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STATUS OF CLIMATE-SMART AGRICULTURAL PRACTICES AT JAINTAPUR UPAZILA OF SYLHET DISTRICT

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Abstract

Climate-smart agriculture (CSA) challenges to create zero hunger world through sustainably increasing agricultural productivity and income, reducing greenhouse gas emission, and building resilience to climate change. This paper documents the existing CSA practices adopted by farmers in Jaintapur upazila of Sylhet district. Data were collected through personal interview as well as focus group discussion from 102 randomly selected farmers from three unions of Jaintapur upazila during July to December 2017. We identified nineteen CSA practices that were practiced by the farmers in the study area. Those practices were perching, high yielding varieties, adjusting planting time, farm yard manure, green manuring, crop rotation, vermicomposting, cover crop, fallowing, rain water harvesting, AWD, improved livestock breed, community seed bed, USG, IPM, sorjon method, floating bed fodder, zero tillage and raised bed planting which were categorized into six pools. Finally, we proposed a three-tier up-scaling approach for the dissemination of fifteen potential CSA practices as short, medium and long term strategy for the study site which would be also applicable for other areas of Sylhet region.

Keywords: Climate-Smart Agricultural practices, up-scaling approach, Jointapur.

Introduction

The Food and Agriculture Organization (FAO) defines climate-smart agriculture (CSA) as agriculture that sustainably increasing productivity to support equitable increases in incomes, food security and development; adapting and building resilience to climate change from the farm to national levels; and developing opportunities to reduce Greenhouse Gas (GHG) emissions from agriculture compared with past trends (Lipper *et al*., 2014). There are two ways by which agricultural production can contribute to mitigate climate change, i.e., (i) to improve efficiency by decoupling production growth from emissions growth, and (ii) to enhance soil carbon sinks (FAO, 2013). Researchers have conducted field trials and experiments to determine the ‘climate-smart’ potential of many different farming techniques (Smith *et al.,* 2008). It has been determined that not every technique is appropriate for every soil, climate, landscape, or socio-economic situation (Bryan *et al.,* 2013). With the right practices, policies and investments, the agriculture sector can move onto CSA pathways, resulting in decreased food insecurity and poverty in the short term while contributing to reducing climate change as a threat to food security over the longer term (Lipper *et al*., 2014).

Bangladesh is one of the most vulnerable countries to the impacts of climate change in the world. According to the Global Climate Risk Index (GCRI) in 2017, Bangladesh was the sixth most climate-vulnerable country in the world (Kreft *et al*., 2017), though during 2010 it was the most climate-vulnerable country (Harmeling, 2009). Farmers introduced climate smart agricultural practices, through a large number of agricultural innovations by their own initiative and with the financial and technical support of various government and nongovernment organizations. Agriculture is the principal livelihood option of Bangladesh. But it is the most vulnerable to the increasing frequency and intensity of extreme events such as floods, cyclones, storm surges, hailstorms, erratic and heavy rainfall, and salinity intrusion (Mainuddin *et al*., 2011). Climate change and climate variability are affecting the land use patterns, crop systems, productivity, and optimum agriculture output (GOB, 2009). Many forms of adaptation practices such as hard and soft adaptation are being implemented throughout the world to reduce the loss and damage from extreme climate events and climate variability (ADB, 2011). Many agricultural adaptation options are being practiced in Bangladesh to adapt to climate-induced agricultural disasters like salinity, flood, waterlogging, drought, etc. To ensure

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climate smart agricultural development in Bangladesh, many structural and nonstructural soft and hard interventions are being practiced all over the country. Some of these innovations are devised by local communities through their indigenous knowledge, and some are planned interventions promoted by different government and nongovernment organizations.

Adaptation procedures of CSA can be autonomous, planned, or natural (Chambwera *et al*., 2014). Autonomous activities are those which are undertaken by private actors, prompted by climate change-induced market or welfare changes. Planned actions are those which are carried out by both private and public actors. These actions mainly include deliberate policy decisions based on the awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve the desired state (Carter *et al*., 1994). Natural actions appear within the ecosystem as a reaction to climate change (Chambwera *et al*., 2014). The agriculture sector adaptation in Bangladesh is triggered by autonomous, planned, and natural adaptation in different regions by the government and nongovernment sector.

