to farmers who adopt the technologies.
- Improved coordination through introducing a number of new initiatives, these include the opportunity to develop a CA Hub to serve farmers in extending the technologies, other options include a DAE farm machinery service centre.
- An opportunity to better engage and support the role that NGOs have in terms of the out scaling of the CA mechanisation technologies, giving the private sector a more significant role to play, including support for CASI technology service provision and capacity building.

## Appendix 3: A summary of group exercises and discussion points from the workshop

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Workshop participants

### Key discussion points from the workshop

- Participants consider that it is a matter of time before the ‘tipping point’ is reached in relation to the technology being accepted and adopted, but there is still a significant amount of work that needs to be done to reach this turning point.
- As demand for CA builds in Bangladesh, it was considered that additional support would be required to help maintain any particular momentum that was generated.
- Any particular support from government would need to be fully justified, evidence based with specific benefits clearly identified (in terms of increased yield, profitability and scale of the benefits).
- There is an opportunity to improve the engineering skills (design and manufacturing) in the Bangladesh CA manufacturing industry. Skills could be enhanced through identifying opportunities to access such skills from the advanced manufacturing sector in India (such as through the advanced training of Bangladesh industry engineers and manufacturers).
- There is a need to provide long term practical ‘hands on’ training programs that targeted entrepreneurial youth. Selecting those who have left school (and are quite articulate) and develop career opportunities for them in CA machinery operation through providing intensive training would help build the overall skills and capabilities of operators, and raise the professionalism of the industry.
- There is the need to utilise existing networks, rather than trying to establish new ones for the promotion and out scaling of CA mechanised seeding technologies.

## **Some key questions**

The following represent some key points of discussion and points that were raised during group discussion and activity feedback sessions.

### **Where are the drivers and the incentives for adoption of the CA technology?**

It appears that there are currently insufficient incentives for adoption to take place at all places along the CA mechanisation value chain. Therefore, adopting a planned and strategic approach would be of considerable benefit, to identify where any particular support can be best targeted and in turn supporting the specific 'drivers of change'.

### **How best can we create demand for the technology?**

There were a number of elements discussed, for example it was necessary to initially create and awareness of the CA technology. It was considered that there was a need to establish a CA platform that would focus on demonstrating the technology and to provide a focus on out scaling of the technology. Those attending the workshop were well aware of the benefits of CA mechanisation, but there were no established pathways in relation to communicating and extending information to farmers and other stakeholders effectively.

### **How best can awareness of CA be raised as the first step towards adoption?**

The need to have farmer testimonials (for promotion of the technology) that illustrate the adoption processes that they have gone through would be a useful approach to begin with. It was considered that there is the need to develop an overall strategy to increase awareness of the technologies. Importantly, there was the need to identify who would be responsible for implementing an awareness raising exercise. This process could be led by a CA platform.

### **How best could incentives be designed and targeted to maximise uptake of CA?**

There was quite a bit of discussion in this area, with no real consensus reached. For example, those engaged in the manufacturing felt that the government should provide financial support to help establish factories that could be set up for the purposes of undertaking large scale manufacturing of CA equipment.

### **What is the role of the private sector in supporting uptake of the technology?**

It was considered that there is an important role for the private sector to take on a significant role in driving up demand for the technology. In the manufacturing sector there was the need to think in large volumes of machinery output, to focus on producing quality products rather than short-run production that was often project based, with price being put ahead of machinery quality.

### **Where to from here?**

It was identified that there is the need to identify how best policy makers can be informed and influenced by the high level of understanding and opportunities that are associated with the development of CA mechanisation seeding systems in Bangladesh. This understanding relates to the

wealth of knowledge and experience that has been developed by key stakeholders and organisations such as those that were represented at this specific workshop.

It was considered that a follow up meeting with the Standing Committee of Agriculture, as well as the Bangladesh Minister of Agriculture would be of significant value. What would be required to be presented would be clear and concise evidence based recommendations relating to the development of enabling policy supportive of strengthening CA seeding mechanisation value chains and increased on-farm adoption of associated technologies. A range of different scenarios accompanied by a range of different outcomes (including the scale, potential benefits and net impacts) according to the design of interventions would be presented to, and discussed with policy makers. This activity would also serve as an opportunity to inform them of the need to prioritise support relating to CA machinery, as opposed to supporting the blanket subsidy of machinery that was in opposition to CA principles (rotovators for example). As a longer term outcome, ideally the opportunity to revise the Agricultural Policy relating to CA would be the ultimate goal.

