FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

FEED THE FUTURE BANGLADESH DIGITAL AGRICULTURE ACTIVITY
SHUFOLA PILOT END LINE ASSESSMENT REPORT

AUGUST 2022

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ACRONYMS AND ABBREVIATIONS

B2B	Business to Business
B2C	Business to Consumer
BDAA	Bangladesh Digital Agriculture Activity
DAI	Development Alternatives Incorporated
DF	Digital Frontiers
FGD	Focus Group Discussion
FTF	Feed the Future
GoB	Government of Bangladesh
IPs	Implementing Partners
KII	Key Informant Interview
MERL	Monitoring, Evaluation, Research, and Learning
mPower	mPower Social Enterprises Ltd.
PAE	Prantojon Agro Enterprise
SRS	Simple Random Sampling
ToC	Theory of Change
USAID	United States Agency for International Development
USG	United States Government
ZOI	Zone of Influence
ZOR	Zone of Resilience

EXECUTIVE SUMMARY

The FTF Bangladesh Digital Agriculture Activity (BDAA), in partnership with Prantojon Agro Enterprise (PAE) and mPower Social Enterprises Ltd. (mPower), rolled out a pilot to determine the effectiveness and efficacy of the digital tool, SHUFOLA, an agricultural weather-based advisory service tool developed by mPower Social Enterprises Ltd. that offers information on crop management practices. Based on crop variety, growth stage, and weather conditions, farmers receive customized and actionable advisory services through the following methods:

- SMS (text messages) on basic cell phones or smartphones
- Voice messages on basic cell phone or smartphones, which can be customized in local dialect if needed
- Calls from an agricultural call center specialist (a feature that was incorporated after feedback from the Activity on user literacy rates during baseline data collection)

SHUFOLA uses a Business-to-Business (B2B) model, working with companies to deliver timely and accurate weather-based agricultural advisory to farmers. The tool's owner, mPower, works with private companies like PAE to customize a suite of advisory messages to users to ensure agricultural inputs are appropriately used and optimized for local conditions.

PAE is interested in increasing output quality for contract their farmers and is thus incentivized to deliver better, more efficient advisory through technology, as opposed to through direct field agents. Farmers subscribe to the SHUFOLA service by providing their location, the names of crop(s), and sowing dates to receive personalized and timely weather information and crop management advice. Under this pilot, SHUFOLA's service delivery costs were estimated at USD$[1] per user, crop, and season[2], which for this pilot was a season duration of 4.5 months. It should be noted that the cost-per-user decreases as the number of users grows.

Under this pilot, PAE, in partnership with BDAA, selected 500 participants actively engaged in mung bean cultivation from two sub-districts of the Barishal district. This pilot was carried out throughout the entire mung bean production process in the climate vulnerable geographic area of the FTF Zone of Influence (ZOI) in Bangladesh.

For the endline assessment, 114 individuals were selected out of the 500 pilot participants, following systemic sampling procedure. The sampling considered age (youth and adult) and gender (female and male) representation in the pilot population. The endline assessment examined the effectiveness and usability of SHUFOLA for the farmers as a weather-based advisory tool, as well as the potential value propositions of private enterprises. Summary findings from the pilot performance assessment with recommendations are shared below.

Knowledge on Crop Advisory Services:

The assessment found that a significant proportion (89%) of sample participants in the endline assessment had retained knowledge on the different types of advisory services provided by SHUFOLA, including knowledge of the methods used to deliver services to farmers/growers.

Accessibility of Services:

To access SHUFOLA's services, farmers are required to have access to a mobile device and to have a basic level of digital literacy, including an understanding of how to use basic features on a mobile phone such as opening and reading texts or listening to voice messages. The endline study found that around

[1] mPower reported a total cost of USD$3,010 per crop per season for 500 pilot users (1US$= 93 Tk).
[2] Annual crops are grown in different seasons of the year. Crops are grouped under the seasons in which are their major field duration: Rabi season period starts in mid-October and continues up to mid-March; Kharif 1 season duration mid-March to June and Kharif 2 season duration July to mid-October

81% of respondents had their own device and could operate it by themselves, while rest of the respondents (19%) used family phones. Among sample pilot participants, 90% of respondents confirmed to have received advisory services, either in text or voice message form—or both— throughout the season. However, both types of respondents (those who used their own devices and those who used family phones) expressed a preference for using interactive voice calls, which had been incorporated by mPower as an additional service (besides SMS and voice messages), to enable them to seek clarification from service providers., The tool owners added interactive voice calls as an option based on the feedback generated from the Activity, considering the digital literacy observed of users (only 56% were able to open and read text messages) during the baseline study. Farmers mentioned that the main reason for this preference was the ability to interact directly with service providers as they sought clarification on services. Regarding preferred timing to receive SMS and voice calls, participants preferred their leisure periods (in the late afternoons and evenings). However, it is worth noting that 8% of respondents did not notice any incoming SMS messages from SHUFOLA on their phones, because they lacked an understanding of SMS functionality, and 2% reported not receiving any SMS messages whatsoever on their phones from SHUFOLA. Out the 90% of respondents who received SMS messages, 50% of them were able to open and read out the messages by themselves, with49%) of respondents reporting that the received messages were readable and understandable. In terms of age and gender, male participants (52%) were more proficient in opening and reading messages compared to female participants (42%). The analysis found similar results for youth (69%) as compared to adults (45%).

Relevance of Advice:

More than half of the respondents thought that, except for a few cases, the crop management suggestions and proposed inputs for mung bean farming were mostly relevant in the local context. Similarly, most respondents (67%) reported that weather forecast alert messages were delivered in a timely manner.

Delivery Preference:

Regarding service delivery preferences, 59% of respondents mentioned that they preferred voice calls over text messages, as voice delivery was easier to understand for all involved, especially for illiterate users. Respondents generally noted a preference for a combination of voice message and periodic contact by call centers, or the combined implementation of all three mediums (text message, voice messages, and calls from a call center).

Adoption of Services:

More than half of the total respondents believed that SHUFOLA suggestions were mostly aligned with local weather conditions. 75% of respondents applied **at least one advisory service** of SHUFOLA during mung bean cultivation in this pilot period. Among all advisory services provided by the tool, the most adopted services were weather forecast (58%) and pesticide application (58%), followed by land preparation (36%) and fertilizer application (11%). The least adopted service was seed treatment (1%), due to lack of supply of inputs, or inoculants, in the local market. The next lowest adopted service was found to be crop variety selection (2%), as the respondents found the variety suggestions irrelevant. For example, the recommended BARI-06 crop variety was already commonplace among the respondents; during baseline surveys, around 78% of participants were found to already use BARI-06 in mung bean cultivation.