Onyeneke *et al*. (2017) identified five broad and important practices relevant to climate smart agriculture practices namely, adjusting agricultural production systems, mobility and social networks, farm financial management, diversification on and beyond the farm, and knowledge management and regulations. Hasan *et al*. (2018) identified seventeen CSA practices *viz.* saline-tolerant crop varieties, flood-tolerant crop varieties, drought-resistant crop varieties, early maturing rice, vegetables in a floating bed, sorjan method of farming, pond-side vegetable cultivation, the cultivation of watermelon, sunflower or plum, relay cropping, urea deep placement, organic fertilizer, mulching, use of pheromone trap, rain water harvesting and seed storage in plastic bags or glass bottles in Kalapara upazila in Patuakhali, Bangladesh. Billah and Hossain (2017) also reported cultivating HYV, zero tillage, crop diversification, crop rotation, intercropping, mulching, improved irrigation, use of stress tolerant varieties, integrated farming system, rain water conservation, agroforestry, box ridges, AWD method, pit planting and short duration varieties as existing CSA technologies practiced by the coastal farmers. Climate-smart-agricultural practices have significant role on food security through sustainable crop production in Bangladesh (Billah and Hossain, 2017; Hasan *et al*., 2018). For example, eradication of insects from the cropland by using birds is commonly known as Perching method. Through this method, birds are allowed to sit on branches or sticks erected in the field 30 to 35 feet away each and to catch flying insects and consume those. Birds of various species, especially finches sit on those branches or sticks tied horizontally in the field where birds used to sit and catch flying insects, larvae and eggs of insects to consume. This method of removing harmful insects from the field with minimum cost and without applying any pesticides is becoming popular among farmers in the study area.

Therefore, Bangladesh urgently needs support in developing and expanding a climate-smart agriculture if its people are to survive and prosper in the long term. The objective of this study is to document the dynamics of CSA practices adopted by farmers in Jaintapur upazila of Sylhet district in Bangladesh and to propose a suitable up-scaling framework.

Materials and Methods

Study site

Jaintiapur upazila has 6 unions namely Nijpat, Jaintiapur, Charikata, Darbast, Fatehpur and Chiknagul. Among the six, three unions (Jaintiapur, Fatehpur and Chiknagul) were selected randomly for the study. The study was conducted from July to December 2017. Thirty four (34) farmers were sampled from each union. In total face to face interviews were conducted with 102 farmers using structured questionnaire with both open and closed questions. To assess the current state of the research, a review of the existing journal literature, books, report, blogs and newspaper were carried out. Information was also collected from GO and NGO’s by personal communication. Focus Group Discussions (FGDs) were carried out to verify the information and to discuss the important issues.

Results and Discussion

Demographic and Socioeconomic Characteristics:

The age of the farmers ranged from 28 to 87 years, with a mean of 48±15 [mean± standard deviation (SD)] (Table 1). The farmers were classified into three age groups: ‘young’ (up to 35 years), ‘middle aged’ (36–50) and ‘old’ (> 50). The majority of farmers belong to the old aged category. Based on the educational level, farmers were divided into four groups. The largest proportion (51%) of the farmers had primary education (1-5 years of schooling). Regarding family size, 60.8% of the farmers had a medium sized family (5-8 family members) followed by 25.5% with a large family (> 8 family members). The farm size of the respondents ranged from 0.04 to 7.16 hectares with the mean of 1.45 and the standard deviation was 1.30. Family income of the respondents ranged from 94,910 to 360,000 with a mean of 139.39 ±

94.91. Respondents were classified into two categories as training received (39.2%) and not received (60.8%). Data presented in table showed that 57.8%, 34.3% and 8.8% respondents had plain, slope and both plain and slope land topography, respectively. Respondents were classified into two categories as credit received (28.4%) and not received (71.6%). Respondents were classified into two categories as erosion hazard found (37.3%) and not found (62.7%) in their field. Low extension contact category was 57.8%. Respondents were classified into two categories as remittance received (9.8%) and not received (90.2%). Respondents were grouped into two categories as involved (39.3%) and not involved (66.7%) in a society/organization. Distance from home to local market of the respondents ranged from 0.05 to 6.0 km with a mean of 1.66±0.92 km. Distance from home to road of the respondents ranged from 0.01 to 3.0 km with a mean of 0.82±0.72 km.

