Benefits, Advantages, Disadvantages and Key Decision Processes in CASI Adoption in South Asia: Results of Focus Group Discussions

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Abstract

This report presents the results of the Focus Group Discussions (FGDs) examining the benefits, advantages and disadvantages, issues and the key decision processes and criteria for conservation agriculture sustainable intensification (CASI) technology adoption in South Asia. Included in the discussion are the problems and issues, advantages and disadvantages, criteria for adoption, and risks associated with CASI technology adoption. A total of eight districts are covered in this report - Sunsari, Nepal; Dhanusa, Nepal; Madhubani, Bihar, India; Purnea, Bihar, India; Coochbehar, West Bengal, India; Malda, West Bengal, India; Rajshahi, Bangladesh; and Rangpur, Bangladesh. Across 40 nodes, a total of 1182 participants were involved in the focus group discussions composed of 670 males and 512 females. The CASI technologies assessed include zero-tillage, strip tillage, direct-seeded rice, rice transplanter, and laser land leveller. Weed control was the primary problem faced by the participants due to zero-tillage approach and the problem was more manifested due to the non-availability of suitable herbicides. The timely availability of irrigation coupled with the uneven sowing and distribution of seeds had resulted to poor germination of the crop. The limited skills of machine operators also contributed to the uneven sowing of the seedlings. The technology, however, was promising due to a number of reasons. The reduction of labour was primarily attributed to less labour requirement for nursery preparation, tillage and replanting. The principle of zero-tillage helped improve the soil condition and saved time. Better or satisfactory yield was also achieved with the adoption of the technology. The low tillage cost resulted to cost savings. However, weed control was the primary challenge of the farmers due to the lack of suitable herbicides. This condition resulted to increased insect, pest and diseases. The limited skills of operators also resulted to poor germination of the crops. Farmers were willing to adopt the technology if it can reduce the labour requirement and the cost of production. Moreover, enhancement of yield was also an important criterion. The savings in terms of time and irrigation requirement also contributed to the decision of the farmers to adopt the technology. Lastly, weed control was an important consideration for CASI technologies. The main concern of the farmers were the timely availability of the machine, the timing issues for the harvest season for early planting, and yield risk due to poor germination, weed infestation and pests and diseases.

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Benefits, Advantages, Disadvantages and Key Decision Processes in CASI Adoption in South Asia: Results of Focus Group Discussions

1. Introduction

This report summarizes the key benefits, advantages, disadvantages, issues and the key decision processes and criteria for Conservation Agriculture Sustainable Intensification (CASI) technology adoption in the Eastern Gangetic Plain of South Asia through the Sustainable and Resilient Farming Systems Intensification (SRFSI) project covering Nepal, India, and Bangladesh.

A total of eight districts are covered in this report - Sunsari, Nepal; Dhanusa, Nepal; Madhubani, Bihar, India; Purnea, Bihar, India; Coochbehar, West Bengal, India; Malda, West Bengal, India; Rajshahi, Bangladesh; and Rangpur, Bangladesh.

2. Research Approach

Focus group discussions (FGDs) were conducted in SRFSI project sites. Across 40 nodes, a total of 1182 participants were involved in the FGDs composed of 670 males and 512 females. The CASI technologies assessed include zero-tillage, strip tillage, direct-seeded rice, rice transplanter, and laser land leveller. This research employs a qualitative approach in analyzing the key decision processes and criteria for CASI technology adoption among rural farmers in South Asia.

NVivo 11 was utilized to create nodes to aid the analysis. A total of eight districts were covered in this report – 1) Sunsari, Nepal; 2) Dhanusa, Nepal; 3) Madhubani, Bihar, India; 4) Purnea, Bihar, India; 5) Coochbehar, West Bengal, India; 6) Malda, West Bengal, India; 7) Rajshahi, Bangladesh; and 8) Rangpur, Bangladesh (Table 1).

Table 1. FGD participation by gender

District	Season	Period	Nodes	Male	Female	Total
Sunsari, Nepal	Post-Rabi; Pre-Kharif	May 2016	5	55	42	97
Dhanusa, Nepal	Post-Rabi; Pre-Kharif	May 2016	5	60	60	120
Madhubani, Bihar, India	Post-Rabi; Pre-Kharif	May 2016	5	146	153	299
Purnea, Bihar, India	Pre-Rabi; Pre-Kharif		5	184	168	352
Coochbehar, West Bengal, India	Kharif; Pre-Rabi	December 2015	5	65	19	84
Malda, West Bengal, India	Kharif; Pre-Rabi	January 2016	5	84	16	100
Rajshahi, Bangladesh	Post-Rabi; Pre-Kharif	May-June 2016	5	39	31	70
Rangpur, Bangladesh	Post-Rabi; Pre-Kharif	May-June 2016	5	37	23	60
Total			**40**	**670**	**512**	**1182**

In Sunsari, 15 FGDs were conducted in five nodes namely: Bhokraha, Simariya, Bhaluwa, Kapatangunj and Salbani on May 2016 during the Post-Rabi and Pre-Kharif season.

There were 5 male FGDs, 5 female FGDs, and 5 mixed FGDs. A total of 97 participants composed of 55 males (57%) and 42 females (43%) participated.

In Dhanusa, the 15 FGDs were composed of an equal distribution of male participants and female participants. There 5 FGDs composed of male participants, 5 FGDs composed of female participants and 5 FGDs composed of mixed participants. A total of 120 participants were involved in the five nodes including Lalgadh, Giddha, Phulgamma, Sinurjoda, and Raghunathpur. The FGDs were conducted in May 2016 covering the Post-Rabi and Pre-Kharif seasons.

In Madhubani, a total of 299 farmers participated during the FGDs for Post-Rabi and Pre-Kharif seasons. There were 15 FGDs composed of male participants and 15 FGDs composed of female participants. These FGDs were conducted in five nodes namely: Korahia, Sukhet, Mahuahi, Nanaur and Khairi in May 2016.

In Purnea, two sets of FGDs were conducted during the Pre-Rabi and Pre-Kharif seasons across five nodes. From a large number of participants totaling to 352, there were 184 males (52%) and 168 (48%) females who participated in the FGDs.

In Coochbehar, a total of 84 respondents participated in five FGDs composed of 65 males (77%) and 19 females (23%). The FGDs were conducted in December 2015 during Kharif and Pre-Rabi trials. The FGDs in Patchara, Folimari, and Ghugumari nodes were facilitated by Satmile Satish Club O Pathagar. Also, the FGDs in Mansai and Durganagar nodes were facilitated by Anwesha and Sabujmitra FC, respectively.

In Malda, FGDs were conducted in five nodes including Ugritola by Manikchak Prog. FC., Mohadipur, and Vidyanandapur by Farmers Club, Kalinagar, and Gorangapur by Vivekanada FC. A total of 100 respondents with 84 males and 16 females participated in the FGDs on January 2016 during the Kharif and Pre-Rabi trials.

In Rajshahi, FGDs were conducted on May-June 2016 covering the period of Post-Rabi and Pre-Kharif seasons. Across five nodes, a total of 70 farmers were engaged in FGDs with 39 males (56%) and 31 females (44%). There were 6 FGDs conducted composed of 2 all males, 2 all females, and 2 mixed participants. The FGDs were facilitated by the Bangladesh Agricultural Research Institute (BARI).

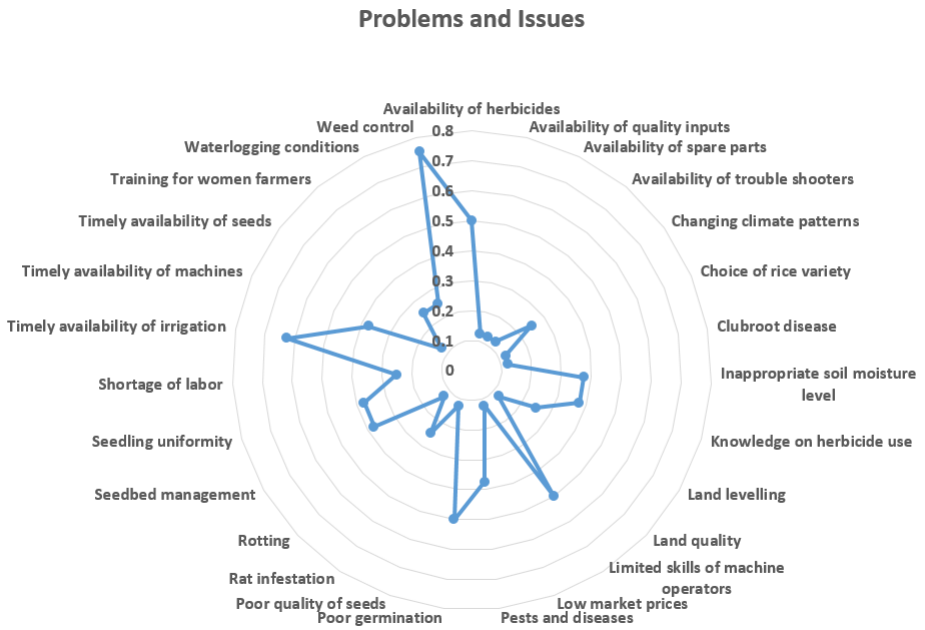
In Rangpur, a total of 60 farmers composed of 37 males (62%) and 23 females (38%) were involved in FGDs. There were 6 FGDs conducted composed of 2 all males, 2 all females, and 2 mixed participants. These FGDs were conducted during May-June 2016 covering Post-Rabi and Pre-Kharif seasons.

The results of the analysis are presented in four thematics associated with the use of CASI technology – problems and issues, advantages and disadvantages, criteria for adoption, and risks associated with technology adoption. Concluding remarks are offered in the final section.

3. Problems and Issues

Various issues were encountered by the farmers across districts during the trials (Figure 1). Specifically, they were asked regarding the key issues affecting the returns from their seasonal crops and the performance of CASI technologies such as zero-tillage, strip tillage,

direct-seeded rice, rice transplanter, and laser land leveller. In general, the main problems and issues encountered by majority of the districts include weed control (75%), timely availability of irrigation (63%), availability of herbicides (50%), poor germination (50%), and limited skills of machine operators (50%). Also, some districts have encountered the following problems such as limited knowledge on herbicide use (38%), timely availability of machines (38%), seedbed management (38%), seedling uniformity (38%), pests and diseases (38%), inappropriate soil moisture level (38%), land levelling (25%), rat infestation (25%), shortage of labour (25%), training for women farmers (25%), waterlogging conditions (25%), and changing climate patterns (25%). Lastly, other issues identified during the FGDs but limited to specific districts include timely availability of seeds (13%), choice of rice variety (13%), rotting (13%), availability of quality inputs (13%), clubroot disease (13%), availability of trouble shooters (13%), availability of spare parts (13%), land quality (13%), poor quality of seeds (13%) and low market prices (13%).