Benefits of Using the Service:

Overall, participants believed that the advice on pesticide and fertilizer application, weather forecasts, and updated sowing techniques helped them to produce a better yield in the 2022 harvest, which is around 0.84 metric tons/hectare (mt/ha), an increase of 17% of yield from the previous year. Several rain forecast alerts, especially during sowing and harvesting periods, were perceived as effective at reducing crop damage. Pest and disease alerts during production management were also perceived to be effective

at reducing yield damage. Unfortunately, around 74% of respondents reported that although their production was higher than previous years, unexpected tidal waves and heavy rainfall during the harvesting period, resulting in waterlogged fields that impacted overall production volume. SHUFOLA currently does not offer advisory services related to natural disasters. Only 26% of respondents reported to be able to harvest all of their crops, due to strong water drainage facilities at their pilot sites.

During the 2022 pilot harvest, most farmers could harvest their crops only two times, which was less than the three harvests they achieved in the previous year. These two harvests still produced relatively high yields; however, due to waterlogging, the yields came in at around 0.71 metric tons/hectare (mt/ha), down from the 0.72 mt/ha observed during baseline data collection.

Learnings and Recommendations:

- Adult participants' digital literacy was much lower compared with youth participants (only 43% adults were able to read and 36% were able to understand messages, versus the youth's respective 81% literacy rate and 75% message comprehension rate). ***As such, youth could be the target users for SHUFOLA's advisory services, as they are quick learners and potential early adopters.***
- For delivering localized weather forecasts paired with highly customized crop management advice, it is required to input crop-specific sowing/planting dates to optimize the accuracy of advisory messages. Unfortunately, the Activity learned that, when registering for the service, some farmers are not able to recall their dates of sowing/planting, while others entered inaccurate dates. Attempts to rectify this required engaging SHUFOLA staff to call the users to collect and confirm accurate data. These efforts utilized additional resources and increased internal operational costs, which emphasized a need to integrate a call center package into the service for PAE. Unfortunately, this is an additional cost and it increases the overall service fee, which may not be as attractive to companies like PAE who have more ***cost-competitive alternatives available in the market***.
- Under a **Business to Business (B2B) approach**, SHUFOLA is an ideal service for agro-input companies to deliver input-specific advisory services of their products to contract farmers[3]. The cost-per-user of SHUFOLA decreases significantly as the size of the user recipient group increases. As such, this service may not be as cost-effective for processing and procurement companies that work with a limited number of local farmers (i.e., 100-500 users) to produce quality grain and other outputs that align with their requirements. These companies provide close follow-up, management, and input support to the farmers. SHUFOLA may therefore be more attractive and cost-competitive for larger companies like input companies that work with thousands of farmers. In these cases, paid advisory services may allow for a significant increase in returns and output quality, thereby incentivizing other private sector agricultural actors to take a similar approach. Thus, investing in paid advisory services serves the mutual interests of the tool owners, private sector partners, and farmers.

The tool owner had presumed that the Business to Consumer (B2C) approach was not viable for SHUFOLA, as farmers would not be willing or capable of paying for such advisory services. However, based on our study, we found that **farmers are willing to pay a small amount (FGDs revealed this amount would be around US$0.50 per user) for SHUFOLA services**. Willingness to pay depends on several factors, such as the commercial viability of selected crops, whether the selected

[3] Contract farming involves agricultural production being carried out on the basis of an agreement between the buyer and farm producers. Often it entails the buyer specifying the output quality required and the price, with the farmer agreeing to deliver at a future date.

crops are cultivated as chance crops[4] or as cash crops[5] and the perceived return on investment after the adoption of the tool's services. For example, farmers who participated in the pilot who cultivated mung bean would be disinclined to pay for additional advisory services, as mung bean is a chance crop and such services are therefore less likely to lead to increased crop yields and a sufficient return on investment.

1 INTRODUCTION

In recent years, Bangladesh has faced low growth rates in agriculture due to global climate change, with rising temperatures making climate and weather conditions unpredictable and unstable. This is true especially for the south of Bangladesh, where mung bean serves as one of the major crops widely grown (on about 55,000 hectares of land) during the *robi* (winter) season. The mung bean production system, from sowing seed to harvesting and storage, is extremely sensitive to climate issues, especially unexpected rain and drought.

Evidence suggests that, in 2017, mung bean farmers lost a significant amount of their yields due to sudden heavy rainfall, with 60%-70% of crops destroyed just before harvest.[6] They faced similar challenges in 2019, when farmers did not get optimum yields due to heavy drought, sudden tidal flows, and increased rainfall.

To explore adaptation processes that might mitigate these climate challenges, the Bangladesh Digital Agriculture Activity selected SHUFOLA, a weather-based agricultural advisory solution developed by mPower Social Enterprise, for an exploratory pilot process.

BDAA, in partnership with PAE and mPower, rolled out the pilot in January 2022 to examine the effectiveness and efficacy of SHUFOLA's weather-based agricultural advisory service tool during mung bean production in a climate vulnerable geographic area. The pilot took place in two sub-districts of the Barishal district, a major mung bean production area that is also one of the most climate-vulnerable parts of Bangladesh. BDAA selected pilot participants in association with its partner organizations (PAE and mPower) from these two sub-districts. In total, BDAA enrolled 500 farmers in consideration of the following key criteria:

[4] Chance crops are those that farmers grow mainly as subsistence crops to utilize fallow land during a specific period of time. Farmers will sell the remainder of these crops after their own consumption

[5] Cash crops are those that farmers grow for commercial purposes with the aim of generating profit rather than for subsistence. Subsistence crops are those used to feed the farmer and the farmer's family members.

[6] Blue Gold program report 2017

- BDAA sought a group smallholder farmers, which would be at least 49% youth (between 15 to 29 years), with an intentional emphasis placed on recruiting women participants. Further, BDAA looked for participants with access to a smartphone or feature/button phone.
- Participants also needed to be willing to share their mobile phone numbers; further, only one participant per household was allowed to ensure no duplication of mobile phone numbers.
- Additionally, participants were interested in increasing agricultural yield (especially for mung bean crops) by applying SHUFOLA's weather and improved management practices.

Once the pilot participants were registered, BDAA arranged a half-day orientation about the SHUFOLA service and provided the participants with free access to SHUFOLA from mid-January 2022 to June 2022.