Table 1. Salient feature of the selected characteristics of farmers (n=102)

Farmer's characteristics	Categories of the farmers	Scoring method	Number of respondent (%)	Range		Mean	Std. deviation
				Min	Max		
Age	Young (18-35) Meddle aged (36-50) Old aged (>50)	Years	36 (35.3%) 14 (13.7%) 52 (51.0%)	28	87	47.90	14.64
Education	Illiterate (0) Primary (1-5) Secondary (6-10) Higher studies (11 and above)	Years of schooling	37 (36.3%) 52 (51.0%) 6 (5.9%) 7 (6.9%)	0	12	3.92	3.52
Family size	Small (<5) Medium (5-8) Large (>8)	Number	14 (13.7%) 62 (60.8%) 26 (25.5%)	2	22	7.75	3.85
Training	Received (1) Not received (0)	Dummy	40 (39.2%) 62 (60.8%)				
Land topography	Plain (1) Slope (2) Both (3)	Dummy	59 (57.8%) 34 (34.3%) 9 (8.8%)				
Farm size	Landless and Marginal (<0.21) Small (0.21-1.0) Medium (1.1-3.0) Large (>3.0)	Hectare	2 (1.96%) 43 (42.16%) 48 (47.06%) 9(8.82%)	0.04	7.16	1.45	1.30
Annual family income	Low (Up to 100) Medium (101-200) High (above 201)	Thousand Tk.	50 (49.0%) 30 (29.4%) 22 (21.6%)	94.91	360.00	139.39	94.91
Credit received	Received (1) Not received (0)	Dummy	29 (28.4%) 73 (71.6%)				
Erosion hazards	Found (1) Not found (0)	Dummy	38 (37.3%) 64 (62.7%)				
Extension contact	Low (uo to 9) Medium (10-16) High (>16)	No. of visit per year	59 (57.8%) 34 (33.3%) 9 (8.8%)	0	24	7.33	7.10
Remittance	Received (1) Not received (0)	Dummy	10 (9.8%) 92 (90.2%)				
Involvement in a society/organization	Involved (1) Not Involved (0)	Dummy	34 (33.3%) 68 (66.7%)				
Distance to local market	Small Medium High	Km	88 (86.3%) 12 (11.7%) 2 (2.0%)	0.50	6.00	1.66	0.92
Distance to road	Little (<1) Small (1-2) Moderate (>2)	Km	65 (62.7%) 32 (31.4%) 6 (5.9%)	0.01	3.00	0.82	0.72

Farmers' opinion on Experiencing Climate Change:

The respondents of the study were asked a dichotomous question about whether or not they had experienced changes in the climate of the study area within the past 30 years. After their initial response, the farmers were asked about their perceived experience in relation to a series of climatic events commonly associated with global climate change effects in Bangladesh. They could respond selecting the following; experienced increases, decreases, no change, or they did not know, in the occurrence of the event. Fig. 1 reported the responses to the first question. It was found that 96% of respondents indicated that within the last 35 years they have experienced climatic change events.