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 1. Problems and issues associated with SRFSI trials

3.1 Sunsari, Nepal

In Sunsari, in general, the adoption of SRFSI technologies, particularly zero-tillage seeding, had a number of advantages to the farmers including decreased labour particularly for women farmers and decreased costs. With the same level of yield with conventional farming (i.e puddled transplanted rice), most farmers experienced increased revenues. Because of these positive outcomes, a large number of farmers had asked about the SRFSI technologies and the potential to use the technology during the Rabi season – 100 farmers in Bhokraha, 40 farmers in Simariya, and 200 farmers in Kaptangunj. Problems and issues, however, were also encountered during the trials. Specifically, weed control, availability of herbicides, knowledge on herbicide use, and timely availability of the machines were the key issues experienced. The timely availability of the laser land levelers and rice transplanters was also a key constraint.

Raising suitable seedlings for mechanical transplanter was also an issue. The early planting of rice appeared to be more problematic because of the inappropriate soil moisture level. Farmers, on the other hand, were more interested in implementing early planting during the Rabi season because of the potential to increase the cropping intensity, hence, there was also a potential for improved returns.

3.2 Dhanusa, Nepal

The participants in Dhanusa identified the key problem as weed control, which was related to the availability of herbicides and limited knowledge of the farmers. Poor germination was also an issue for some groups, which could be linked to moisture at seeding and the skill of the machinery operator. Two of the issues raised were limited machine availability and limited skilled zero-tillage machine operators. The timely availability of the irrigation in some locations was also a key issue encountered during the trials. However, there was no clear strategy on the part of the project implementers on how to address this issue.

3.3 Madhubani, Bihar, India

In Madhubani, from the total 30 FGDs conducted composed of 15 male groups and 15 female groups, a large majority of the FGD groups rated the trials during the Kharif season as very good (17 groups) and good (10 groups). However, some problems were also encountered during the trials. Issues on less germination, weed problem, land levelling, limited skills of machine operator, availability of irrigation facility and timely availability of seeds.

3.4 Purnea, Bihar, India

The FGDs in Purnea revealed a lot of challenges encountered by the farmers during the Kharif and Rabi trials. The majority of the participants identified that the Direct-seeded Rice and Zero-tillage are potential labour saving technology for resource-poor farm households compared to puddled and unpuddled transplanted rice. The choice of rice variety, particularly Rajendra Mansuri, however, delayed the sowing of the next Rabi crops as experienced in all nodes. Moreover, the terrain of the farm lands being undulated was also a major hurdle for all nodes except Tikapatti. With undulated lands, sowing is challenging through zero-tillage machines. As a result, poor germination of crops was experienced by Udainagar and Dogachhi farmers. Weed infestation was also a major concern in Purani Garel and Tikapatti areas. Rotting and other diseases were also experienced in Kathaili. Rat attacks on Rabi crops were also experienced, particularly in wheat crops. The lack of quality inputs and labour shortage in Tikapatti also affected the crop productivity. During the peak season, there was a shortage of labour in Purani Garel. The low supply of labour during the harvesting and threshing of Rabi crops was particularly linked to the high migration rate in the rural community. Despite these issues, they are interested in increasing the area using DSR in the next Kharif season particularly in Kathaili. To address these issues, the majority of the respondents across the nodes felt that there is an urgent need of land leveling as well as proper irrigation to warrant the efficient use of zero-tillage machines. They wanted to replace the long duration Rajendra Mansuri with a hybrid variety of paddy. In addition, they also expressed their interest to use a happy seeder machine while a few of them are planning to purchase one. They also plan to change their tractors with 60 horsepower to fit the happy seeder machine. To adapt from a rat infestation, some farmers are planning to shift crops from wheat to maize.

3.5 Coochbehar, West Bengal, India

The participants in Coochbehar were asked about their impression on the trials. Patchara, Durganagar, and Mansai participants had good impressions about the trials while Ghugumari and Folimari participants marked their impression about the trials as neither good nor bad. They were also asked for a suggestion to improve the trial to be conducted in the next Kharif season. Among their suggestions were uniform seeds and seedling size, provision of training especially for women farmers, address the waterlogged conditions and management of seedbed in Mansai farms, and timely availability of Zero-tillage machines / Transplanters.

3.6 Malda, West Bengal, India

In Malda, the participants were also asked about their impression on the trials. Kalinagar, Gourangapur, and Mohadipur participants had very good impressions about the trials while Ugritola and Vidyanandapur participants marked their impression about the trials as neither good nor bad. Among their suggestions to improve the production in the next Kharif season were uniform seeds and seedling size, provision of training especially for women farmers, timely availability of Zero-tillage machines / Transplanters, modification in seedbed preparation and machine, and address the problem of clubroot in Mustard production.

3.7 Rajshahi, Bangladesh

The FGDs in Rajshahi offered opportunities for the farmers to identify the challenges encountered during the Rabi trials. Conservation agriculture technologies were relatively new. Strip tillage including direct-seeded rice successfully reduced the cost of production without sacrificing the output level. It saved both time and labour. Since labour shortage had already become a major issue, these technologies provide a good alternative solution. Because of successful trials, neighboring farmers were now interested in adopting the technology. However, a number of issues were encountered during the trials. The most common across the nodes were the lack of skilled operators. Seeding uniformity and depth were also an issue. In the event of machine breakdown, trouble shooters and spare parts were not readily available. Another major problem experienced across the nodes was the weed management issue. Suitable herbicides for weed control were not available in Rajshahi. While unpuddled transplanted rice had gained popularity in Premtoli, the farmers were concerned about the land quality after the trials as the land were observed to be harder. Insect pests and diseases were also common. Limited irrigation was experienced in the Barind area. Other issues raised by the farmers relate to changing climate patterns and market prices. During the Rabi season, pulses especially lentil crops had low yield due to some rainfall during late January. Also, a hail storm in the early February affected the yield of wheat crops. Cereals had high yields but market prices were low. On the other hand, pulses had higher market prices but yields were considered low. Low market prices primarily affected the net returns of the farmers. To improve the adoption of CASI technologies in Rajshahi, it is important to address the three primary problems - availability of machines, availability of machine operators, and availability of suitable herbicides.

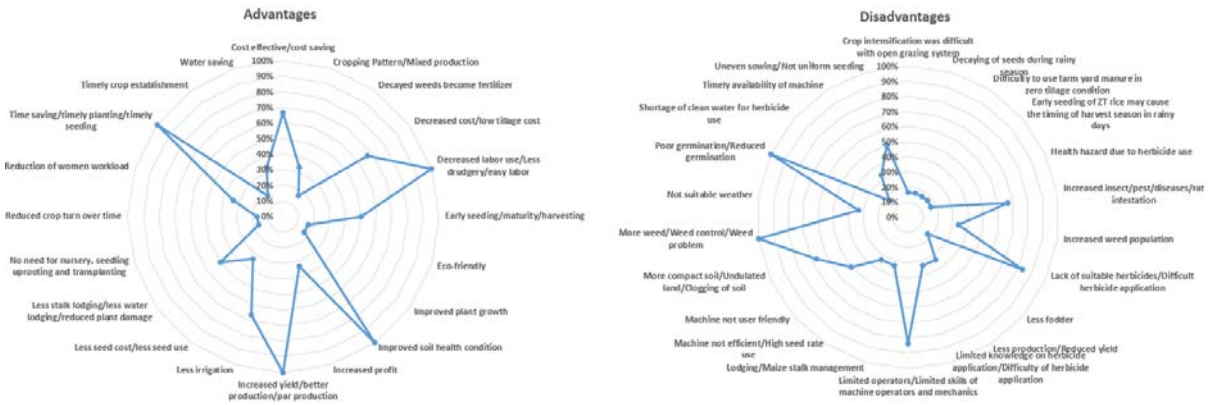
3.8 Rangpur, Bangladesh

The participants in Rangpur also identified various challenges during the Rabi trials. In general, the yield of the maize was relatively higher during the May-June 2016 FGD compared to the previous performance in 2015 primarily because of the hail storm experienced during the previous season and the promising performance of CASI technologies. These technologies reduced the cost of production and the use of farm labor. Specfically for women who were also

performing planting and weeding tasks, the technology provided more time for other income generating activities such as poultry and cattle rearing. Production in most nodes were at par with the conventional approach, thus, increase in incomes were experienced by most farmers. With these results, farmers across the nodes opined that neighboring farmers were now interested in adopting the technology. However a number of issues were experienced during the Rabi trials. The key problem was weed control which was associated to the availability of herbicides and the limited knowledge about their use. Poor germination was an issue in some nodes due to inappropriate moisture level and limited skills of the machine operators. Also, in some nodes, limited machine availability and limited skilled operators were the primary issues. Other issues encountered include the neck blast disease in Rabi rice, rat infestation in wheat fields, poor quality of maize and wheat seeds, shortage of irrigation water, unavailability of herbicides and changing climate patterns specifically high temprerature affecting the wheat production during the Rabi season and uneven rainfall distribution. To improve the adoption of the CASI technologies, there is a need to make the machines available, upskill machine operators and identify suitable herbicides appropriate to the specific sites.

4. Advantages and disadvantages

The CASI technologies were assessed in terms of their advantages and disadvantages as identified by the farmers during the trials (Figure 2). The advantages identified by the farmers across districts include: decreased labour use/less drudgery/easy labour (100%), improved soil health condition (100%), time saving/timely planting/timely seeding (100%), increased yield/better production/at par production (100%), cost effective/cost saving (67%), decreased cost/low tillage cost (67%), less irrigation (67%), early seeding/maturing/harvesting (50%), and less stalk lodging/less water lodging/reduced plant damage (50%). Also, some districts experienced cropping pattern/mixed production (33%), increased profit (33%), less seed cost/less seed use (33%), reduction of women workload (33%), and water saving (33%). Other advantages identified during the FGDs but limited to specific districts include address shortage of labour (17%), decayed weeds become fertilizer (17%), eco-friendly (17%), improved plant growth (17%), no need for nursery (17%), seedling uprooting, and transplanting (17%), reduced crop turn over time (17%), and timely crop establishment (17%). On the other hand, the disadvantages associated with the use of CASI technologies include: more weed/weed control/weed problem (100%), poor germination/reduced germination (100%), lack of suitable herbicides/difficult herbicide application (83%), limited operators/limited skills of operators and mechanics (83%), increased insect/pest/diseases/rat infestation (67%), more compact soil/undulated land/clogging of soil (67%), machine not user friendly (50%), and uneven sowing/not uniform seeding (50%). Also, some districts experienced increased weed population (33%), less production/reduced yield (33%), limited knowledge on herbicide application/difficulty of herbicide application (33%), lodging/stalk management (33%), machine not efficient/high seed rate use (33%), and not suitable weather (33%). Other disadvantages identified during the FGDs but limited to specific districts include timely availability of the machine (33%), crop intensification was difficult with open grazing system (17%), decaying of seeds during rainy season (17%), difficulty to use farm yard manure in zero-tillage condition (17%), early seeding of zero-tillage may cause the timing of harvest season in rainy days (17%), health hazard due to herbicide use (17%), less fodder (17%), and shortage of clean water for herbicide use (17%).