The following represents the responses to a range of questions/group discussion activities posed to each of the 5 work teams participating in the workshop. This provided the opportunity for each of the teams to discuss in further detail the range of issues that were identified in the pre-workshop discussion paper. This information has been utilised in the compilation of the resulting discussion paper from this project.

## TEAM 1: CA Machinery

1. Review the findings from the survey. Provide a list of specific advantages associated with each of the machines (column 1). Place a tick in all of the machine types that they advantage also applies to.

Specific advantages	A. 2WT strip till planter (Min till)	B. 2WT Strip Planting using VMP s	C. Zero-till drill; 2WT operated	D. Raised bed planter; 2WT oper	E. ZT seed drills; 4WT operated
Ability to till, seed and fertiliser placement in one pass	X	X	X	X	X
Reduce time, labour and cost of planting	X	X	X	X	X
Ability to disperse small to large seeds	X	X	X	X	X
Knowledge based machine*	X	X	X	X	X
Residue management	X	X	X	X	X

\* requires a detailed level of understanding and skill to operate the machine; underlying complexity.

2. Review the findings from the survey in relation to the specific constraints. List the most important constraints (first column) associated with the CA seeding equipment.

Specific constraints	A. Two wheel tractor operated strip till planter (Min till)	B. Strip Planting using Versatile Multi-crop Planter seed drill; 2WT	C. Zero-till drill; 2WT operated	D. Raised bed planter; 2WT operated	E. ZT seed drills; 4WT operated
Skilled operator	X	X	X	X	X
High residue management	X	X	X	X	
Machine quality	X	X	X	X	
Higher priced					X
Farmers mind set	X	X	X	X	X

3. Identify common issues that are experienced by multiple CA seeding machinery types that could be addressed collectively. Indicate specifically what needs to be done, and the specific approach.

Common Issue	What needs to be done	Approach to be taken
Quality machine manufacturing	Improved workshop machine Technical training Soft loan for manufacturing	Private sector investment provides longer term sustainable model. Government investment and support in R&D that is provided to both manufacturers and research institutes is also required.
Capacity building for machinery operator	Arrange training on CA systems	Hands on training. Exposure visits
Upscaling of CA technology	Large scale demos Experience sharing	Block demonstrations
Collaborative approaches	R, D & E should be one (integrated) approach	Establishment of a CA centre

4. What initiatives can be implemented immediately following this workshop, that require few resources but can have a significant impact?

Conduct a survey to identify the opportunity of CA systems.
Development of a knowledge bank on CA systems

## TEAM 2: Adoption CA Seeding Systems

1. Identify the major constraints to the adoption of CA seeding systems in Bangladesh. Categorise these according to where they occur along the CA mechanisation value chain.

Constraints	Machinery design & research	Manu-facturing	Service providers and access	Repairs and maintena nce	Farmer extension and adoption	In-field operation	Govt policy
Lack of policy support on CA							X
Lack of skilled operators amongst LSPS			X	X	X	X	
Lack of awareness among farmers/end users			X		X	X	
Lack of knowledge of the practices and adopter profile					X		
The market of CA is small and segmented			X				
Low involvement of women in CA operations					X		
Lack of suitable seating in operation of equipment	X	X				X	
low operational efficiency in the field	X	X				X	
Lack of subsidies							X
High weed pressures						X	

2. What are the three most significant constraints and why?

Lack of policy support on CA
Lack of skilled operators, CA machinery mechanics, service providers
Lack of awareness amongst farmers, end-users and relevant stakeholders

3. How can Gender Equity Social Inclusion Principles be integrated into CA mechanisation activities?

Build the capacity and understanding of CA amongst women (including training).
Develop extension strategies factoring in social and cultural barriers to adoption (and also mobility, safety & women operators)
Develop 'women friendly' machines, supporting them in the use of such equipment
Develop post-harvest enterprises and engage women (can be entrepreneurial business driven approaches).

4. Selecting the most important constraints (from Q1), identify what can be done to address these

Constraint	What needs to be done	Approach to be taken
Lack of policy support on CA.	Policy dialogue required, and needs to be collectively driven by all stakeholders, not just government. Advocacy by influential people. Written policy.	Organise a CA committee to inspire the viability and promote CA in Bangladesh.
Lack of skilled operators, mechanics and LSPs.	In-depth training on CA by the operators, mechanics and LSPs. Ensure tools/spare parts are available.	Provision of practical training Develop training manuals/resources. Require certification of operators.