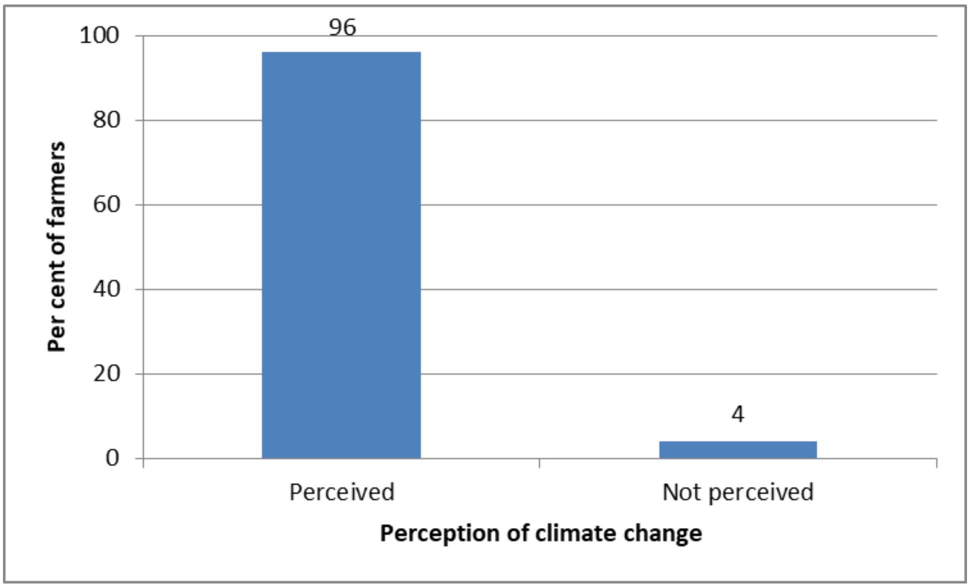

Fig. 1. Opinion of farmers by self-reported experience regarding climate change

Table 2 reported the farmers' response to individual climatic events. Here, all respondents indicated that they had experienced increases in temperature in summer and winter, rainfall amount, droughts, hailstorm and lightening. Across all events, at least 42% or more reported having experienced climatic shifts which are likely to have a negative impact on agricultural activity. The majority of farmers perceived an increased trend of temperature in summer and winter, droughts, hailstorm and lightening. Increasing temperature along with decreasing rainfall may enhance the water scarcity resulting drought, which, in turn, may affect crop production.

Table 2. Distribution of farmers to perceived changes in specific climatic events (n=102)

Climatic event	% of farmers			
	Increased	Decreased	No change	Don't know
Temperature in summer season	63	25	10	2
Temperature in winter season	58	29	13	0
Amount of rainfall	42	48	10	0
Uneven distribution of rainfall	59	14	17	11
Drought length and severity	48	25	22	5
Hailstorm amount and severity	58	30	7	5
Lightening	54	34	9	3

Farmers involvement in the production activities:

Most of the respondents in Jaintapur upazila were involved in homestead agroforestry (94%). The crops grown in the homestead were mainly for household consumption and for sale in case of surplus. The fruits and timber trees were found to provide support for growing herbaceous crops e.g., black pepper, betel leaf etc. Same per cent of respondents were used to rear livestock, poultry and fishes. Field crop production (92%), roadside agroforestry (78%), citrus based agroforestry (71%) production activities were also reported by the majority of respondents followed by agroforestry (49%), pineapple based agroforestry (40%), crop land agroforestry (39%), betel leaf agroforestry (27%) and golmorich based agroforestry (23%). Few percent respondents were involved in drumstick production (13%), apiculture (12%), others production practices (12%) and agarwood plantation (10%).

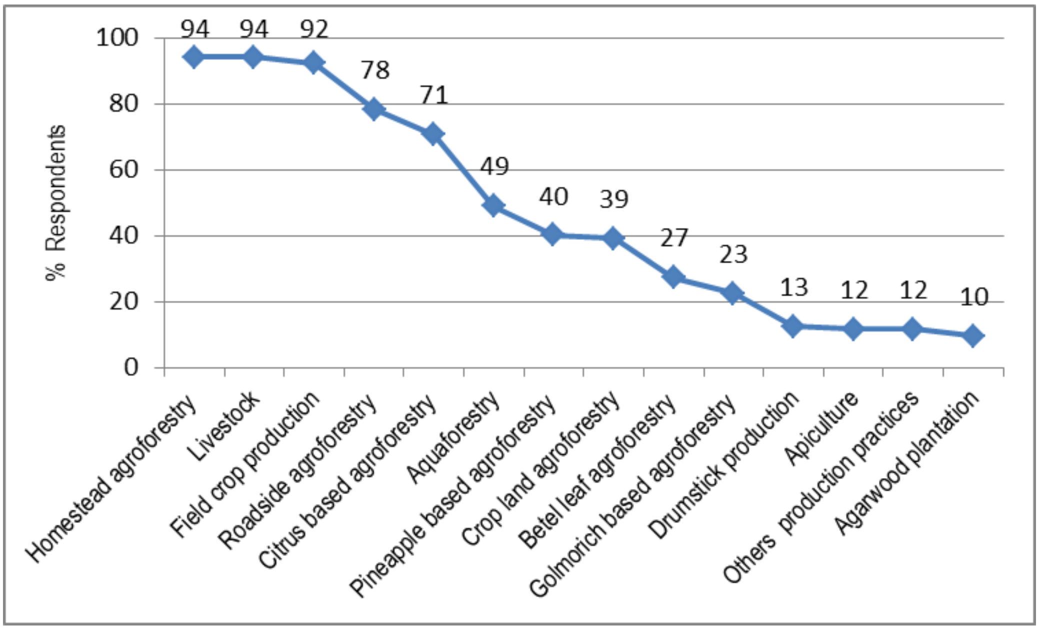

Fig. 2. Responses of the farmers regarding the involvement in diversified production activities in the study area. Total sum to over 100% due to the multiple responses received from farmers