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 2. Advantages and disadvantages associated with soil conservation technology

4.1 Sunsari, Nepal

The advantages and disadvantages of using the CASI technologies were also documented in each district (Table 2). In Sunsari, men and women farmers believed that zero-tillage technologies had a lower cost of tillage operations, low irrigation requirement with 35%-40% savings for water use as compared to conventional tillage technologies, timely crop establishment, and less stalk lodging for maize as well as wheat crops. Because transplanting and weeding activities are usually performed by women farmers were no longer necessary in CASI technologies, the effect of these technologies specifically for women was the reduction of workload. Thus, women farmers can utilize their extra time for other activities. Other benefits of CASI technologies include the use of decayed weeds as fertilizer after post-emergence herbicide application in the rice field. There was no need to establish a nursery, seedling uprooting and transplanting activities with zero-tillage rice technologies. Thus, there was a reduction of cost as well as time. The timely seeding of the crop because of tillage reduction in zero-tillage reduced the turnover time for crops. There was also a perceived improved soil health condition in zero-tillage and early planting opportunity for maize and wheat crops. Because there was a shortage of labor, most farmers in all nodes in Sunsari were interested in adopting the zero-tillage technologies. While grain production between zero-tillage and conventional tillage technology was almost similar, the reduced cost of production in zero-tillage encouraged most farmers to extend their areas of adoption for winter crops such as wheat, maize, and kidney bean. In particular, the farmers in Salbani node had a very impressive outcome of the trials and were planning to extend the area of adoption. Laser leveled fields in Bhokraha and Kapatangunj nodes were increasing and there was a high demand for other district such as Jhapa. The use of improved variety introduced by RARS Tarahara resulted in crop yield increase as well. These varieties include Swarna Sub 1, Tarahara-1, Samba-masuli sub 1 & Sukha dhan-3 in rice and Vijay variety in wheat.

Disadvantages associated with the use of CASI technology were also experienced in Sunsari (Table 2). The primary problems experienced were weed control using herbicide in rice fields, availability of machines and trained operators and mechanics, and poor germination due to weather conditions and machinery operations. Maize stalk management for zero-tillage

was difficult. Herbicide application in the rainy season was challenging because herbicide can be easily washed away. Also, there was a limited knowledge of the farmers on the type and amount of herbicide application. In some cases, the recommended dose of herbicides was not effective. There was also a shortage of clean water in the field for herbicide application. For large-scale farmers, there was also a challenge in using the manual method of herbicide application. Clogging of soil during the rainy season was also a source of concern for uniform seed distribution. In addition, decaying of seeds was experienced when rainy days followed immediately after seeding. There was a difficulty operating the transplanter machine in unpuddled condition. There was also a lack of trained and skilled tractor operators and mechanics for maintenance of seed drill, sprayers, and rice transplanting machines. Also, undulated land causes difficulty in operating the zero-tillage machines. Maintenance and troubleshooting of machine, seed drill and sprayer were also identified as a constraint by the farmers. There was also difficulty using the farmyard manure in zero-tillage condition. Crop intensification was also challenging with the open grazing system in Bhaluwa and Simariya nodes. Most of the nodes experienced unavailability of the zero-tillage machines on time. In general, most of the farmers were disinterested in adopting zero-tillage in rice farming because of weed control and difficulty to operate machine during the rainy season but were keen to expand the adoption of winter crops such as wheat, maize, and kidney bean.

Table 2. Advantages and disadvantages of CASI technology in Sunsari

Advantages	Disadvantages
Low cost of tillage	Weed problems in rice field
Low irrigation requirement	Timely availability of ZT machine
Timely crop establishment	Limited skills of machine operators and mechanics
Less stalk lodging problem in maize and wheat	Poor germination
Reduced workload	Maize stalk management for ZT DSR was difficult
Time saving	Herbicide application was difficult during rainy seasons
Decayed weed becomes a fertilizer	Limited knowledge on herbicide application
No need for nursery, seedling uprooting and transplanting in DSR	In some cases, herbicide dosage was not effective
Timely seeding	Shortage of clean water for herbicide application
Reduced crop turn-over time	Difficulty of herbicide application by manual method for large-scale farmers
Improved soil health condition	Clogging of soil
Early planting opportunity	Decaying of seeds during rainy season
Address shortage of labor	Difficult operation of transplanter machine in unpuddled condition
	Lack of maintenance and troubleshooting of machine, seed drill & sprayer
	Undulated land causes difficulty in operating ZT machine
	Difficulty to use farm yard manure in zero-tillage condition

4.2 Dhanusa, Nepal

In Dhanusa, a number of advantages were also documented (Figure 3). The technology was described by most FGD participants as labour saving, labour easy, and less drudgery with 100% of FGD participants in rice supporting the statement, 100% for wheat farmers, 75% for maize farmers and 57% for mung bean farmers. The technology was also predominantly described as a cost saving with 93% for rice, 100% for wheat, 100% for maize, and 14% for mung bean farmers agreeing to the statement. Some farmers described also the effect of the technology as having better or satisfactory production. For rice farmers, 53% of them identified better production results while 20% agreed with satisfactory production results. For wheat farmers, 20% and 13% identified better and satisfactory production, respectively. About 13% of the maize farmers agreed to either result. Lastly, about 7% agreed for better production and 7% for satisfactory production results. Other advantages of CASI technology for rice farming include the potential for mixed production (7%) and timely planting (7%). Also, for wheat farmers, the technology was appraised as having the potential for mixed production (15%), early seeding and harvesting (7%) and less irrigation requirement (7%).

The disadvantages associated with the use of the CASI technology was also documented in Dhanusa (Figure 3). Primarily, the main concern of majority of the farmers was the issue of weed control. This problem was cited by 93% of the rice farmers, 100% of the wheat farmers and 100% of the maize farmers. The other two notable disadvantages were the

poor germination in rice farms (47%) and less fodder output (47%) in wheat farms. An equally important problem associated with the implementation of CASI technologies in Dhanusa were the limited skilled operators in the rice (7%), wheat (13%) and maize (50%) farming using conservation technology. The issue of lack of herbicide in the locality was also affecting rice farms (7%), wheat farms (13%), and maize farms (50%). Additional problems in wheat production using CASI technology was the spread of diseases (7%) and lodging of wheat plants (7%). In mung bean production, the main problem experienced by a few (14%) farmers were the extent of less production associated with CASI technology adoption.

** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 3. Advantages and disadvantages of CASI technology in Dhanusa

4.3 Madhubani, Bihar, India

The participants in Madhubani were also asked regarding the advantages and disadvantages of the CASI technology. A total of 30 FGDs were involved with an equal distribution of male and female groups. According to the farmers, three primary advantages were observed during the trial (Figure 4). The most cited advantage of male (47%) and female (47%) FGDs was the less expenditure and more yield associated with CASI technology. The second advantage of CASI technology was the savings in labour, tillage and seed cost. This was reflected in 33% of male FGD sessions and 33% of female FGD sessions. Lastly, the CASI technology was also described as water and time-saving technology as supported by 7% of male FGD sessions and 13% of female FGD sessions.

In addition, Madhubani FGD participants were also asked of the disadvantages associated with the adoption of the technology (Figure 4). The majority of the groups did not identify some disadvantages. Among those groups that identified the disadvantages, weed control (20%) topped in female FGD groups followed by not uniform seeding and spacing (13%), and lesser seed germination (7%). For male groups, an equal distribution of FGD sessions cited the same disadvantages such as weed control (13%), not uniform seeding and spacing (13%), and lesser seed germination (13%). Weed control was particularly more burdensome for female farmers. Proper seeding was not achieved if some space were left vacant. Lesser seed germination was experienced when the depth of sowing was too deep.

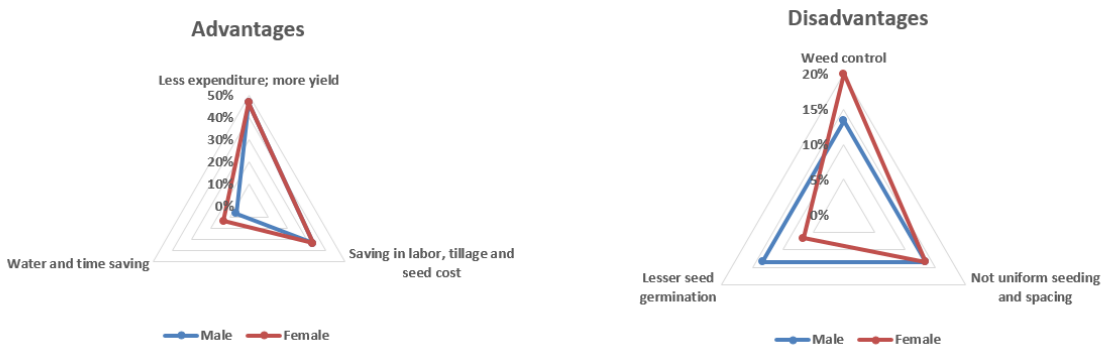


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Figure 4. Advantages and disadvantages of CASI technology in Madhubani