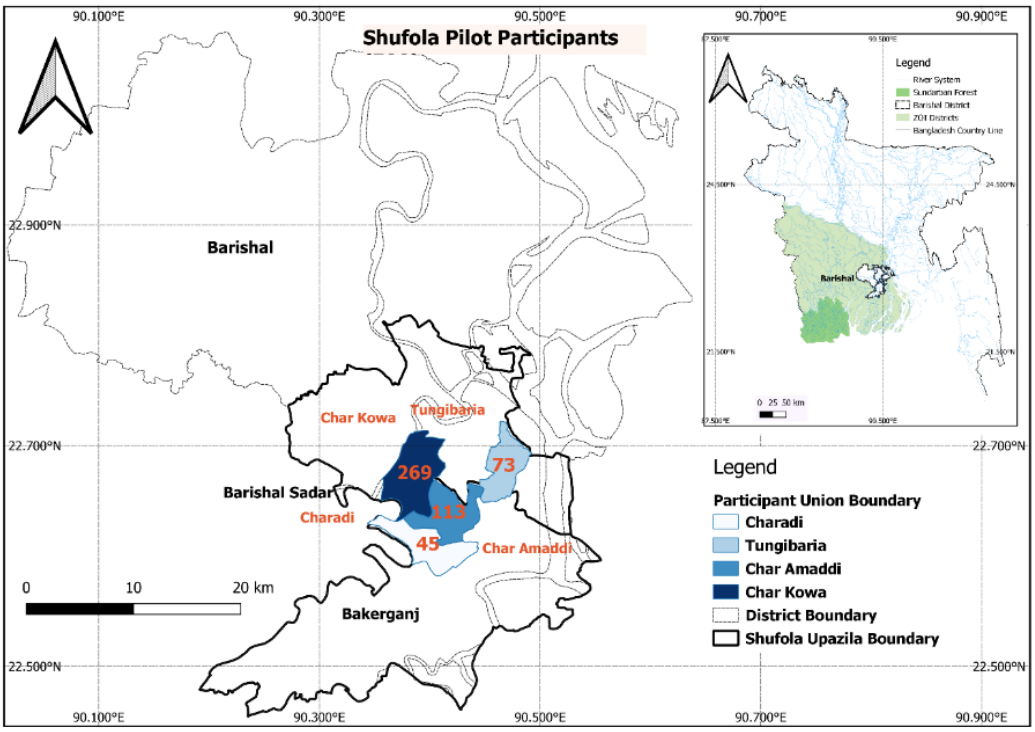


Figure 1: SHUFOLA Pilot Participants Map

BDAA conducted baseline data collection for the pilot during the second week of January 2022. As per pilot protocol, the endline assessment was conducted in the second week of June 2022. All the pilot participants were selected from Barishal Sadar and Bakergonj *upazilas* in Barishal District. The baseline study found that 53% of selected participants were from the Char Kaowa union, 22% were from the Char Amaddi union, 14% were from the Tungibaria union, and 11% were from the Charadi union. Considering youth and gender, 17% of participants were below 30 years old (youths) and 29% were female. In terms of education, 36% of selected participants were below primary class and 18% had received no formal education, while the remaining 46% of participants had secondary and above education.

1.1 Objectives of the Endline Study

- To understand the effectiveness and usability of the SHUFOLA app as a weather-based advisory tool.
- To understand the cost-effectiveness of SHUFOLA for PAE.

- To gather recommendations for future SHUFOLA uses, especially regarding the process of additional future deployments.

2 STUDY METHODOLOGY

The endline study used a mixed-methods approach consisting of a quantitative survey and qualitative inquiries. Data collection was comprised of four methods: (a) a questionnaire survey using the Kobo platform, (b) focus group discussions (FGDs), (c) case stories, and (d) key informant interviews (KIIs). Through FGDs and KIIs, BDAA captured intended and unintended outcomes regarding use of the SHUFOLA tool. Study results and lessons learned were communicated with BDAA's partners to inform management decisions and to improve the tool.

2.1 SAMPLING PLAN

For sampling framework preparation, the Activity listed down all the pilot participants ordered by geographical location, age, and gender. Since the Activity has a comprehensive list of pilot participants including all the information details without any sampling cluster, the Activity considered a single-stage design with systemic selection of participants for this quantitative survey. For the one-stage design with systemic selection of participants, it was essential that there would be a comprehensive, complete, and up-to-date participants frame (consisting of the complete list of participants within all implementation clusters, like union, age, and gender).

In general, there are two ways to sample participants directly using one stage of sampling: systematic sampling and simple random sampling (SRS). These sampling methods can then be performed when the complete list of participants has been ordered by cluster and subsets of the participants (geographic location, age, and gender) have been selected using a fixed interval across the entire list (systematic sampling).

The formula for calculating the initial sample size for the estimation of indicators of totals is given by:

$$n_{initial} = \frac{N^2 X Z^2 X S^2}{MOE^2}$$

Where,

Z = critical value from the normal probability distribution (95% confidence level: 1.96)

N = total number of estimated participants (access outreach)

S = standard deviation of the distribution of participants data (0.41)

MOE = margin of error (5%)

*Considering 5% non-response rate

Total Population (N)	Standard Deviation (S) on Digital Literacy (from Literacy Study)	Acceptable % of Error (p)	Margin of Error (MOE)=p*N	Confidence Level CI	Critical Value (Z)	Initial Sample Size ($n_{initial}$)	Adjust factor required or not (5% of $n_{initial}$)
500	0.3	5%	25	95%	1.96	138	25

Adjust factor for ninitial/N>=0.05, (1/(1+ $n_{initial}$ /N))	If sample size is greater than 5% of population size, then adjustment required; otherwise no adjustment required.	Design effect (DEFF) as per def	Sample size with DEFF	Adjusted nonresponse (1/0.95), as per def (5% nonresponse rate, response rate of 95% is assumed)	Adjusted Sample Size 3 (with non-response) and final sample size	Final Collected Sample
0.783333668	108	1	108	1.05	114	114

For an in-depth understanding of what did and did not work well, BDAA conducted nine KIIs and two FGDs with 6-7 direct participants per FGD.

The nine KIIs were conducted with: the PAE Executive Director and one PAE staff member, two representatives of mPower, and five mung bean farmers. These KIIs help ascertain the respondents' understanding of SHUFOLA advisory services and the tool owner's points of view regarding the sustainability of the service.

Two FGDs were held with around 12-14 direct users. Participants were selected from two different sub-districts, or *upazilas*, for piloting. Priority was given to users in areas near the BDAA team, which reduced time and transportation costs.

3 Key Findings

3.1 Endline Participant Demographics

PAE was engaged as a partner for the endline evaluation in the two sub-districts of Barishal within the FTF ZOI.

Under the pilot, 500 participants who cultivated mung bean this year received orientation from BDAA, and among those, 114 participants were considered for the survey. In the end, 100 respondents (88%) were available to participate in survey data collection. Two-thirds (67%) of the respondents were male and one-third (33%) of respondents were female. The majority (84%) of the respondents were adults, while the rest (16%) were youths.