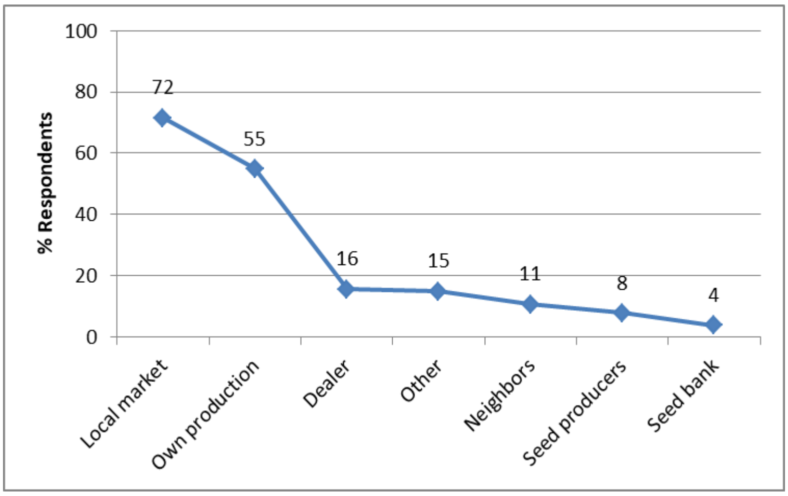

Fig. 3. Responses of the farmers regarding the sources of propagation materials in the study area. Total sum to over 100% due to the multiple responses received from farmers

Traditional Management practices:

In the study area, most of the farmers bought seedlings from local markets (72%) and own production (55%) (Fig. 3). Farmers mentioned different problems regarding quality seed. Among those, availability and quality seed were the major challenges. Weeding, irrigation, fertilization and pesticide application were practiced more extensively for crop management (>55%) followed by mulching, staking, drainage and earthing up (Fig. 4a). In case of tree species management, pruning was the major management activities (60%) followed by fertilization, pesticide application, training, staking, irrigation and mulching (Fig. 4b).

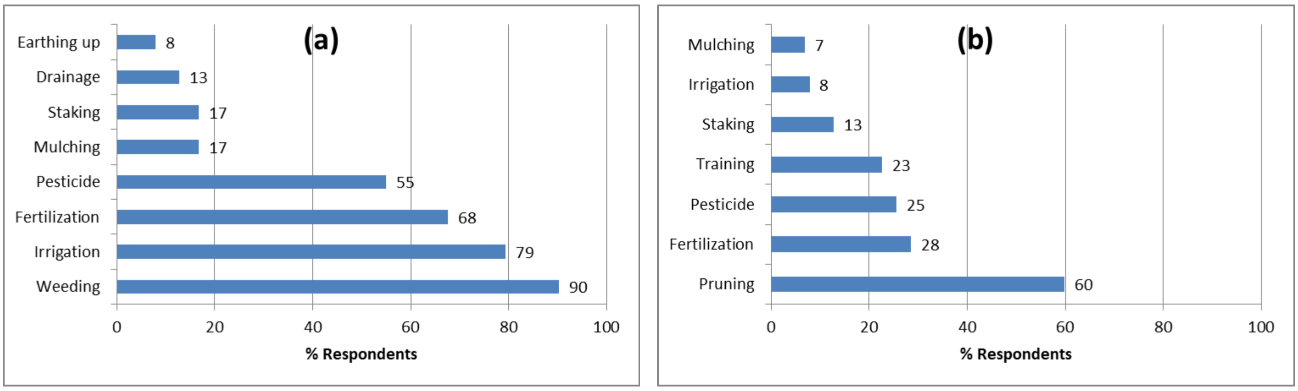

Fig. 4 Responses of the farmers regarding the general management practices applied in their (a) agricultural crops, and (b) tree species. Total sum to over 100% due to the multiple responses received from farmers.

Existing CSA practices:

It is found that amongst the nineteen existing CSA technologies in Jaintapur upazila, perching (84%), high yielding varieties (79%), adjusting planting time (74%), farm yard manure (65%), green manuring (63%), crop rotation (57%) and vermicomposting (53%) are being practiced by the farmers largely (Fig. 5) (Field Survey, 2017). On the other hand, less adopted practices were cover crop (49%), fallowing (45%), rain water harvesting (38%), AWD (38%), improved livestock breed (36%), community seed bed (30%), USG (27%), IPM (26%), sorjon method (25%), floating bed fodder (19%), zero tillage (18%) and raised bed planting (11%) (Fig. 5) (Field Survey, 2017).