4.4 Purnea, Bihar, India

In Purnea, the advantages of zero-tillage, direct-seeded rice, and other conservation agriculture technologies were documented by male and female farmers during Rabi and Kharif seasons. Seven primary advantages were mentioned by the FGD participants (Figure 5). The CASI technologies were considered cost effective by the majority (81%-91%) of the Rabi participants while 36%-41% of the Kharif participants identified this advantage. Male participants had slightly higher assessment for cost effectiveness compared to female participants for zero-tillage (90%:88%), direct-seeded rice (91%:88%), and other conservation agriculture technologies (89%:81%) during the Rabi season as well as for zero-tillage (41%:36%) during the Kharif season. Similarly, labour saving was also identified by the majority (50%-85%) of the participants during both seasons. It is important to note that the proportions of male participants agreeing to this advantage were higher compared to female participants. About 85%, 85%, and 78% of male participants agreed to labour saving advantage of zero-tillage, direct-seeded rice, and other conservation agriculture respectively. On the other hand, about 74%, 74% and 65% of the female counterparts agreed to the labour saving advantage of CASI technologies respectively. In comparison, the Kharif participants experienced relatively lower proportions of male (50%) and female (72%) participants identifying labour saving as an advantage of CASI technologies. Time saving was also identified by most of the participants. The proportions of male participants agreeing to this advantage were slightly higher than their female counterparts for zero-tillage (64%:63%), direct-seeded rice (49%:47%), and other conservation agriculture technologies (71%:63%) during the Rabi season. It is important to note that the experiences of farmers during the Kharif season was more favourable with 90% of the male participants and 88% of female participants agreeing to the time-saving advantage of zero-tillage. Reduction of womens' workload was also identified during the FGD, particularly by women farmers. In this regard, the female participants had higher proportions agreeing to this advantage. Female participants were supporting this observation for zero-tillage (72%) and direct-seeded rice (83%). On the other hand, about 50% and 65% of men participants agreed to these statements respectively. The Kharif experience was contrasting. More male farmers (85%) compared to female farmers (74%) identified the reduction of women workload as one of the advantages of CASI technologies. Water saving advantage was also relevant to zero-tillage and other conservation agriculture technologies among men (45%, 51%) and women (41%, 46%) respectively during the Rabi season. A higher proportion of men (64%) and women (63%) farmers identified this

advantage during the Kharif season. Soil health improvement was also one of the primary advantages of zero-tillage (41%) and (53%) other conservation agriculture technologies as experienced by men farmers during the Rabi season. Also, female farmers (36%, 48%) shared the same insights although in relatively lower proportions for both conservation agriculture technologies respectively during the Rabi season. In the Kharif season, the same advantage was observed by 45% of the male participants and 41% of the female participants. Lastly, being ecologically friendly was identified as among the advantages for other conservation agriculture during the Rabi season by male farmers (32%) and female farmers (33%).

These technologies were also not free from shortcomings. Three primary disadvantages of zero-tillage and direct-seeded rice technologies were documented in Purnea – weed control, uneven sowing and difficulty in handling the machine (Figure 5). Weed control had become a major issue especially during the Rabi season among male (79%) and female (64%) farmers. A lesser extent of weed control problem was identified during the Kharif season by both male (52%) and female (48%). Another serious disadvantage of the technology was the uneven sowing. This was cited by 52% of the male farmers and 48% of the female farmers during the Rabi season. A higher proportion of male (79%) and female (64%) farmers reported this issue during the Kharif season. Lastly, the difficulty in handling the machine during the Rabi season was identified by farmers. It is important to note that it was the female farmers (51%) who felt more burdensome on machine operation compared to men farmers (45%).

** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

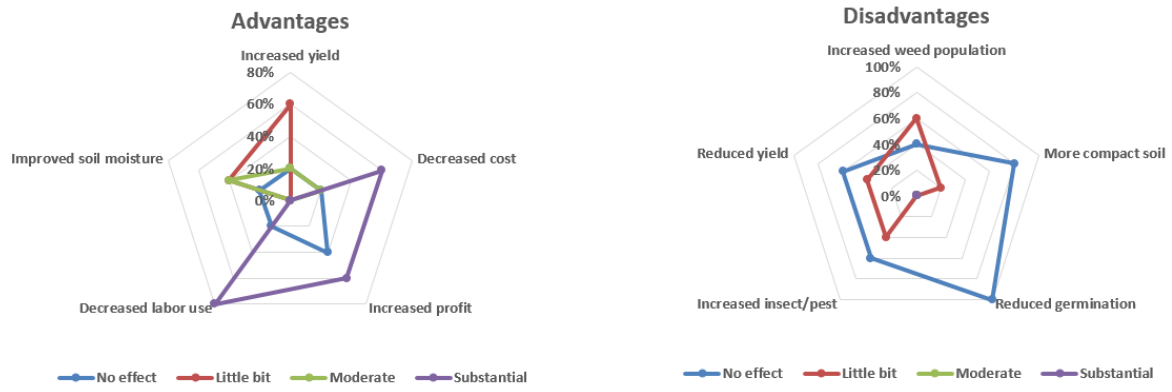
Figure 5. Advantages and disadvantages of CASI technology in Purnea

4.5 Coochbehar, West Bengal, India

The participants in Coochbehar were asked regarding the advantages of zero-tillage and direct-seeded rice technologies based on their experiences during the trial (Figure 6). Four responses were possible – no effect, little bit, moderate and substantial. There was a little bit improvement in Ghugumari, Folimari and Durganagar areas (60%) in terms of yield increase. Farmers in Mansai experienced moderate improvement (20%) in terms of the increased yield while the remaining node (20%) did not notice any effect in terms of yield increase. In terms of cost reduction, Patchara, Durganagar, and Mansai areas (60%) were substantially improved and Ghugumari area (20%) was moderately improved. The remaining node (20%) did not notice any effect in terms of cost reduction. In terms of profitability, participants from Patchara, Ghugumari, and Durganagar areas (60%) reported substantial improvement while the

remaining nodes (40%) did not notice any effect in terms of cost reduction. Moreover, in terms of less use of labor, Patchara, Ghugumari, Durganagar, and Mansai areas (80%) were substantially improved while the remaining node (20%) did not notice any effect in terms of cost reduction. Lastly, in terms of soil moisture, there was a little bit improvement in Patchara and Durganagar areas (40%) while Ghugumari and Folimari areas (40%) were moderately improved. The remaining node (20%) did not notice any effect in terms of soil moisture.There were also other beneficial aspects observed by the participants which include the early establishment, reduced undulation of land and early maturity.

There were also disadvantages observed while using the zero-tillage and direct-seeded rice technologies (Figure 6). There was a little bit increased in weed population in the farm areas of Ghugumari, Durganagar and Mansai (60%) while the remaining nodes (40%) did not notice any effect in terms of weed population. Also, there was a little bit compactness of soil in Durganagar area (20%) while the majority of the nodes (40%) did not notice any effect in terms of soil compactness. Farmers in Patchara and Folimari areas (40%) reported a little bit increased in terms of insect/pest population while the majority of the nodes (60%) did not notice any effect. Lastly, in terms of yield, there was a little bit reduction experienced by farmers in Patchara and Folimari areas (40%) while the majority of the nodes (40%) did not notice any effect in terms of decreased yield. Moreover, non-uniform seed distribution and labour issues were other demerits reported.



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

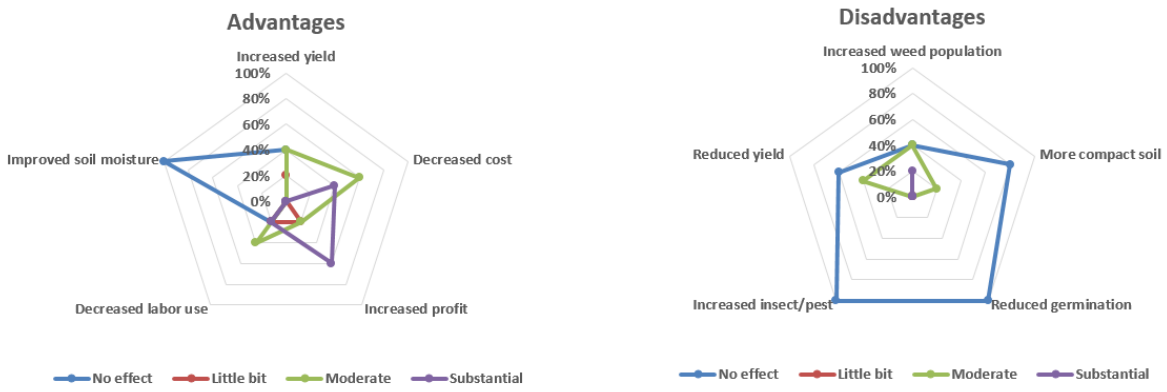
Figure 6. Advantages and disadvantages of CASI technology in Coochbehar

4.6 Malda, West Bengal, India

The participants in Malda were asked regarding the advantages of the use of zero-tillage and direct-seeded rice technologies based on their experience during the trial (Figure 7). There was a little bit improvement in Mohadipur area (20%) in terms of yield increase. Farmers in Kalinagar and Gourangapur (40%) experienced moderate improvement in terms of the increased yield. The remaining nodes (40%) did not notice any effect in terms of yield increase. In terms of cost reduction, Gourangapur, Ugritoola, and Vidyanandapur (60%) areas were moderately improved and Kalinagar and Mohadipur (40%) areas were substantially improved. In terms of increased profitability, participants from Kalinagar, Gourangapur, and Mohadipur areas (60%) reported substantial improvement, moderate improvement in Vidyanandapur (20%) and little bit improvement in Ugritola (20%). Moreover, in terms of less use of labor, Mohadipur area (20%) was substantially improved. Areas in Kalinagar and Vidyanandapur

(40%) were moderately improved in terms of labour use while there was a little bit improvement in Gourangapur (20%). The remaining node (20%) did not notice any effect in terms of labour use. No reported advantage (100%) related to soil moisture. There were also other beneficial aspects observed by the participants, which included early establishment, reduced undulation of land and early maturity. Profuse tillering and less disease were also noted in Mohadipur area.

There were also disadvantages observed while using the CA technology (Figure 7). There was a moderate increased in weed population in the farm areas of Kalinagar and Mohadipur (40%) while a substantial increase in weed population in Gourangapur (20%) was also observed. The remaining nodes (40%) did not notice any effect in terms of weed population. Also, there was a moderate compactness of soil in Vidyanandapur area (20%) while the majority of the nodes (80%) did not notice any effect in terms of soil compactness. There was no reported negative effect of the technology in terms of reduced germination (100%) and insect/pest population (100%) during the Kharif trial. Lastly, in terms of yield, there was a moderate reduction experienced by farmers in Ugritola and Vidyanandapur areas (40%). The majority of the nodes (60%) did not notice any effect in terms of yield reduction. Moreover, non-uniform seed distribution and labour unrest were other demerits reported. Seedbed management and early maturity of the crop were also depicted as disadvantages in Kalinagar. More labour use associated with the ZT technology was also reported in Gourangapur.