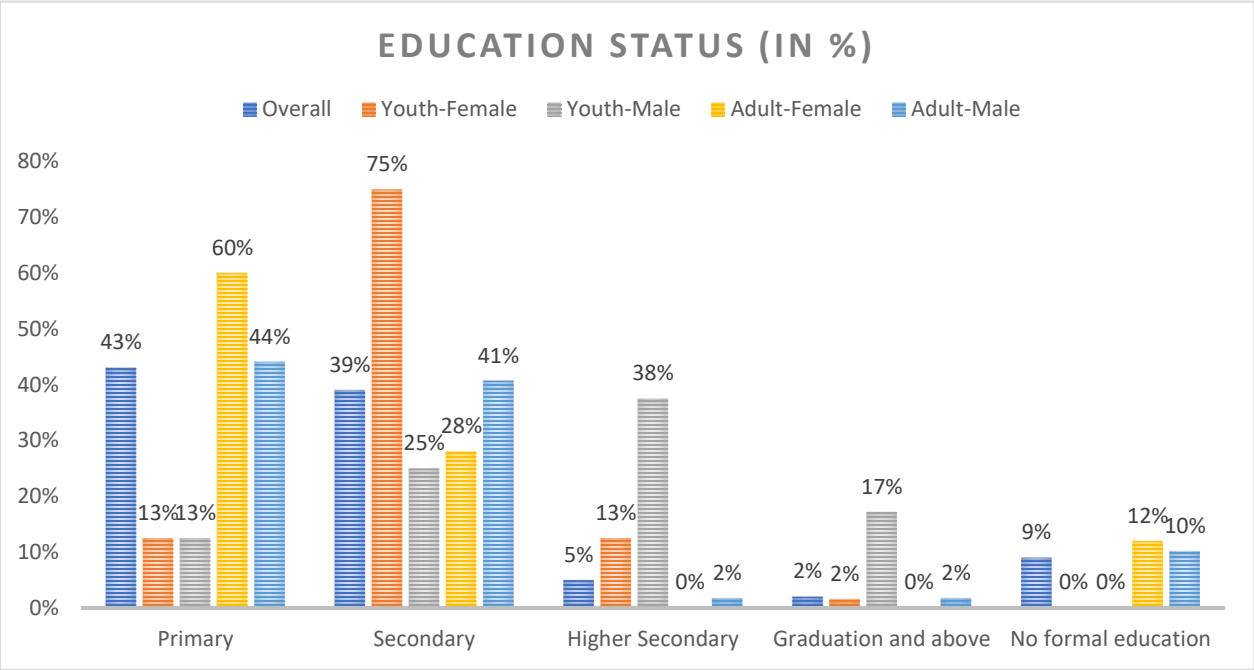


Figure 2: Education Status of Sample Pilot Participants

Respondents' education levels varied from primary school to post-graduate, with most participants reporting they had completed primary level education (43%) and secondary school education (39%). Only 2% were educated at the graduate or post-graduate education level. 9% of respondents had not received any formal education, and they could not read or write. Considering age, youth respondents, comparatively, had higher levels of education, with 88% of youth-females and 63% of youth-males completing secondary and higher secondary education; interestingly, only 17% of youth-males and only 2% of youth-females and 2% of adult-males completed graduate school. Around 12% of adult-females and 10% of adult-males had received no formal education. In the case of female participants, most (87%) completed primary and secondary school, while 9% had not received any formal education.

The respondents who cultivated mung bean this year had an average of 15 years of farming experience. Most farmers were smallholders and cultivated mung bean on fields averaging 0.31 hectares of land. In terms of variety, 83% of farmers cultivated BARI-6, a variety characterized by large grain and high yield (during baseline it was 78%); 74% cultivated only BARI-6, while 9% of farmers also cultivated sona mung—a local variety characterized by small grain and taste. Overall, around 16% of the respondent farmers cultivated multiple varieties of mung bean in the pilot area.

3.2 Participants' Knowledge

The survey assessed the pilot participants' knowledge of the technical advice provided by SHUFOLA. SHUFOLA provided guidance on best seed-to-seed crop management practices and have actionable advice on bad weather conditions. Around 89% of respondents retained knowledge on various topics; 80% stated that they retained pest and disease-related information, while 75% remembered rain alerts being useful. Meanwhile, others recalled information from SHUFOLA on land preparation (48%), and fertilizer application information (31%).

The "least-remembered" SHUFOLA guidance related to harvesting technique or timing (18% of respondents reported this useful), grain preservation (8%), and seed treatment processes with inoculant and benefits (4%).

3.3 ACCESSIBILITY

The endline survey respondents all had access to a mobile phone (either a basic "feature' phone or smartphone). However, respondents, or those receiving SHUFOLA services, did not always have ownership of their phones. 81% of respondents owned a cellular device, while the remaining respondents used a family phone. Device ownership rates were the same for both youth and adults (81%). On the other hand, female device ownership was lower (61%) than their male counterparts (95%).

Tool owner mPower used three methods to deliver SHUFOLA advisory services: 1) SMS, or text messaging, 2) pre-recorded one-way voice calls with the same content as SMS, or 3) two-way remote consultation with an agent or agricultural call center so that pilot participants would be able to follow up on or seek clarity on advisory services. This third service option was made available after BDAA noted the digital literacy status of pilot participants during baseline study.

Access to services was also discussed at the beginning of the survey, and it was found that 90% of respondents confirmed receiving either text or voice messages or both throughout the season. 8% of respondents received SMS messages from SHUFOLA, but did not understand how to open them, while the other 2% reported they never received any SMS messages from SHUFOLA. Those that did not recognize any SMS or voice calls cited reasons such as lack of comfort with carrying or using a phone, a lack of interest in advisory services, or their phones being operated by other family members who ignored calls and messages when received. The remaining 2% of respondents didn't receive any calls or text messages due to a change in their phone number or because they had inputted the wrong phone number during registration at the beginning of the pilot.

Of those 90% who received messages and calls from the SHUFOLA service, 70% had their own phones, while 19% used a family phone. Most of these respondents who used a family phone to receive services were mostly informed by family members of new messages and calls within a day; only 1% of respondents reported they were never informed about the delivery of any text or voice call.

The respondents' preferred modes of receiving advisory services are shown in the figure below. Respondents were generally more comfortable with voice calls over text messages. Voice delivery was easy to understand for all, especially for those who are illiterate. 12% of respondents preferred a combination of all three modes of contact (SMS, voice calls, and call center messages). Regarding the ideal timing to receive SMS and voice calls, respondents preferred to receive messages during their leisure periods (typically the late afternoon and evenings).