Lack of understanding of CA by farmers.	Trained men and women farmers as operators. Increasing farmer awareness through practical demonstrations.	Develop a CA mechanisation training centre. Consider training men and women separately considering social, cultural & religious norms.
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**5. What initiatives can be implemented immediately following this workshop, that require few resources but can have a significant impact?**

Organise an annual round table meeting/workshop of all stakeholders (to include agricultural ministry, secretary, policy makers, researchers, extension personnel, NGOs, private sectors, farmers, LSPs in national and regional areas of the country).
Organise training of LSPs and mechanics in districts and regional areas.
Organise CA demonstrations by cropping patterns at specific sites; with CA machines to help better understand and determine suitability of best design features and suits best.

## TEAM 3: Sustainable Business Models

1. Identify and describe the range of different business models that can be developed to help provide farmers with access to CA seeding machines. Describe their general features, and provide comments on their applicability to the 5 different types of CA mechanised seeding types

Specific Business model	General features and characteristics	Types of CA seeding machines can be used in this model
LSP	Field demonstrations	Strip Till 2WT
	Interest in machine	VMP
	Interest in the business	ZT 2WT
		Raised Bed planter
Farmers groups	Field demonstrations	Strip Till 2WT
	Entrepreneur selection	VMP
	Group decision making	ZT 2WT
		Raised Bed planter
Farmers Hub (federation)	Social enterprise	Strip Till 2WT
	Farmers become agri-entrepreneurs	VMP
	Group demonstrations at agri-centres	ZT 2WT
	Financial linkages (Bank of Asia, MFI)	Raised Bed planter

2. For each of the business models, describe their strengths and weaknesses for each

Specific model	Business	Strengths	Weaknesses
LSP		Individual business interest	Challenge of market entrance
		Choice of investment	Capital mobilisation
		Freedom of decision making	Market monopoly
Farmers groups		Better mobilisation of markets	Achieving consensus may not be easy
		Easy access to finance	Synchronisation of machine operations difficult
		Offer lower service cost	
Farmers Hub (federation)		Secure capital mobilisation	Leadership conflict
		Different pricing systems	Problems associated with decision making
		Offers multiple services	
		Captive market	

3. What are the most important characteristics associated with the range of sustainable business models that you have identified?

Skilled in machine operation and maintenance.
Good business understanding.
Provide multiple services (a 'one-stop' shop, whereby service providers provide an integrated multiple service package (seeds, fertilisers, tillage, seeding, crop protection, harvesting and marketing support).

4. What needs to be done to establish the different business models?

(the following elements can also be initiated immediately following this workshop, that require few resources but can have a significant impact)

Market assessment
Create entrepreneurs

Develop skills
Post-sale services and spare parts available

#### TEAM 4: Efficient CA Mechanisation value chains

##### 1. What are the characteristics of an efficient CA mechanisation value chain?

To what degree do these characteristics already exist? 1=non-existent, 2=low level, 3=moderate 4=high  
If the characteristic is low or non-existent, is it possible to change the situation

Specific characteristic	Rating of characteristic (1-4)	Is it possible to change the situation?
Importers and manufacturers	4	-
Dealerships – AZF credit, distribution, after sales service	2	Y
LSP	2	Y
Workshop, mechanics, operators, spare parts	2	Y
Training; LSP, operators, mechanics, business, manufacturers, finance, public/projects	2	Y
Partnership development; development organisations, GDB, NGOs, others	2	Y
Demonstrations and extension activities, issues with lack of budgets	2	Y
Farmers associations and groups	2	Y
Manufacturers association and retailers	3	Y
ERD/planning commission – interconnection of Ministries	2	Y

##### 2. What are the main impediments to an efficient local manufacturing base for CA machines in Bangladesh?

What can be done to resolve the situation?

Major impediments	What needs to be done
Markets; knowledge and demand for machinery	Promotion, awareness raising, demonstrations
Policy – mechanisation needed, no support for the environment, taxes, import duties and subsidies skew and corrupt the market	Relationship building, training, linkage integration, awareness , discuss with GoB to reduce taxes and alter policies accordingly
Quality of inputs (such as steel for manufacturing, poor quality sourced from ship break-ups). No metal testing facilities (metallurgy labs)	Material testing to strengthen quality parameters, developing appropriate methodologies (no metallurgical testing exist in Bangladesh)
High cost of some machinery makes it unaffordable to many end-users.	Explore options for leasing of more expensive machinery, in addition to improved access to finance
Poor quality training and capacity building (these are not linked to what the industry needs) Private sector is driving training needs	Training and capacity building, upgrading of equipment, improved facilities, tools – private sector to invest in TVETS system
Integrating of parts/components and machinery manufacturing – no knowledge on what is needed by large manufacturers, no connectivity, not aware of BD’s comparative advantage to supply US/European manufacturers	Clustering, capacity building, networking, development of common components shared between manufacturers. Connect with OS companies especially those that have already established facilities in other developing nations.