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

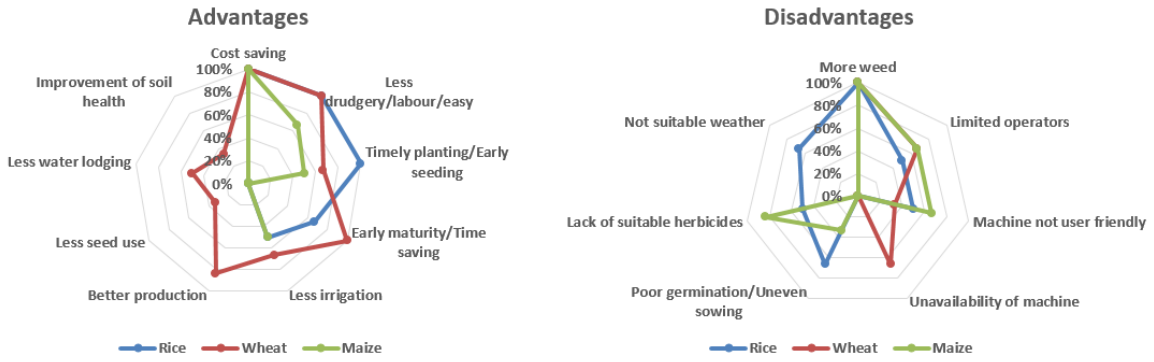
Figure 7. Advantages and disadvantages of CASI technology in Malda

4.7 Rajshahi, Bangladesh

The strip tillage technology was compared with conventional tillage technology in Rajshahi. It was revealed during the FGDs that the strip tillage technology resulted in less cost, less drudgery or less labour requirement, timely planting or early seeding, early maturity or time saving, less irrigation, better production, less seed use, less water lodging, and improved soil health (Figure 8). These advantages varied across crops namely rice, wheat and maize crops. All (100%) the FGD sessions for rice, wheat, and maize farmers identified the cost saving feature of strip tillage technology. In terms of less drudgery/labour or easy labour advantage, all the FGD sessions of rice (100%) and wheat (100%) farmers recognized this advantage while 67% of the participants planting maize identified this advantage. Timely planting or early seeding was also mentioned by all (100%) rice farmers, 67% of wheat farmers and 50% of maize farmers during the FGDs. The participants also cited the early maturity

resulting in a time-saving advantage for rice (67%) and wheat (100%). Some farmers were able to identify less irrigation requirement of strip tillage technology particularly during the first irrigation in rice (50%), wheat (67%), and maize farms (50%). Specific to wheat production, the participants also recognized some advantages of strip irrigation such as better production (83%), less seed use (33%), less water lodging (50%) and improvement of soil health (33%).

There were, however, some disadvantages experienced during the trials of strip tillage technology in Rajshahi (Figure 8). Weed management was consistently the major problem (100%) for all crops. The technology requires skilled operators for effective operation. However, there were limited operators across crop farms – rice (50%), wheat (67%), and maize (67%). The machines for strip tillage technology were not user-friendly. This observation was noticed in rice (50%), wheat (33%) and maize (67%). Specific to wheat farmers, the unavailability of the machine was a major drawback (67%). Sometimes seed placement by strip tillage machines was uneven resulting in poor germination. This disadvantage was particularly experienced in the context of rice (67%) and (33%) maize farms. Suitable herbicides to control the weeds were not available for rice (50%) and maize (83%) farmers. Some rice farmers (67%) complained about the hampered operation of direct-seeded rice due to heavy rain.



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

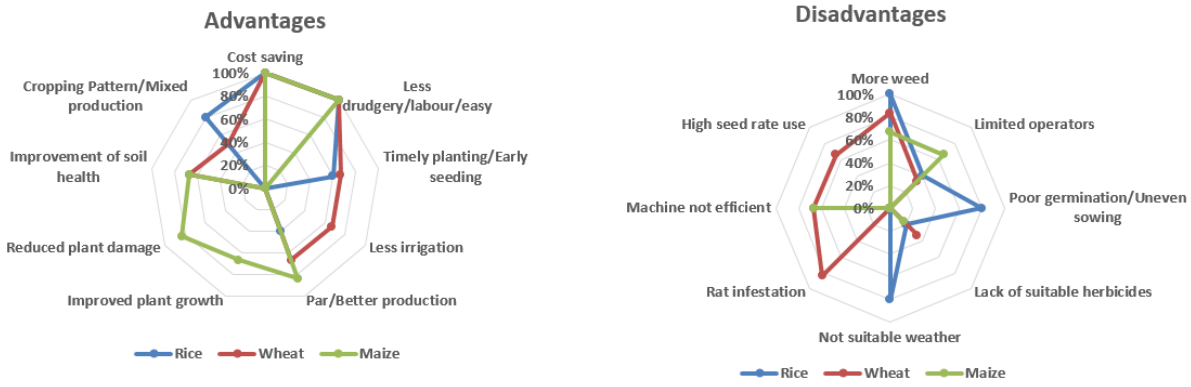
Figure 8. Advantages and disadvantages of CASI technology in Rajshahi

4.8 Rangpur, Bangladesh

The advantages of the CASI technology were also documented in Rangpur such as direct seeding, puddled and unpuddled rice technology and other CASI technology (Figure 9). All the participants (100%) of the FGD sessions identified the cost saving and labour saving feature of the technology across all crops. Timely planting or early seeding was identified by rice (60%) and maize farmers (67%). Specifically for wheat crops, 67% of the participants mentioned less irrigation as an advantage. Across the crops, par or better production was experienced – rice (40%), wheat (67%) and maize (83%). Specific to maize crops, the participants identified improved plant growth (67%) and reduced plant damage (83%) as advantages. Improvement of soil health condition was also experienced by wheat (67%) and maize (67%) farmers. Lastly, the cropping pattern allowing mixed cropping system was a particular advantage for rice (80%) and wheat (50%) farmers.

On the other hand, a number of disadvantages were also experienced by the FGD participants (Figure 9). Weed control was a major concern for all (100%) rice farmers, 83% of wheat farmers and 67% of maize farmers. Also, limited machine operators was also an issue

for rice (40%), wheat (33%) and maize (67%) farmers. Specific to rice farmers, the poor germination caused by uneven sowing was a problem to the majority (80%) of the farmers. To address weed problems, appropriate herbicides were needed. However, there was a lack of suitable herbicide across crops – rice (20%), wheat (33%) and maize (17%). Particular to rice farming, the weather being uneven and having early heavy rainfall was not suitable for the CASI technology (80%). Also, rat infestation was a major disadvantage in wheat farms (83%). The use of CASI machines was described as not efficient for wheat (67%) and maize (67%) farmers. A high rate of seed use was required for wheat farming (67%).



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 9. Advantages and disadvantages of CASI technology in Rangpur

5. Criteria for technology adoption

The main criteria for technology adoption specific to CASI technologies were explored during the FGD (Figure 10). In all districts, the labour saving/labour-friendly feature (100%) of the technology was highlighted. Majority of the nodes identified cost effectiveness/saving/advantage (83%), enhanced yield/crop production/productivity (83%), tillage time/time saving/timely sowing of next crop (83%), less irrigation/water requirement/saving (67%), weed control/herbicide use/availability (67%), easy management/operational use (50%), land levelling/good field/soil condition (50%), machine availability (50%), soil conservation/health/management/fertility (50%), and early maturity/cropping frequency/timeliness (50%). Some districts identified the availability of irrigation facilities (33%), awareness of other technologies/information (33%), difficulty of transplanting (33%), preparation of nursery bed/mat nursery/seedlings (33%), proper row spacing/seeding accuracy (33%), quality of transplanting (33%), resources availability (33%), skilled operator availability (33%), and technical skills/technical support (33%). Other criteria specific to particular districts include available subsidy (17%), availability of family and hired labour (17%), fuel cost (17%), gender friendly (17%), stress resistance (17%), moisture content of the field (17%), no stagnant water (17%), and availability of inputs (17%).

** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 10. Criteria for adopting CASI technology

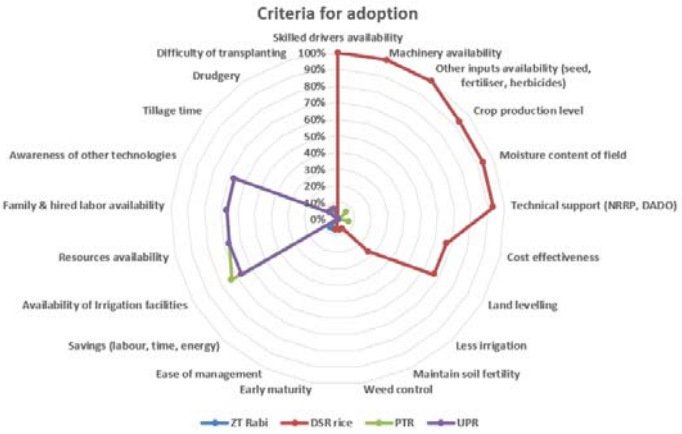
5.1 Sunsari, Nepal

Among the key criteria for Sunsari farmers to adopt CASI technology include the availability of the machine and the availability of suitable herbicides and their technical skills in applying these herbicides. It was important that the machines were available at the right timing. Moreover, those who adopted SRFSI technologies were more educated, relatively larger land holding compared to non-adopters, and lesser family size. It was also important that the machine was gender friendly. In the case of rice transplanter, it reduced the time and labour for transplanting rice. For manual technology, it required 35 people for one ha of transplanting. However, only one rice transplanter was available in the district, hence, the machine was not available at the right time when transplanting was needed. Late transplanting would result to failed establishment of the seedlings. In terms of the type of transplanting machine, the farmers preferred a labour friendly machine. In particular, the walking type of rice transplanter was difficult to operate compared the riding type which was also more fit for larger farm areas. A good field condition was crucial for the rice transplanter to be effective. Specifically, flooded and more puddled condition resulted to poor establishment of the seedlings. Another critical factor that influence the adoption of rice transplanter was the ability of the farmer to raise suitable seedlings. It was observed that more training and capacity building are required to improve the raise seedlings.