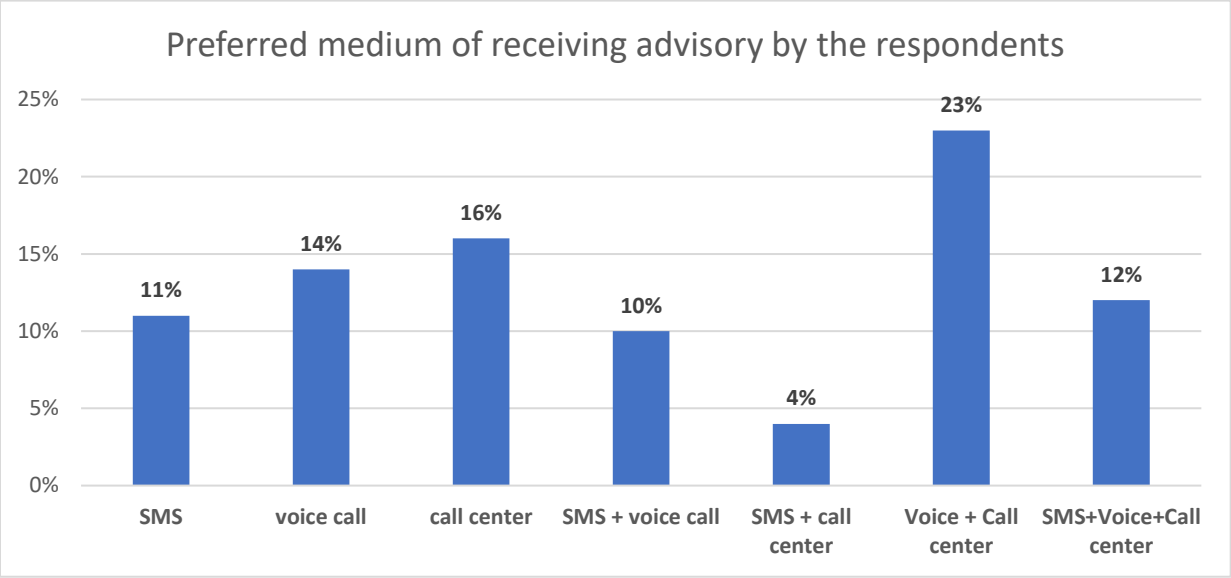


Figure 3: Preferred Medium of Receiving Advisory Services

The endline survey asked respondents to open messages from their phones and read out loud the content of the messages. 49% of respondents could open and read the messages by themselves, and 42% of respondents reporting that they understood message content. Meanwhile, 41% could not open messages or read them out loud due to lack of literacy, eyesight issues (common for elderly respondents), or discomfort with digital technology. Meanwhile, 69% of youth respondents were able to access and understand the content of the messages, as compared to 45% of adults. In terms of gender, fewer female participants (44%) were able to understand message content, while 63% of males indicated they were. Overall, male and youth participants (88%) were more comfortable and familiar with text-based advisory services. Similar investigation was performed to check the acceptance of voice call and data and found that 70% of respondents understood the content of the advice delivered by voice call in comparison to text message (49%).

The graph below illustrates data regarding accessibility, readability, and understandability by age and gender. Youth-male participants performed better in every category as compared to other participants. Interestingly, youth-female participants' mobile access was found to be low, but with respect to operations such as message opening, reading, and understanding messages, performance was found to be significantly higher.

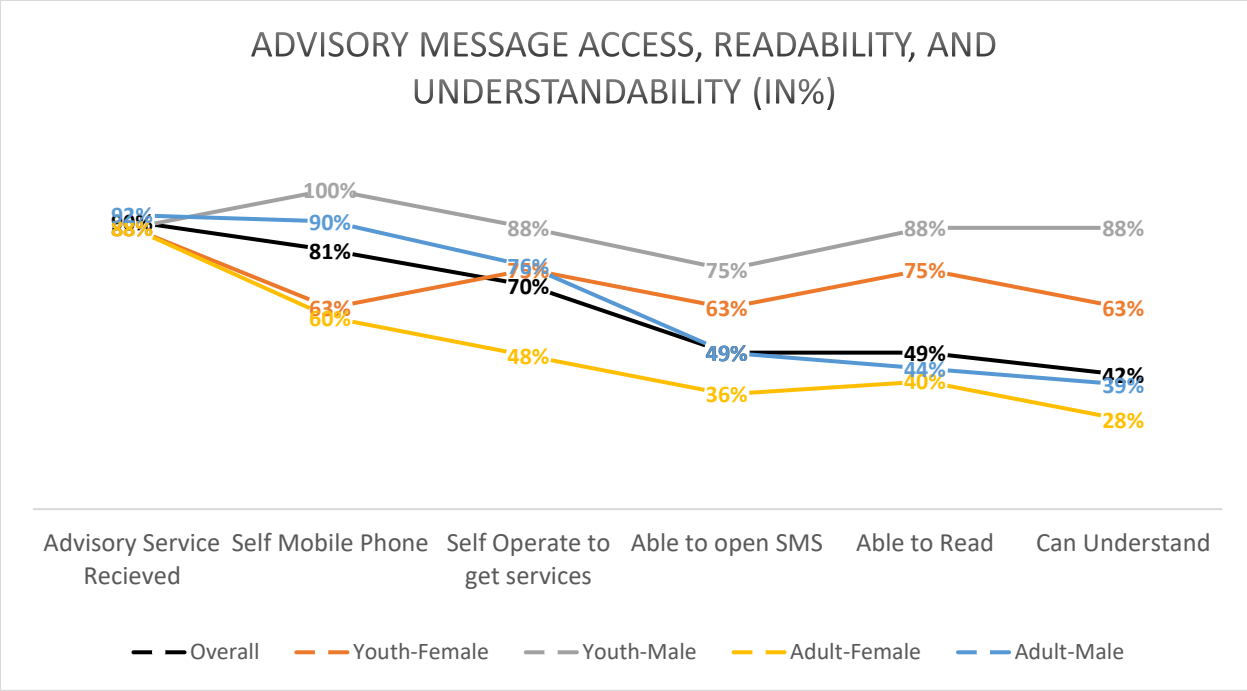


Figure 4: Accessibility, Readability, and Understandability (in %)

3.4 Factors Leading to Adoption

According to the data, 76% of respondents applied at least some of the advice given to their mung bean field production. Youth-females and youth-males applied recommendations at almost the same percentage (75%), whereas for adult-females, this rate was only 68%, which is less than adult-males (80%). Among the rest of the respondents, around 10% did not receive or notice the messages, and around 14% did not apply any recommendations/suggestions. Reasons for lack of application included non-actionable recommendations which failed to align with usual practices, messages were not irrelevant to farmers' activities based on when the time recommendations were received, delay in receiving advisory messages, lack of input resources, and lack of ability to make farming decisions (especially a consideration for female farmers). The below figure shows types of recommendations and the percentage of respondents who applied them. Recommendations related to rain forecast (58%) and pesticide application (58%) were more useful and applicable than other types of recommendations.