### 3. How can government policies enhance the efficiency of the CA mechanisation value chains, and why?

Policy initiatives	Why they would work (improving CA mechanisation value chains)
Shift subsidies to incentives – align with climate smart outcomes	Better management, more sustainable practices, less corruption (leakage in the system).
CA platform – centralising activities and funding – and demonstrations	Training, awareness, integrated approaches that also consider agronomy and crop husbandry practices as part of an integrated approach to cropping systems improvement (including non-rice crops outside of rice based systems).
CDP – specific detail relating to benefits of CA – outcomes result framework and economics.	Greater understanding of the impact of CA
Machine, crop, geographic specific databases – selection of the right machine for the cropping system	People select the best machines
Quality of extension staff, including improved recruitment processes. Generic staff are no longer adequate as we move into professionalising and modernising farming systems	More engineers, advanced education in CA
A single government window for business	Faster approval, efficient support

### 4. What initiatives can be implemented immediately following this workshop, that require few resources but can have a significant impact?

CA platform, group demonstrations, sharing, networking, correlation experiences, MoU, MoA, introductions to policy makers....develop a one page brief on CA as it can be applied in BD
Boost collaboration, better north-south cooperation in Bangladesh, networking with colleagues.
Strengthening public-private relationships, developing new and stronger partnerships.
Prepare a synthesis of what is already known about CA practice in different regions of Bangladesh and form the basis of CA brain storming platform.
There should be a good empirical basis to argue for to CA mechanization in the context of currently practiced wetland cultivation of rice. Special emphasis is needed to demonstrate to farmers clearly that CA mechanization does not only do good to environment (soil, water savings) which is rather remote for an individual farmer but CA does significantly improve yield, cropping intensity, reduce weeds & labour costs etc which is more direct.

## TEAM 5: Collaboration and communication

### 1. Describe the current strengths and weaknesses in relation to the level of collaboration amongst stakeholders associated with CA mechanisation in Bangladesh

Strengths	Weaknesses
Strong scientific consensus	Isolated research programs; silos inside of organisations as well as between organisations/institutions.
Evidence: research results : to convince stakeholders	CA not an identified priority of research institutions and of government.
Some level of understanding now exists.	Communication and collaboration gap between middle level and top levels of management
Informal network of researchers and manufacturers now exists	CA import standards Networks
Good basis of CA machines	
Basic human capacity at least in research, manufacturing and farmers.	

### 2. What opportunities exist to improve collaboration? How can this be undertaken or initiated?

Specific opportunity	How can this be undertaken or initiated
Government commitment to: Ag mechanisation -> CA to be promoted	Through capacity building, including end users
Use existing infrastructure and networks (farmer groups, dealers, NGOs etc)	Bridge the gap between mid-level managers and policy makers
Link to climate change responses	Broaden discussion; carbon credits, future issues (straw).
Link to rural development and income generating activities	

### 3. What opportunities or initiatives are available to improve communication and the sharing of information between different stakeholders associated with CA mechanisation in Bangladesh?

Specific opportunity/ initiative	How can this be undertaken or initiated
Innovate communication messages and CA definitions	-
Media, branding	-
CA as part of the climate smart agenda	-
CA suitability mapping, according to cropping systems, land suitability (exists)	-
Cross boundaries lessons, learning, sharing experiences	-

### 4. What initiatives can be implemented immediately following this workshop, that require few resources but can have a significant impact?