5.2 Dhanusa, Nepal

The key reasons considered by most FGD groups in Dhanusa when considering adopting zero-tillage for Rabi crops and Kharif rice were: availability of resources such as skilled drivers, machinery and inputs such as seeds, fertilizers and herbicides (Figure 11). These criteria were identified by all FGD sessions for zero-tillage Rabi crops and Direct-seeded rice. Moreover, the crop production level, moisture content of the soil and technical support coming from NRRP and DADO were also identified by the majority (93%) of the FGD participants for zero-tillage Rabi crops and Direct-seeded rice. The crop production level was also a concern of some farmers for the puddled transplanted rice (7%). Cost effectiveness and laser levelling were also considered key criteria by the majority of the participants (67%) for

both zero-tillage Rabi crops and Direct-seeded rice. In addition, cost effectiveness was also mentioned by a few puddled transplanted rice farmers (7%). Other criteria for adoption identified by both zero-tillage Rabi crops and Direct-seeded rice farmers were less irrigation (27%), maintain soil fertility (7%), weed control (7%), and early maturity (7%). Specific for zero-tillage Rabi crops, ease of management (7%) and savings in terms of labor, time and energy (7%) was also identified as factors affecting their decision to adopt the CASI technology. Availability of irrigation facilities was also crucial for both puddled transplanted rice farmers (73%) and unpuddled rice (67%). Majority (67%) of the farmers of both puddled transplanted rice and unpuddled rice also identified availability of resources, availability of hired and family labour, and awareness of other technologies as main criteria for adoption. A few (7%) farmers identified tillage time as critical for direct-seeded rice, puddled transplanted rice and unpuddled rice. A few farmers (7%) considered drudgery as important criterion for puddled transplanted rice while a few farmers (7%) also identified difficulty of transplanting as important consideration for unpuddled rice. All groups considered both zero-tillage for Rabi crops and for direct-seeded Kharif rice to be gender-friendly because they required less labour and reduce drudgery for women who were particularly responsible for transplanting rice.

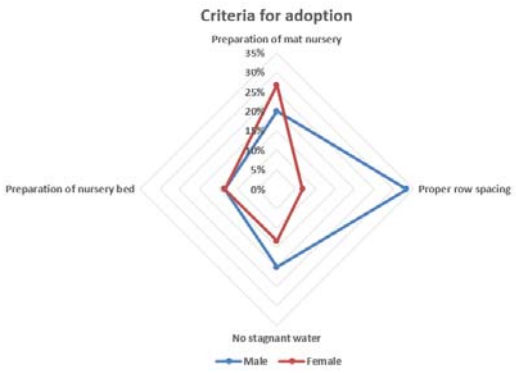


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 11. Criteria for adopting CASI technology in Dhanusa

5.3 Madhubani, Bihar, India

The participants of the FGD in Madhubani were particularly asked to the criteria for adopting CASI technology particularly rice transplanter (Figure 12). A few of the men farmers (20%) and women farmers (27%) considered preparation of mat nursery as a crucial consideration. Also, the proper row spacing of the transplanter was an important consideration for both male (33%) and female farmers (7%). It was also important that there was no stagnant water in the field for the transplanter to be effective according to male (20%) and female farmers (13%). Lastly, the preparation of nursery bed was particularly important for both male (13%) and female farmers (13%).

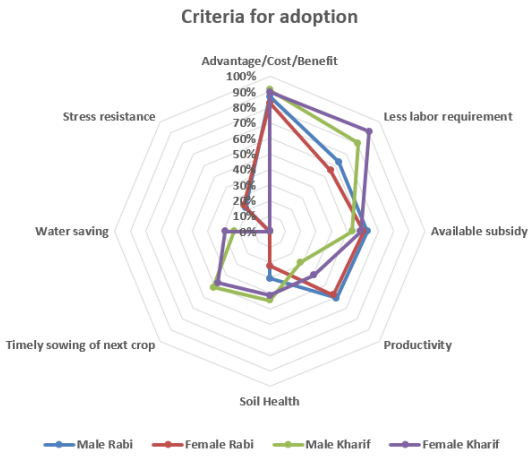


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 12. Criteria for adopting CASI technology in Madhubani

5.4 Purnea, Bihar, India

The FGD participants in Purnea were also asked regarding the criteria for adopting CASI technology across male and female farmers (Figure 13). The most important consideration was the relative advantage of the technology in terms of cost and benefits as mentioned by the male (87%) and female (83%) farmers during the Rabi FGD and male (91%) and female (90%) farmers during the Kharif FGD. Another important consideration for adoption was the requirement for less labour or labour saving technology. This was identified by the majority of the male (63%) and female (56%) farmers during Rabi season and more importantly for male (80%) and female (91%) farmers during the Kharif season. If the technology was introduced with a subsidy, the decision to adopt increased according to male (63%) and female (60%) farmers in the Rabi season as well as the male (53%) and female (59%) farmers during the Kharif season. The potential yield or productivity of the crop was particularly important for the male (61%) and female (58%) farmers during the Rabi season but relatively not that important for male (28%) and female (40%) farmers during the Kharif season. Some farmers also identified soil health as a crucial factor in deciding whether or not to adopt the technology. This was considered by some male (30%) and female (22%) farmers during the Rabi season and some male (45%) and female (41%) farmers during the Kharif season. Other factors affecting the decision to adopt include timely sowing of the next crop and water saving feature of the technology as identified by male (51%, 23%) and female (47%, 29%) farmers during the Kharif season respectively. Specific for Rabi season, male (22%) and female (23%) farmers identified also stress resistance as an important consideration for technology adoption.

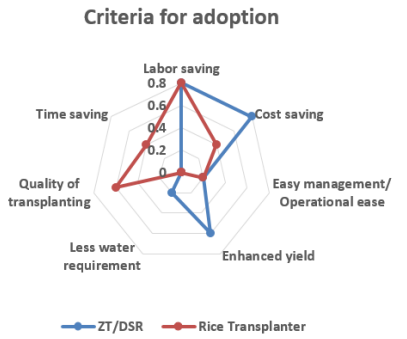


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 13. Criteria for adopting CASI technology in Purnea

5.5 Coochbehar, West Bengal, India

In Coochbehar, participants of the FGD were asked to identify the criteria for adopting CASI technology (Figure 14). The criteria were identified specific to two types of technologies – zero-tillage / direct-seeded rice and rice transplanter. Three primary criteria were consistently identified across the two types of technologies. First, it was important for the participants that the technology was labour saving. This was identified by 80% of the nodes for both zero-tillage / direct-seeded rice and rice transplanter. Second, the cost saving feature of the technology was particularly important for zero-tillage (ZT) / direct-seeded rice (DSR) (80%) as compared to rice transplanter (40%). Third, the easy management feature or the operational ease of the technology was also considered for both zero-tillage / direct-seeded rice (20%) and rice transplanter (20%) technologies. Specific to zero-tillage / direct-seeded rice, 60% of the nodes identified enhanced yield and 20% of the nodes identified less water requirement as crucial criteria for adoption. Specific to rice transplanter, the quality of transplanting (60%) and time-saving feature (40%) of the technology were considered important criteria for adoption.

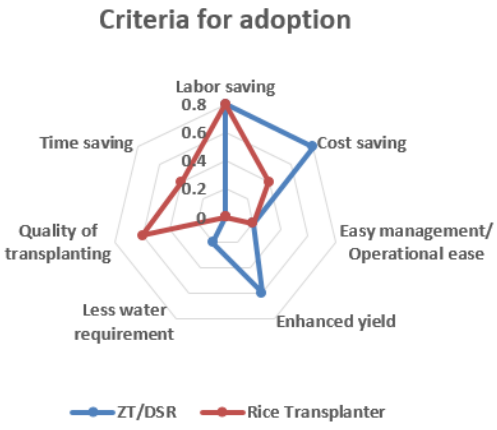


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 14. Criteria for adopting CASI technology in Coochbehar

5.6 Malda, West Bengal, India

The participants in Malda were asked regarding the criteria for adopting CASI technology (Figure 15). Labour saving feature of the technology was the most important consideration of the participants (80%) for both zero-tillage (ZT) / direct-seeded rice (DSR) and rice transplanter. This was followed by cost saving feature particularly for zero-tillage / direct-seeded rice (80%) and to some extent rice transplanter (40%). A few nodes (20%) identified easy management or ease of operation as a crucial factor for both technologies. Particularly important for zero-tillage / direct-seeded rice, enhancement of yield (60%) and less water requirement (20%) were among the criteria for adoption. On the other hand, the quality of transplanting (60%) and time saving (40%) were also an important consideration for rice transplanter technology.



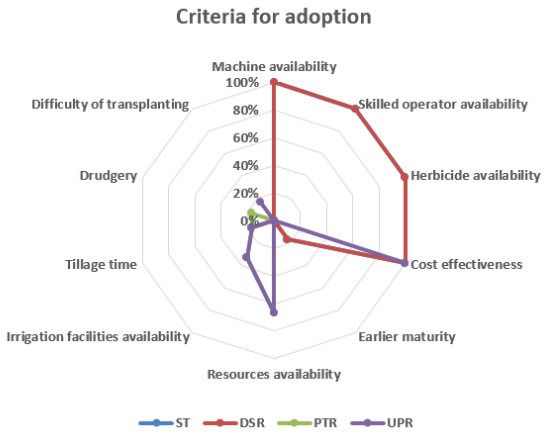
** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 15. Criteria for adopting CASI technology in Malda

5.7 Rajshahi, Bangladesh

In Rajshahi, the FGD participants were asked to identify the criteria affecting their decision to adopt or not adopt the CASI technology (Figure 16). Four main technologies were identified – strip tillage (ST), direct-seeded rice (DSR), puddled transplanted rice (PTR) and

unpuddled rice (UPR). For strip tillage and direct-seeded rice technologies, all the FGD sessions (100%) identified machine availability, skilled operator availability, herbicide availability, and cost effectiveness as the main criteria for adoption. Cost effectiveness was also identified by the all the FGD sessions (100%) for unpuddled rice. The early maturity of the crop was also considered an important factor for few farmers (17%) for both strip tillage and direct-seeded rice technologies. Also, the majority of the farmers (67%) identified resources availability as a crucial factor while a few farmers (33%) identified the availability of irrigation facilities as critical for adopting puddled transplanted rice and unpuddled rice. Some farmers (17%), identified tillage time as important criterion across all technologies except strip tillage. Particular for puddled transplanted rice, drudgery was an important consideration for some (17%) farmers. Lastly, the difficulty of transplanting was also crucial for some farmers (17%) before adopting the technology, especially for unpuddled rice.