The farmers of Jaintapur upazila in Sylhet district have mostly introduced Perching technique in the crops and vegetables field as climate-smart agricultural practices. It was found that about 84% of respondents are involved in this eco-friendly technique in order to cope with adverse effect of climatic change in terms of food security (Fig. 5) (Field Survey, 2017). Farmers in the study area are achieving remarkable success in controlling pest in the paddy field by using this method as an alternative to pesticides. This modern technology has become very popular to the farmers as it has reduced production cost to a great extent and enhanced rice production significantly. Previously, farmers were using toxic insecticides in the fields to eradicate the insects which have far reaching effects on environment and on human health. By using Perching method, farmers were producing toxic insecticides free crops and vegetables with lowest cost and at the same time helping to maintain balance of the environment. As a result, the method was getting immense popular in various places of Jointapur upazila in Sylhet district. Hasan *et al*. (2018) also identified sorjan method, urea deep placement, organic fertilizer, mulching, use of pheromone trap and rain water harvesting as CSA practices in Kalapara upazila in Patuakhali, Bangladesh. Billah and Hossain (2017) also reported HYV, zero tillage, crop rotation, mulching, rain water conservation, agroforestry, AWD method as existing CSA technologies practiced by the coastal farmers.

It is perceived that existing above mentioned practices have been used to (i) increase agricultural productivity and food security, (ii) adapt agriculture to climate change, and (iii) modify agriculture to mitigate climate change as like FAO Climate-Smart Agriculture framework (Lipper *et al*., 2014).

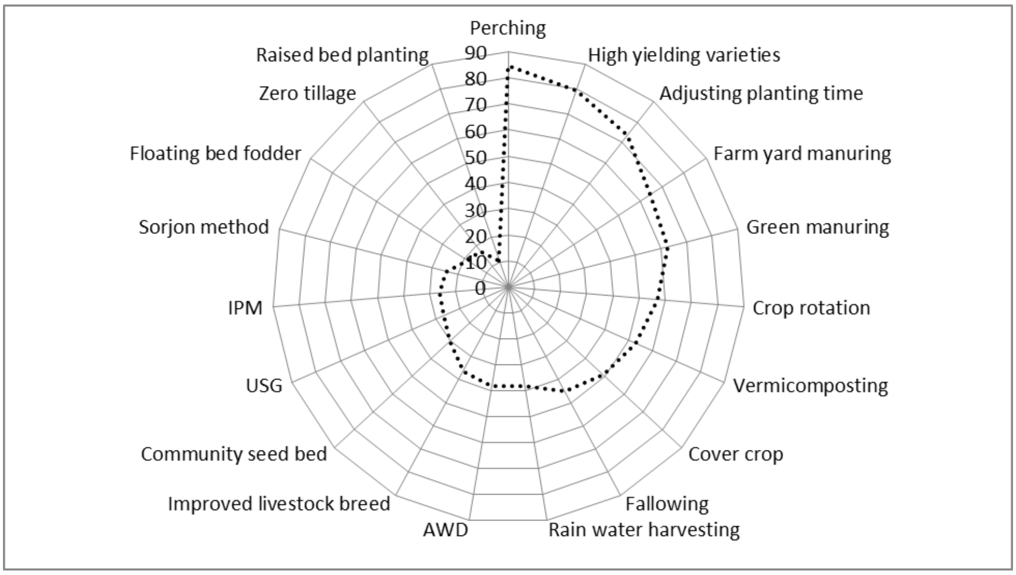

Fig. 5. Existing CSA practices in Jaintapur upazila. Total sum to over 100% due to the multiple responses received from respondents. (Source: Field Survey, 2017)

Pools of existing CSA practices:

In Jointapur upazila, we categorized into six pools. Paudel *et al.* (2017) also reported six pools of CSA options as carbon smart, nutrient smart, water smart, weather smart, knowledge smart and energy smart. But, we did not found practices under the energy smart pools. In addition, we proposed a new pool as "pest smart". As a result, existing nineteen CSA practices of Jaintapur upazila were divided into also six pools as shown in the Table 3. It is noted that few practices were found in more than one pool *e.g.*, AWD practice was found in both carbon smart and water smart pool.