Capacity building of the whole value chain including policy and users (producers)
Remove support to rotovator and other soil structure destroying equipment
Rice production under minimal soil disturbance practices.
Provide support to CA machines (subsidies?)
Prepare for residue management under combine harvesting systems
Update the CA definition from FAO to better reflect the practices and environment of South Asia (context)

## Appendix 4: Workshop Program

 Australian Government Australian Centre for International Agricultural Research	<b>Workshop for          Sharing Experiences with          CA-based Seeding Mechanisation          in Bangladesh          October 12<sup>th</sup> 2019, Dhaka, Bangladesh</b>	 <b>Australian          Aid</b>
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9.00am to 9.20am	Welcome and opening remarks <ul style="list-style-type: none"> <li>• Workshop purpose and anticipated outcomes</li> <li>• Self-introduction of participants</li> </ul>	
9.20am to 10.20am	<b>Setting the Scene</b> <i>introductory presentations examining different CA seeding machine designs, focusing on equipment design features, advantages and disadvantages.</i>	
	1. Two wheel tractor 2WT operated strip till planter (Min till)	Dr. Md Arshadul Hoque
	2. Versatile Multi-crop Planter (VMP) seed drill (2WT operated)	Dr. Md. Enamul Haque
	3. Zero-till drill (2WT operated)	TBA
	4. Bed planter (2WT operated)	Dr Md Arshadul Hoque
	5. Zero-Till seed drills (various) (4WT operated)	TBA
	Questions and points of clarification	
10.20am to 10.40am	<b>Workshop discussion paper: what the pre-workshop survey told us</b>	Dr Jay Cummins
10.40am to 11.00am	<b>Morning tea break</b>	
11.00am-12.40pm	<b>CA systems constraints and opportunities; working group activity</b> <i>Working group teams will focus on one of five specific aligned to the area of individual interest/expertise. Small group discussions will provide the opportunity for participants to reflect on their experiences to help address specific constraints that are 'cross-cutting issues' across all CA sowing machinery systems.</i> <p><b>Team 1: CA Machinery:</b> Identifying advantages of CA machinery configurations (including integration into farming systems). Specifications and performance overview, integration into farming systems, agronomic performance (soil disturbance, soil fertility, weed management)</p> <p><b>Team 2: Adoption CA Seeding Systems:</b> Enhancing the adoption of CA seeding systems through addressing systems constraints, training and capacity building, scaling considerations and strategies, adoption pathways/roadmaps, market segmentation considerations, GESI integration.</p> <p><b>Team 3: Sustainable Business Models:</b> Building the capacity and sustainable business models for Local Service Providers (LSP). rental service/local service provider models, operator training, operational models, repairs and maintenance, economic comparisons</p> <p><b>Team 4: Efficient CA Mechanisation value chains:</b> Developing an enabling environment to improve CA mechanisation value chain efficiencies (including Govt policy).</p> <p><b>Team 5: Collaboration and communication:</b> Improving collaboration and communication across the CA mechanisation value chain (including opportunities for forming an association), improved approaches to sharing information, opportunities for developing Innovation Platforms.</p>	

*The specific issues to be addressed will be linked to the discussion paper and will provide the opportunity to elaborate, debate and develop the outputs. Focussed group discussions will discuss in detail issues identified in the discussion paper, with the view of revising and providing concrete recommendations that will feed into the workshop output, this being a workshop report titled 'Opportunities for accelerating adoption and out scaling of CA Seeding Mechanisation in Bangladesh'.*

12.40pm-1.30pm	<b>Lunch break</b>
1.30pm-3.15pm	<p><b>Feedback presentation (CA systems constraints and opportunities session)</b></p> <p>Each group will be allocated 20 minutes each to report back on their findings (summary points captured on a PowerPoint presentation)</p> <ul style="list-style-type: none"> <li>Team 1: CA Machinery</li> <li>Team 2: Adoption CA Seeding Systems</li> <li>Team 3: Sustainable Business Models</li> <li>Team 4: Efficient CA Mechanisation value chains</li> <li>Team 5: Collaboration and communication</li> </ul>
3.15pm-3.40pm	<b>Afternoon Tea break</b>
3.45pm to 4.20pm	<p><b>Plenary Session</b></p> <p><b>Identifying the gaps in achieving the successful adoption and outscaling of CA mechanisation seeding systems in Bangladesh</b></p> <p>Facilitated discussions aimed at identifying range of outscaling opportunities, and how best to work collaboratively across projects and organisations.</p> <ul style="list-style-type: none"> <li>• Identification of future actions.</li> <li>• Identification of expert team to contribute to workshop strategy paper</li> </ul>
4.20pm to 4.30pm	<b>Closing remarks and vote of thanks</b>
4.45pm to 6.45pm	<b>Optional machinery visit</b> Hoque Corporation (HC, manufacturer and commercial partner of VMP)