Other advisories applied by residents included land preparation, pest and disease, fertilization

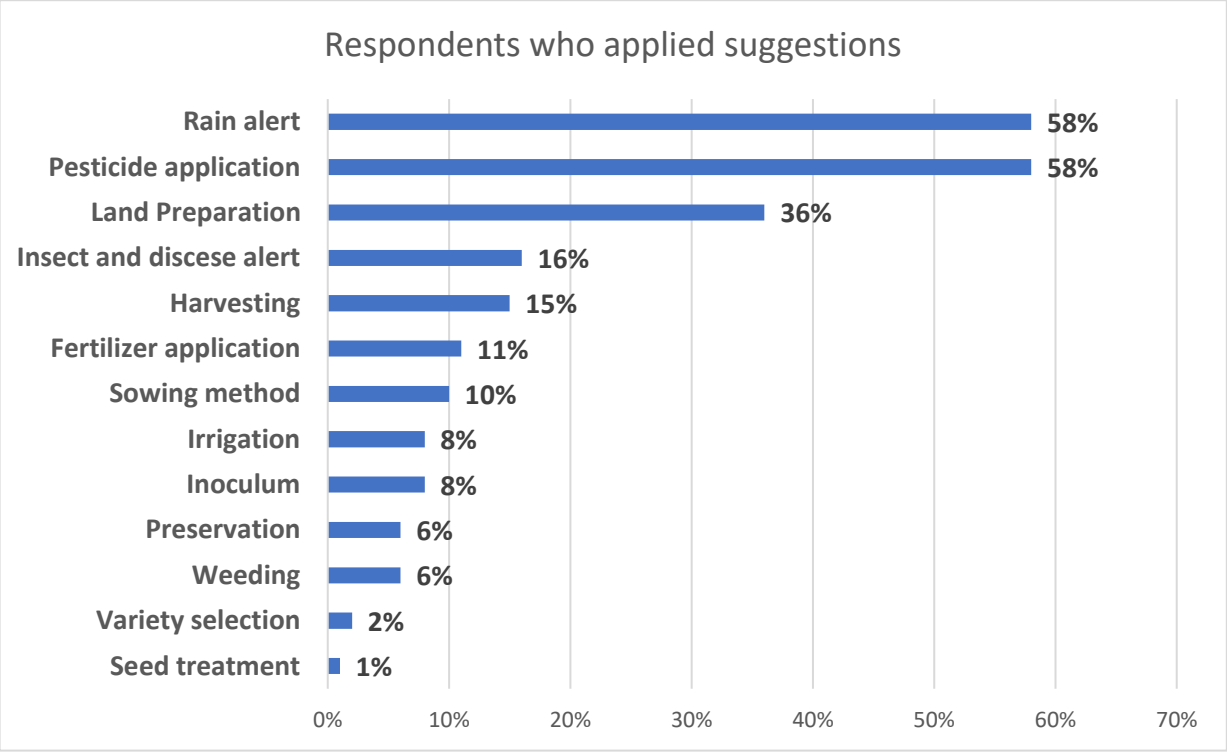


Figure 5: Respondents Who Applied Suggestions

application, and sowing technique-related advisories.

Relevance: BDAA analyzed data obtained in the survey to determine whether the advisories provided were relevant within the local context. The figure below shows that more than half of the respondents thought that crop management-related recommendations and input recommendations related to mung

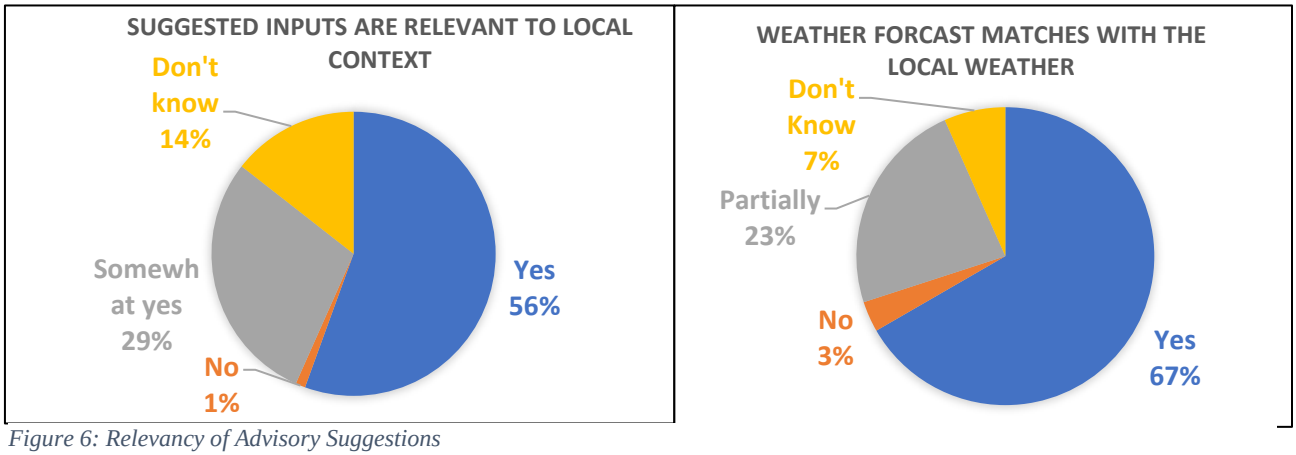


Figure 6: Relevancy of Advisory Suggestions

bean farming were relevant in the local context.

Similarly, localized weather forecasts and recommendations related to delivery time (with respect to growth of the crop) were also relevant to at least 67% of respondents. Only 5% to 6% of respondents

reported a mismatch between the forecasts and the actual weather in their localities. Therefore, weather forecasts proved to be reliable and delivered in a timely manner for the majority of the farmers.

3.5 RESULTS

90% of respondents confirmed receiving messages from the service, with 89% of total respondents recounting information and advisory delivered through the service. 76% of all respondents applied the recommendations to their mung bean fields and more than half (55%) of the total respondents believed that the recommendations aligned with their usual practices.

In terms of impact, 74% of total respondents reported benefitting from SHUFOLA advisory services, specifically by protecting their crops from damage through timely weather updates (35%); better timing and planning for input application (36%); increased yield (17%); and enhanced confidence in mung bean cultivation (23%). Further, 5% of reported that they were able to reduce production costs by using inputs in a timely manner.

While exploring how these benefits affected individual respondents, information regarding land preparation, pesticide and fertilizer application, weeding, irrigation, and harvesting was received well ahead of time. This helped farmers in planning and implementing inputs and actions in a timely and organized manner. Respondents also believed that advice on pesticide and fertilizer application, bad weather forecasts, and updated sowing techniques helped them to have a better yield during this harvest. For example, a few respondents applied rain forecasts to save production costs by rescheduling pesticide, irrigation, and fertilizer applications in their fields. However, in the end, 74% of respondents reported not being able to harvest crops either fully or partially due to waterlogging from tidal water or heavy rainfall.