Pools	Existing practices
Pest smart	Perching, IPM, Crop rotation
Carbon smart	Zero tillage, USG, AWD
Nutrient smart	Farm yard manuring, Green manuring, Vermicomposting
Water smart	Cover crop, rain water harvesting, AWD, Sorjon method, Floating bed planting
Weather smart	Adjusting planting time
Knowledge smart	High yielding varieties, Adjusting planting time, Improved livestock breed, Community seed bed

Attributes of existing practices under CSA framework:

According to FAO (Lipper *et al*., 2014) climate-smart agriculture (CSA) has three pillars, namely food security, adaptation and mitigation. Nineteen practices were reported in which six practices possess full set and thirteen practices possess two attributes of CSA framework (Table 4). For example, farmers mentioned two attributes of "fallowing" practice as (i) increase productivity through maintaining nutrient reserves, and (ii) increase resilience and soil fertility.

Table 4. Attributes of the existing Climate-Smart Agricultural practices in Jointapur upazila (Source: Field Survey, 2017)

Existing practices	Attributes of the existing CSA practices		
	Sustainably increasing agricultural productivity	Adapting and building resilience to climate change	Opportunities to reduce GHG emissions
Perching	√	√	
High yielding varieties	√	√	
Adjusting planting time	√	√	
Farm yard manuring	√	√	
Green manuring	√	√	

Crop rotation	√	√	√
Vermicomposting	√	√	
Cover crop	√	√	√
Fallowing	√	√	
Rain water harvesting	√	√	
AWD	√		√
Improved livestock breed	√	√	√
Community seed bed	√	√	
USG	√		√
IPM	√	√	
Sorjon method	√	√	√
Floating bed fodder	√	√	√
Zero tillage		√	√
Raised bed planting	√	√	√

Key challenges Associated with adopting CSA Practices:

Challenges associated with adopting existing CSA practices were reported during field survey in Jointapur upazila were summarized in table 5.

Table 5. Challenges associated with adopting existing CSA practices in Jointapur upazila (Source: Field Survey, 2017)

CSA Practices	Challenges reported
Perching	Initial cost.
High yielding varieties	Lower quality and higher price of HYV. Pest and disease susceptibility.
INM	Lack of proper knowledge and skill.
Adjusting planting time	Lack of information.
Farm yard manuring	Lack of proper knowledge and skill.
Green manuring	Lack of information.
Crop rotation	Lack of information.
Vermicomposting	Lack of information and skill.
Cover crop	Availability of proper material.
Fallowing	Lack of information.
Rain water harvesting	Insufficient information and lack of infrastructure for collecting rain water.
AWD	Lack of skill and unreliable irrigation source
Improved livestock breed	Quality, price and availability of new breeds.
Community seed bed	Lack of information.
USG	Lack of information and supply.
IPM	Insufficient knowledge and skill.
Sorjon method	Lack of information and skill.
Floating bed fodder	Lack of information.
Zero tillage	Lack of information.
Raised bed planting	Lack of information.

Proposed approach for up-scaling potential CSA options:

"Approach for up-scaling" means the sequence of steps used to promote the extension and demonstration of potential CSA technologies in collaboration with local communities and government stakeholders to make informed decisions for climate change adaptation in agriculture. Based on the understanding from the research, a three-tier up-scaling approach (Table 6) was proposed consisting of different time scale for the study area as well as also applicable for other region of Sylhet district. Proposed "up-scaling approach" would have vital role to address the challenges of climate change and variability in agriculture. Paudel *et al*. (2017) also proposed a three-tier up-scaling model for CSA options in Nepal.

Table 6. Proposed approach for up- scaling potential CSA options

Up-scaling approach	Examples of proposed CSA options	Time scale	Role of contributors
Information-transfer approach	Community seed banks, Vertical drainage, pH management, Sandbar cropping, Rice-cum-fish farming, Case-fish farming, Farmer managed natural regeneration, Agroforestry, etc.	Short term	Support for extension and information dissemination through demonstration and training with financial incentives to target local community
Entrepreneur development approach	Biochar, Water saving laser land leveling, Improved cook stoves etc.	Short and/or mid term	Attract entrepreneur by providing financial support and removing barriers.
Policy inclusion approach	Solar based irrigation, Agricultural insurance, Site specific real time based agro-advisory services and weather forecasts, Incentive for CSA practices etc.	Long term	Framing the situation, describing the dynamics and synthesizing the understanding into policy framework for priority and investment

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