## Appendix 5: Workshop participants who attended the workshop

#	Organisation	Name / Position	Project	Email address
<b>Extension and out scaling</b>				
1	CIMMYT	Mahesh Gathala	Cropping Systems Agronomist	m.gathala@cgiar.org
2		Jack McHugh	Systems Agronomist, CSISA	a.mchugh@cgiar.org
3		Hera Lal Nath	CSISA-MI	h.l.nath@cgiar.org
4	iDE	Mr. Abir Ahmed Chowdhury	Senior Tech Specialist, CSISA MI	abir.chowdhury@ideglobal.org
5	RDRS	Md. Mamunur Rashid	Agricultural Project Coordinator	mamunrdrs@gmail.com
6	University of WA	Fay Rola-Rubzen	Behavioural Economics	Fay.rola-rubzen@uwa.edu.au
7	Rural Development Academy (RDA), Bogura	Mr. Abdullah Al Mamun,	Director (Agricultural Sciences Division)	aamamun15@gmail.com
8	Solidaridad Network, Noyakhali, Bangladesh	Md. Atikuzzaman,	Program Manager,	atikuzzaman@solidaridadnetwork.org
9	CIMMYT SAfrica Regional Office, Zimbabwe	Frederic Baudron	Systems Agronomist	F.Baudron@cgiar.org
10	Melkasa Ag RC, Ethiopian Inst Ag Research	Bisrat Getnet Awoke	Director and Researcher, Agricultural Research Directorate	bisrat.get@gmail.com
<b>Government Policy (shaping, influencing and implementing policy)</b>				
11	Bangladesh Ag Research Council/SAARC/KGF	Wais Kabir	Executive Director Krishi Goveshona Foundation (KGF), BARC, Ministry of Ag	waiskabir@hotmail.com
12	Barind Multipurpose Dev, Authority (BMDA), Ministry of Ag	Akram H Chowdhury	Chairman	akramchowdhurymp@hotmail.com chairman@bmda.gov.bd
13		Shohel Ahamed	Assistant to the Chairman BMDA	shohel.ahamed@gmail.com
14	SAARC Agriculture Centre	Rudra Shrestha	Senior Program Specialist (NRM)	rudrabshrestha@gmail.com
15	BAU	Prof. Dr Sattar Mandal	Emeritus Professor in the Dept. of Ag. Economics & Former Vice-Chancellor of BAU, Mymensingh	asmandal11@gmail.com
<b>R&amp;D Mechanisation Development</b>				
16	Murdoch University	Dr Md Enamul Haque	Adjunct Associate Professor Coordinator, NUMAN and CA Projects, Dhaka	e.haque@murdoch.edu.au
17	Bangladesh Maize and Wheat Research Institute BWMRI/BARI/BARCBRRRI	Muhammad Arshadul Haque	Senior Scientific Officer, FMPE Division, BARI, Gazipur FMP Engineering Division, BARI, Gazipur, Bangladesh	arshadul@bari.gov.bd
18	Bangladesh Rice Research Inst. Gazipur	AKMS Islam	PSO, Farm Machinery and Postharvest Technology Division.	akmsaifulislam68@gmail.com
19		Dr Md Abdur Rahman	Chief Scientific Officer Farm Machinery and Postharvest Technology Division.	abrahaman42@yahoo.com
20	BAU	Md Mohshiuur Rahman	Dep Agronomy	rahmanag63@gmail.com
21		M. A. Monayem Miah	Agricultural Economics Division	monayem09@yahoo.com
<b>Machinery Manufacturers and Retail</b>				
22	Alim Industries	Alimul Ahsan Chowdhury	Managing Director	ahsan@alimindustriestd.com
23		Md Alamgir Hassain	Engineer	alamgir@alim.com.bd

24	Janata Engineering	Md. Ole Ullah	Director	janataengineering786@gmail.com
25	The Metal Private Limited	Mr Jamil Sadid	Managing Director	sadid.jamil@metalbd.biz
26		Mr. Amitave Paul	Assistant Manager, Business Development Department, TMPL	amitave.paul@metalbd.biz
27	Hoque Corporation (HC)	Md. Mizanul Hoque	Managing Director	hoquecorporation@gmail.com
<b>Others</b>				
28	ACIAR	Eric HUTTNER	Research Program Manager	eric.huttner@aciar.gov.au
29	ACIAR	Todd SANDERSON	Economist and Policy Associate	Todd.Sanderson@aciar.gov.au
30	IAfD	Jay Cummins	Workshop Facilitator	jay@iafd.org