Survey data collection found that the average cultivated land for mung bean was 0.31 hectares, with land

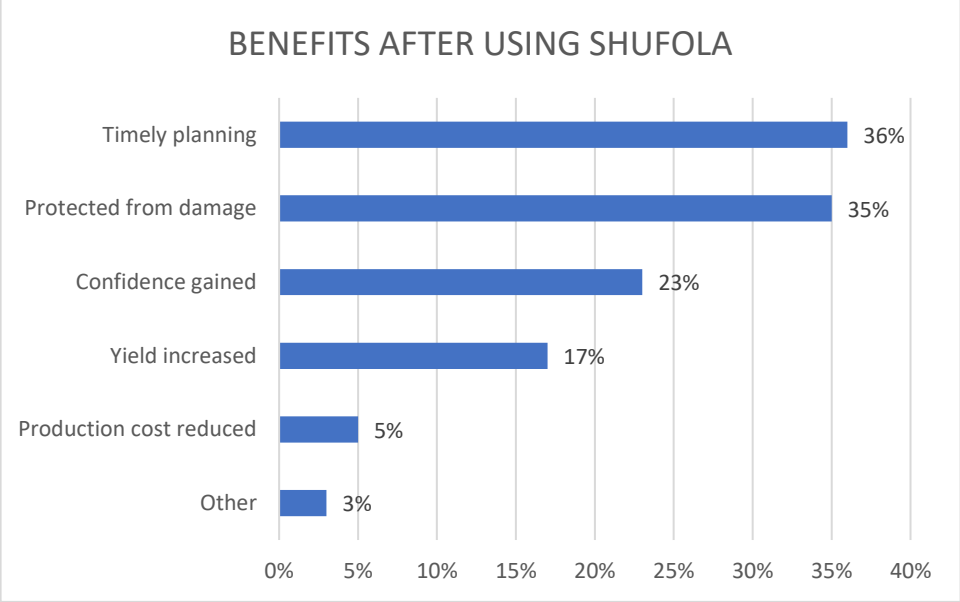


Figure 7: Benefits After Using SHUFOLA

size cultivated by youths (0.23 hectares) significantly smaller than land size cultivated by adults (0.32 hectares). No deviation was found regarding gender. Production costs for respondents varied from $176 USD[7] to $278 USD per hectare, with average production costs of $228 USD per hectare (6% less than

[7] 1 USD=85 Tk.

the previous year). Considering gender and age, male-youth farmers reported higher production costs of $278 USD per hectare, while female-youths and female-adults reported significantly lower production costs at $196 USD and $176 USD per hectare, respectively. The variation in production cost is mostly influenced by cost of seed, with a certain number of farmers either receiving seeds from PAE free of cost or using seeds left over from the previous year.

74% of respondents reported damage to either partial or full crop harvests due to waterlogging from tidal waves (44%), heavy rainfall (33%), or pest attacks (16%). Only 26% reported being able to harvest their whole crops due to water drainage facilities at their sites. This year, most farmers were able to harvest crops only twice, while in the previous year they were able to harvest three times. Considering all these situations, respondents predicted in their KIIs that this year's production would be higher than it turned out to be. Waterlogging allowed for 0.71 mt/ha in production, down from the 0.72 mt/ha predicted during baseline data collection. It should be noted that the SHUFOLA application did not provide any precautionary suggestions that could mitigate waterlogging damage, so mung bean farmers were not able to harvest the expected amounts of crops this year, though plant growth was high.

Around 51% of respondents reported that they had yet to sell their products after harvest, while 40% of respondents reported that they had recently sold grain to their local market, and 9% reported selling to aggregators. From this analysis, the data reflected that most of the farmers were waiting for increases in market prices. At the same time, PAE had also not started to procure grain, as they were waiting for the fall of market prices.

Farmer willingness to pay for SHUFOLA services is dependent on several factors, such as whether selected crops are cultivated as commercial crops or whether they are slated for home consumption. Farmers prefer to receive an attractive return on investment which allows them to bear additional costs for services, and therefore they are more likely to pay for SHUFOLA if they are confident that the tool's advisory services will stimulate increased crop production. In the case of mung beans, many farmers primarily cultivate them as a "chance crop" for home consumption, with only the surplus mung beans being sold in local markets; therefore these farmers were less interested in paying for additional advisory services.

***Tool Owner's Perspective*:**

SHUFOLA services were delivered in an automatic manner using a configurable web platform. Farmers' information, including weather data, sowing dates, and other crop information were input into the platform. A background algorithm then generated lists of daily recommendations for farmers specifically tailored by time elapsed since sowing. These recommendations were delivered in the form of text or voice messages. According to the tool owners, the SHUFOLA web platform is "crop agnostic" and can be scaled to any part of Bangladesh or beyond.

Tool owners also suggested that the B2C approach was not viable for SHUFOLA, as farmers were not willing to pay enough to cover the cost of the service. Thus, tool owners are looking for the right private organizations to adopt SHUFOLA under the B2B approach. Under such an approach, the tool owners would preferr to work with agro-input companies and procurement companies—or those who follow appropriate contract farming methods to get better quality grain—as potential SHUFOLA users. The tool owner also emphasized that the number of targeted growers was a factor in reducing subscription fees, as subscription fees could gradually be decreased if the number of service recipients increased.

There is potential to improve the efficiency of the SHUFOLA service. For example, the tool owners could tailor advisory messages to more specifically suit local soil and climatic conditions. Advisory messages could recommend appropriate fertilizer and pesticide doses based on plant variety and include precautionary messages to save crops from waterlogging issues. Improved service delivery timing was also found to be very important in increasing service adoption.

Private Sector Perspective:

As utilized in PAE operations, SHUFOLA services reduced staff engagement costs by US $141/month during the pilot. However, the company felt that the amount in cost reduction was not sufficient to justify the subscription fees.

Since SHUFOLA combines localized weather forecasts with crop-specific management practice, based on planting date, to generate highly customized agricultural advisory in the form of actionable advice for individual smallholder farmers, ***inputting accurate sowing/planting dates for specific crops is a pre-requisite to receive accurate advisory messages***. Unfortunately, farmers are usually not able to specify exact dates of sowing/planting, and obtaining accurate planting information would likely require private enterprises to engage their staff to have in-person discussions with individual farmers. ***As a result, it may not be possible to drastically reduce these operational costs for private enterprises; this leaves a major constraint in place for procurement companies (who rely on contract farming) that are considering purchasing advisory services.***

Since crop production had increased, and early warning advisory helped farmers reduce crop damage, PAE set mung bean collection targets at 20% more than last year accordingly. Additionally, PAE recognized some additional opportunities to enhance brand awareness by sending promotional messages and special daily greetings to contract farmers along with regular service-related messages. PAE later considered offering these promotional initiatives by bundling them in SMS packages from local telecom operators as a means to increase brand awareness and private sector interest in SHUFOLA.