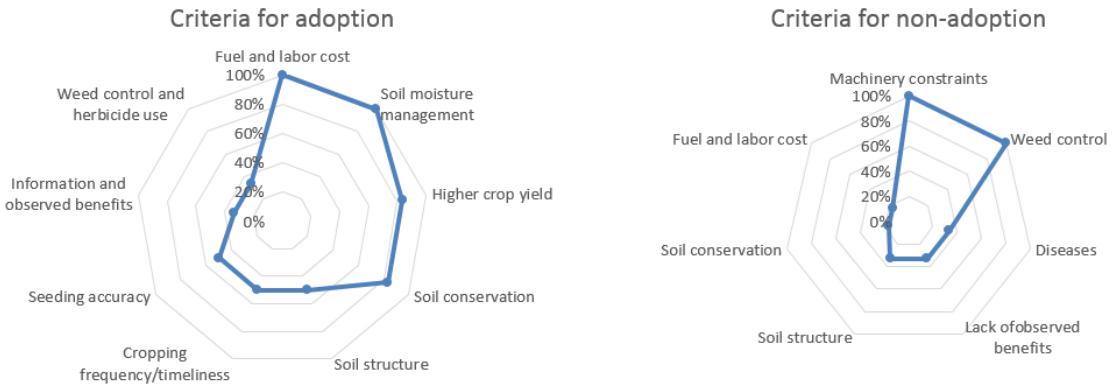


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 16. Criteria for adopting CASI technology in Rajshahi

5.8 Rangpur, Bangladesh

The participants in Rangpur were also asked for the criteria for adopting as well as not adopting CASI technology (Figure 17). All (100%) of the nodes identified fuel and labour cost, and soil moisture management as very important criteria for adoption. The majority (83%) of the participants also considered higher yield and soil conservation as crucial factors affecting their decision to adopt. Half (50%) of the nodes also identified the importance of soil structure, cropping frequency or timeliness, and seeding accuracy as factors affecting their adoption decision. Some (33%) farmers also identified information and observed benefits, and weed control and herbicide use as key criteria for adoption of CASI technologies. On the other hand, some factors also led to the decision of the farmers not to adopt the CASI technologies. All (100%) of the participants recognized the machinery constraints and weed control as factors contributing to their non-adoption of the technology. Some (33%) farmers identified diseases, lack of observed benefits, and soil structure as the criteria leading to non-adoption. Lastly, a few (17%) farmers mentioned soil conservation and fuel and labour cost as unfavorable factors leading to non-adoption of CASI technologies.

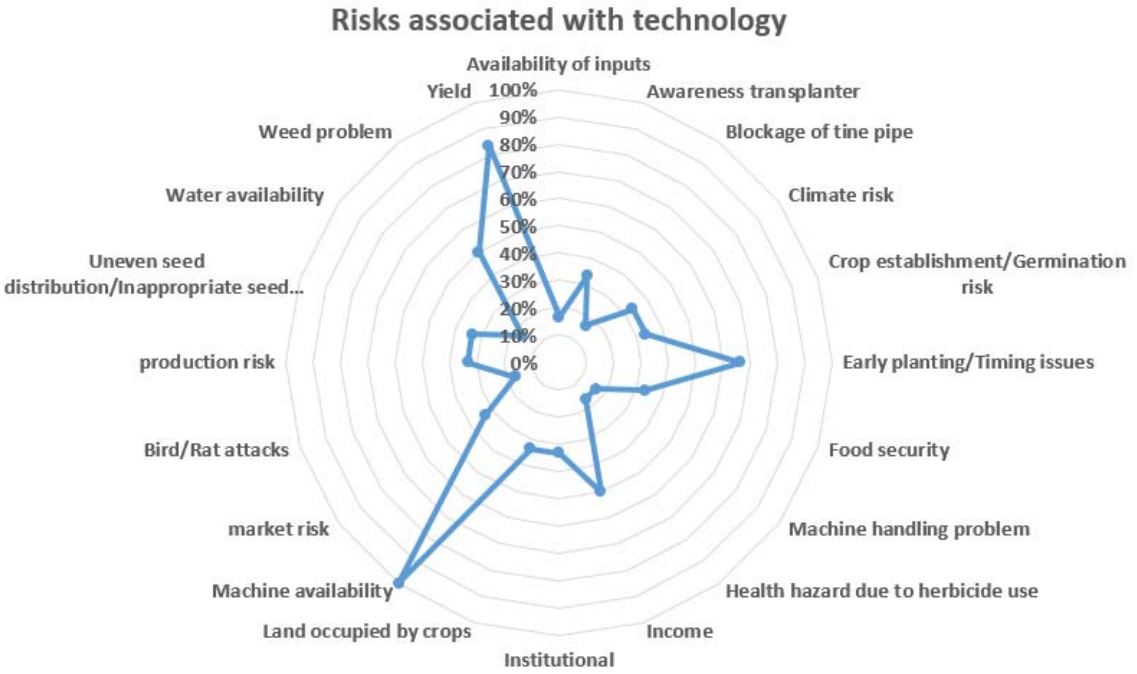


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 17. Criteria for adopting/not adopting CASI technology in Rangpur

6. Risks associated with technology adoption

The risks involved with the adoption of CASI technologies were explored during the FGD (Figure 18). All the districts identified the high risk of machine availability (100%). The majority of the districts were also aware of the risks involved in early planting resulting to timing issues during harvest (67%), yield risks (67%), income risks (50%) and the high risk of weed problem (50%). Some districts identified the risk of low awareness towards transplanters (33%), climate risks (33%), crop establishment/germination risk (33%), food security risk (33%), institutional risk (33%), land being occupied by other crops during early planting (33%), market risks (33%), production risks (33%), and the risk of uneven distribution/inappropriate seed placement (33%). Other risks specific to particular districts include the availability of inputs (17%), blockage of tine pipes (17%), machine handling problem (17%), health hazard due to herbicide use (17%), bird/rat attacks (17%), and water availability (17%).



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 18. Risks associated with technology adoption

6.1 Sunsari, Nepal

Two main risks associated with adopting CASI technology were observed in Sunsari. The technology required extensive use of herbicide due to zero-tillage. The health hazard due to herbicide application could be potentially high. Another risk identified was the early seeding of zero-tillage rice may cause the timing of harvest season in rainy days. This opportunity may cause a problem because the harvest season may be too early coinciding with the rainy season. For nodes with three cropping cycle such as in Salbani, early seeding was difficult to manage. Moreover, the early seeding implies early harvesting which coincides to important festivals such as (Dashain, Dipawali, Chatt). The early maturing of rice could pose a serious problem on labour shortages aside from rainy season. In the case of Rabi season, early planting could be more beneficial because of right moisture level, lower weed population, early maturity, higher production and potential to intensify cropping.

6.2 Dhanusa, Nepal

In Dhanusa, the identification of risks was also focused on the machine availability and early planting opportunity for Rabi season. There is a high risk for not having the machine on time due to difficulty in accessing the fields primarily because of the small size of the field lacking access paths for machines. The early planting opportunity could also result in more problems than opportunity due to timing issues particularly high moisture during seeding. Moreover, there was a concern on adopting late rice varieties associated with early planting.

6.3 Madhubani, Bihar, India

A number of potential risks associated with adopting CASI technology were also identified in Madhubani (Table 3). On the effect on yields, majority (80%) of the male farmers

believed there was no change while the remaining 20% were positive that there was an increase in yields. More female farmers (53%) were positive compared to those who believed there was no yield change (47%) with the technology introduced. On the effect on food security, majority of male farmers (80%) believed was improvement in food security while the remaining 20% expressed there was no change. The women farmers were less optimistic (53%) of the outcome while the remaining 47% had improvement in food security. In terms of income, majority of the male farmers (80%) experienced increase in income while the remaining 20% experienced decrease in income. Similarly, more female farmers (67%) experienced increase in income compared to those who experienced decreased in income (33%). In terms of timely availability of the machine, more male farmers (87%) had positive experience with machine availability composed to those who experienced delays (13%). The same distribution was also observed for female farmers with 87% experiencing timely machine availability while 13% experienced delays. Other risks identified include weed problem among men (7%) and most especially women (40%) farmers. Lastly, in terms of early planting opportunity, majority (87%) of male farmers were willing to plan in zero-tillage / direct-seeded rice in June while 13% were not willing. For women farmers a lower proportion of willing farmers (73%) were observed while the remaining 27% were not willing. The reasons for adopting early planting include increase of yield, saving of irrigation, timely sowing of Rabi crops, avoid flooding, good germination, and no nursery raising. The farmers who were not willing to adopt early planting identified the risks of high temperature, lack of moisture during the month and the presence of summer crops in the field.

Table 3. Risks associated with CASI technology in Madhubani

Risk	Comment	Male	Female
Effect on yields	Increase	20%	53%
	No change	80%	47%
Effect on food security	Increase	80%	47%
	No change	20%	53%
Effect on income	Increase	80%	67%
	Decrease	20%	33%
Timely availability of machine	Yes	87%	87%
	No	13%	13%
Other risks	No problem	93%	60%
	Weed Problem	7%	40%
Early planting	Yes	87%	73%
	No	13%	27%

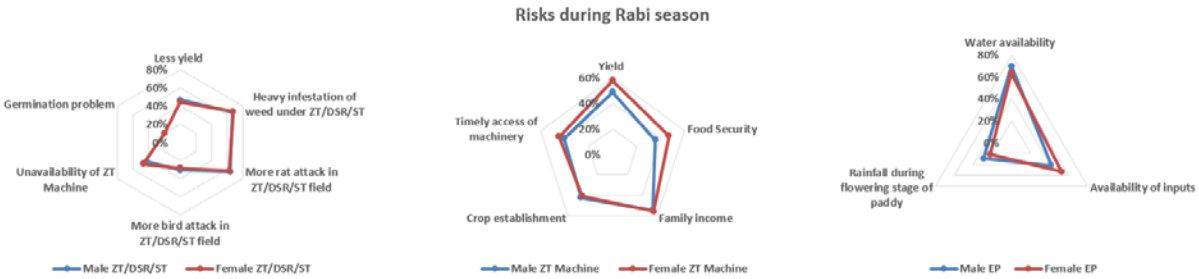
6.4 Purnea, Bihar, India

The FGD participants in Purnea were asked regarding the risks involved with the adoption of CASI technology during the Rabi (Figure 19) and Kharif season (Figure 20). Three technologies were referred to – zero-tillage (ZT) / direct-seeded rice (DSR) / strip tillage (ST), zero-tillage machine, and early planting. During the Rabi season, almost half of the participants were concerned of the lower yield associated with ZT/DSR/ST across men (47%) and women (44%) farmers. The majority of the participants recognized the heavy infestation of weeds under ZT/DSR/ST technologies as identified by 67% of men farmers and 68% of women farmers. Another risk involved was the rat attack in the field as mentioned by men (64%) and women (63%) farmers. Some men (30%) and women (28%) farmers also complained of the

risk of more bird attacks. The risk of the unavailable machine was a concern for 42% of men and 47% of women farmers. Lastly, poor germination of seeds was associated with the use of ZT/DSR/ST technologies across men (22%) and women (20%) farmers.

The zero-tillage machine was also assessed in terms of risks involved. In terms of yield, around half of the participants were concern about the yield performance of the technology with 49% of male and 58% of female farmers having identified this concern. In terms of food security, 36% of male and 47% of female farmers were concerned about the risks of having less food for the family. Slightly half of the participants of male (54%) and female (56%) farmers were concerned about the risk of lower income. Other concerns were related to crop establishment and timely access of machinery of men (42%, 40%) and women (41%, 44%) farmers respectively.

The third risk assessment relates to early planting associated with the technology. Although early planting resulted to time saving, timely sowing of next crop, and avoidance of flooding, there were risks associated with the early planting strategy. The majority of the participants were concerned about the water availability as identified by 70% of male farmers and 63% of female farmers. The availability of inputs was also mentioned during the FGD by around half of the participants with 42% male farmers and 53% female farmers. Lastly, the rainfall during the flowering stage of the paddy was a risk concern for some male (29%) and female (22%) farmers.



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 19. Risks associated with CASI technology in Purnea during Rabi season

For the Kharif season, the participants of the FGD were also asked about the risks involved in the adoption of CASI technology. Primarily, the majority of the participants were concerned about the risk of less yield associated with the use of ZT/DSR/ST as identified by 78% of the male farmers and 75% of the female farmers. Another major concern was the heavy infestation of weed as experienced by the majority (64%) of the male farmers and majority (69%) of the female farmers. Half of the participants (49% of male and 51% of female farmers) were concerned about the risk of a bird attack. Some participants were also aware of the risk of machine unavailability among male (38%) and female (52%) farmers. Also, the majority of the participants of both male (55%) and female (56%) farmers were concerned about the risk of rat attacks in the field. Some male (40%) and female (39%) participants considered the risk of poor germination as experienced during the trials.

The use of zero-tillage machines was also associated with potential risks during the Kharif season. Primarily the blockage of the tine pipe was the major risk among male (83%) and female (84%) farmers. The operation of the machine was also difficult under heavy residue

and weed problem as noted by the majority of the male (67%) and female (63%) farmers. Slightly above half of the proportion of the participants (50% for male and 53% for female) recognized the problem of machine handling. Some farmers also identified the risks of uneven seed distribution and the inappropriate depth of the seed placement as observed by male (47%, 45%) and female (45%, 45%) farmers respectively.

The early planting during the Kharif, although could result to time saving and timely sowing of the next crop, and avoidance of flood incident, had also some risks involved. Three main risks were identified associated with early planting. First, the water availability during the planting season was a challenge with early planting as observed by 64% of the male farmers and 60% of female farmers. Second, there was also a risk in terms of availability of the inputs needed according to male (51%) and female (57%) farmers. Lastly, there was a rainfall during the flowering stage of the paddy as revealed by the male (52%) and female (44%) farmers.

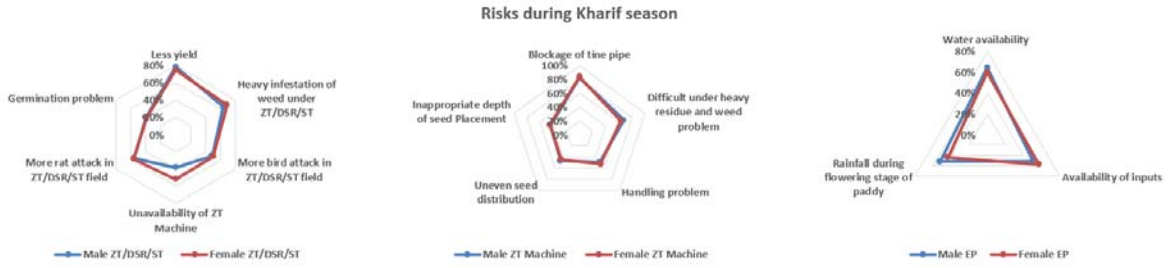
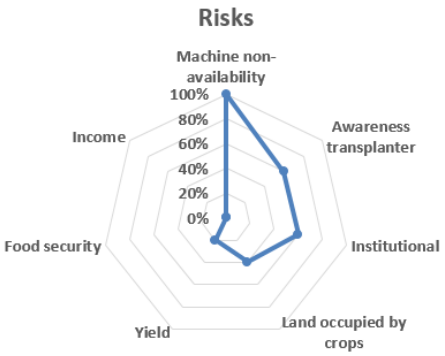


Figure 20. Risks associated with CASI technology in Purnea during Kharif season

6.5 Coochbehar, West Bengal, India

In Coochbehar, the FGD participants were also probed about the risks involved in adopting CASI technology (Figure 21). While the early plant could potentially result in enhanced yield, better time management, and advance Rabi crops planting, all (100%) of the nodes identified the risks of machine non-availability during the early planting in June. There was also a high risk (60%) of low awareness of the transplanter technology. The institutional risk was also identified by the majority (60%) of the farmers. There was also a moderate chance (40%) that other crops were cultivated until June, thus the early planting opportunity could not be materialized. There was a particular concern on potential yield decrease as identified by 20% of the total number of nodes. With respect to food security and income concerns, there were no risks identified by the participants.

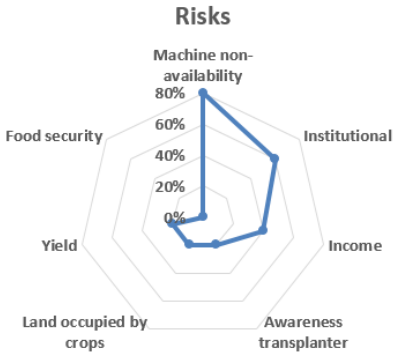


** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 21. Risks associated with CASI technology in Coochbehar

6.6 Malda, West Bengal, India

The participants in Malda were also asked about the risks involved in the adoption of CASI technologies (Figure 22s). Their main concern was the risks involved with early planting in June. Although, the early planting can potentially result in enhanced yield, better time management, and advance Rabi crops planting. However, the main risk involved was the availability of the machines as identified by 80% of the nodes. The institutional risk was also considered by the majority (60%) of the nodes. Some (40%) nodes also were a concern of income risks involved with the adoption of CASI technologies. There was also a risk for low awareness of transplanter (20%) and the land being occupied by other crops by June (20%). The yield potential was also a concern to some (20%) farmers. No risk was identified with regards to food security.



** The scale represents the % of districts (out of 8 districts) where the issue/criterion/effect is identified.*

Figure 22. Risks associated with CASI technology in Malda

6.7 Rajshahi, Bangladesh

In Rajshahi, the participants were asked to identify the risks involved in adopting CASI technology. Three main risks were identified by the farmers. First, there was a high concern for climate risk. There was a late rainfall in January and hail storm in early February resulting

to the lodging of wheat crops and eventually lower yields. The second concern was production risk. The limited irrigation facility and the infestation of pest and diseases resulted in lowering yield return. Lastly, there was a high market risk with regards to unstable market prices. Cereals usually had low prices while pulses offered relatively higher prices. However, production of pulses was low.

6.8 Rangpur, Bangladesh

In Rangpur, the risks involved in adopting the CASI technology were also explored. Three man risks were identified by the participants. The climate risks particularly high temperature and uneven rainfall resulted in lower wheat yields. Production risks also involved neck blast disease attack on Rabi rice, rat infestation in a wheat field, poor quality of maize and wheat seeds, limited irrigation facility and unavailability of herbicides. The third risk identified refer to market risks. Due to unstable prices, the returns for the crops of the farmers were relatively lower.

7. Conclusion

This report explored the key decision processes and criteria for CASI technology adoption in South Asia. The report focuses on the problems and issues, advantages and disadvantages, criteria for adoption, and risks associated with technology adoption. A total of eight districts were covered in this report – 1) Sunsari, Nepal; 2) Dhanusa, Nepal; 3) Madhubani, Bihar, India; 4) Purnea, Bihar, India; 5) Coochbehar, West Bengal, India; 6) Malda, West Bengal, India; 7) Rajshahi, Bangladesh; and 8) Rangpur, Bangladesh. Across 40 nodes, a total of 1182 participants were in involved in the FGDs composed of 670 males and 512 females.

The key problems and issues affecting the performance CASI technologies in the East Ganges Delta covering zero-tillage, strip tillage, direct-seeded rice, rice transplanter, and laser land leveler include the weed control, timely availability of irrigation, availability of herbicides, poor germination, and limited skills of machine operators. Weed control was the primary problem faced by the participants due to zero-tillage approach and the problem was more manifested due to the non-availability of suitable herbicides. The timely availability of irrigation coupled with the uneven sowing and distribution of seeds had resulted to poor germination of the crop. The limited skills of machine operators also contributed to the uneven sowing of the seedlings.

The CASI technologies were assessed by identifying the advantages and disadvantages involved in the adoption of the technology. The technology was promising and among its very important features were a reduction of labour, improvement of soil health condition, time saving, better or satisfactory yield, cost saving, low tillage cost, and less irrigation requirement. The reduction of labour was primarily attributed to less labour requirement for nursery preparation, tillage, and replanting. The principle of zero-tillage helped improve the soil condition and saved time. Better or satisfactory yield result was also achieved. The low tillage cost resulted in savings in cost. However, the main disadvantages of the technology were weed control, poor germination, lack of suitable herbicides, limited skills of operators and mechanics, increased insect, pest and diseases, and difficult to manage in undulated fields. Weed control was the primary challenge of the farmers due to the principle of zero-tillage and the lack of suitable herbicides. Moreover, this condition resulted to increased insect, pest, and diseases. The limited skills of operators also resulted to poor germination of the crops.

With respect to the criteria for CASI technology adoption, labour saving, cost saving, enhanced productivity, time-saving, less irrigation requirement, and weed control were among the most important factors. Farmers were willing to adopt the technology if it can reduce the labour requirement and the cost of production. Moreover, enhancement of yield was also an important criterion. The savings in terms of time and irrigation requirement also contributed to the decision of the farmers to adopt the technology. Lastly, weed control was an important attribute for technology adoption in the context of CASI technologies.

The CASI technologies were also assessed for the risks involved in the adoption. There was a high risk in machine availability, timing issues due to early planting and yield risks. The main concern of the farmers was the timely availability of the machine and it contributed to a major risk in their crop production. While the early planting opportunity could open to a lot of advantages in terms of cropping cycle and intensifying production, the timing issues for the harvest season was a major risk. Lastly, yield performance also had a risk of returning a lower result due to various production issues such as poor germination, weed infestation and pests and diseases among others.

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