4 RECOMMENDATIONS

Recommendations, gathered through quantitative data analysis and qualitative discussions with relevant stakeholders, are summarized below.

4.1 PRIVATE SECTOR

- Digital literacy was much lower among adult users (only 43% of adult respondents were able to read and 36% were able to understand messages) compared to youth participants (81% of whom were able to read and 75% were able to understand messages). Addressing digital literacy must be a key consideration when designing and expanding services for adult users. Youth, on the other hand, can be targeted as potential high/early adopters of the tool, as they have higher levels of digital literacy.
- During the pilot, the highest yield increase observed was 17%[8], mainly in areas where the users did not experience any weather-related problems, such as flooding or excessive rainfall, during the season. To make the business case for SHUFOLA at its current price point, the service can be targeted to groups of farmers engaged in medium- to large-scale production who have implemented measures to mitigate effects of weather conditions such as flash flooding on their yields.
- Among the 152 women participants of the SHUFOLA pilot, around 70% adopted the service. However, once women participants started using SHUFOLA, the technical understanding and farming knowledge they gained from it empowered them within their households and communities, and they earned greater trust in their agricultural decision-making. Therefore, private sector actors can encourage further women's participation in adopting this advisory service by creating more inclusive delivery methods, such as delivery of message services in a time suitable for women users and increasing their access to mobile devices and digital literacy resources.

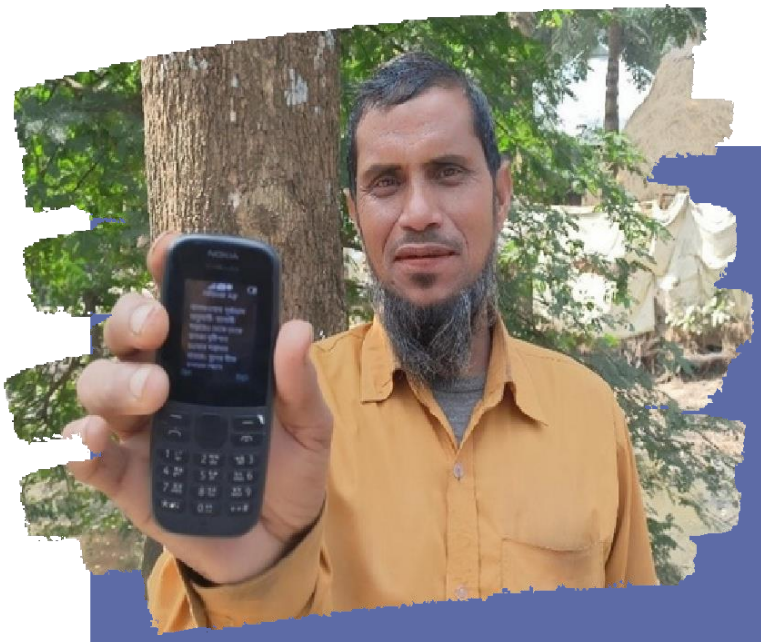
[8] A yield increase seen in around 26% pilot participants.

4.2 TOOL OWNERS

- Integrating SHUFOLA call center services in the pilot had a large impact for the farmers; it helped farmers gain confidence in the SHUFOLA service and more easily adopt specific advisory services. Therefore, the tool owner may consider adding this call center service as a regular service feature.
- The tool owner may consider SHUFOLA to be most commercially viable for agro-input companies and input companies with a large customer base. By adding promotional content to the advisory services, tool owners would be in a better position to justify the additional cost of such a service through the resultant increase in revenue.
- To make such advisory services available for both smart and feature phones, tool owners can consider SMS, IVR, and call center-based services to supplement the app-based messages. This could also attract private sector partners as these channels would mean additional ways to streamline promotional content.

ANNEX: CASE STORIES

CASE 01



Karamat Ali, a 50-year-old rural farmer from the Diar Char village was a participant of the SHUFOLA tool pilot. He cultivates rice, lentils, wheat, and several other plants. This year, he cultivated mung bean and wheat simultaneously in two crop fields, growing wheat for the first time this year on his 36 decimals of land. He received SHUFOLA weather advisory SMS and suggestions and followed all the advice provided.

For example, in April SHUFOLA sent him an alert warning him of heavy rainfall forecast for his region, allowing him to plan accordingly and harvest his wheat in advance. As a result, Ali was able to collect 6.5 pounds of quality grain which he would have otherwise lost if he had waited a few more weeks as initially planned.. His son, Imam, helped him utilize the SHUFOLA services, as Ali cannot read.

CASE 02

"After getting benefits, now they listen to my advice which I get from SHUFOLA service and give value to my opinion so that I feel empowered when my husband gives me priority"

Lima Akhter, a 24-year-old female from the Sadar *upazila*, was one of the beneficiaries of the SHUFOLA pilot. She is educated up to the secondary school level, and has lived with husband, a driver, and her in-laws for more than four years. Before her marriage, she had no experience in agriculture, but now has started helping her family with farming. As she can read and write, she has been able to receive information from SHUFOLA and provide support and information to her family regarding mung bean cultivation.

This year, her family cultivated mung bean and shifted their sowing dates based on SHUFOLA's recommendations. As a result, they experienced a better yield. Throughout the cultivation process, she received SHUFOLA weather advisory messages regularly on her phone and immediately disseminated this information to her family so that they could take immediate action.

Her family members depended on her for these messages, which made her feel more empowered as she gained experience in mung bean cultivation. She hopes to continue to receive these agricultural advisory services, and has said she is willing to pay for them.

CASE 03

Abul Bashar, a 30-year-old rural mung bean farmer from the Dinar village, participated in the SHUFOLA pilot with PAE. He has commercially cultivated mung bean since 2010. Mung bean cultivation is very much dependent on weather, and uncertainties from weather events such as drought, rainfall, tidal flow, and cyclones have significant impacts on crop cultivation. Access to information, technology, and knowledge on modern mung bean farming has been a challenge for farmers in the Barishal district, and therefore dissatisfaction with harvest has been common among farmers in this area.

Bashar usually follows traditional methods to cultivate mung bean, but this year he received SMS and voice messages from SHUFOLA during the season. As per the advice of the SHUFOLA messages, Bashar used 200 gm of inoculum (microbial) for his 4 kg of mung bean seeds on 30 decimals of land this year. He noted that the growth of the mung bean plants and pods have been noticeably better this year, with the plants looking healthier and more robust.

As his region is experiencing drought, Bashar reported that the mung bean plants in his inoculum-treated field withstood the water shortage much better than those of neighboring farmers. In terms of harvest, Bashar received 25 kg of mung bean from his 30 decimals of land. In comparison, he received only 8 kg of mung bean from another 20-decimal-size area of land where he did not use the microbial. He appreciates the value of the advice he received from SHUFOLA.