

Climate-smart agriculture adoption in remote mountain communities

Evidence from a pilot study in Chando Thalay, Gilgit-Baltistan in
Pakistan

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Climate-Smart Agriculture Adoption in Remote Mountain Communities: Evidence from a pilot study in Chando Thalay, Gilgit-Baltistan in Pakistan

Preliminary Extended Abstract

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August 31, 2026

Abstract

Climate-smart agriculture (CSA) has emerged as a key policy framework for simultaneously increasing agricultural productivity, strengthening resilience to climate change, and reducing greenhouse-gas emissions. Yet evidence on CSA adoption remains heavily concentrated in lowland farming systems, with little known about remote mountain communities. This study presents evidence from the Gilgit-Baltistan region of Pakistan, focusing on the village of Chando Thalay, located 2,400–2,900 metres above sea level and highly dependent on glacier-fed agriculture. Using soil analyses conducted in 2026, we introduce locally tailored CSA practices and collect detailed household and network data to study adoption decisions. The baseline survey reveals a substantial adoption gap: while households generally hold favourable views of CSA practices, many report that financial constraints, limited knowledge, and restricted access to land and water prevent adoption. To better understand these barriers, the project combines household surveys with incentivised behavioural games measuring risk, loss, ambiguity, and time preferences, and collective-action behaviour. A comparable non-CSA village provides a counterfactual for future evaluation. By linking behavioural measures, social networks, and subsequent adoption decisions, the project aims to provide new evidence on the determinants and impacts of CSA adoption in one of the world's most climate-vulnerable and understudied agricultural environments.

1 Introduction

Climate change is altering the conditions under which smallholder agriculture takes place. Changes in temperature, precipitation and water availability increase uncertainty over agricultural production, while floods, droughts and other extreme events threaten agricultural livelihoods and food security. These pressures can be particularly severe in remote mountain communities, where difficult terrain and geographical isolation constrain access to markets and agricultural services and where households may have limited opportunities to diversify income, insure against adverse seasons or absorb losses associated with experimentation.

Climate-smart agriculture (CSA) has emerged as an important science-led response to these challenges. The framework seeks to increase agricultural productivity and incomes, strengthen adaptation and resilience to climate change and, where feasible, reduce greenhouse-gas emissions (FAO, 2013; Lipper et al., 2014).

CSA is not a homogeneous technology or standard package of practices. Appropriate practices depend on local soils, climate, water availability, topography and cultivation systems. Practices that improve resilience or productivity in one environment may be ineffective or infeasible in another. An important challenge is therefore not simply to encourage farmers to adopt practices classified as climate-smart, but to identify which changes in agricultural practices are appropriate under highly local environmental conditions and how this research-based knowledge can be translated into farmers' decisions.

This challenge is particularly relevant in the Hindu Kush–Karakoram–Himalaya (HKH) region. Agricultural communities in the region face changing precipitation, glacier and snowmelt dynamics, floods and other climate-related hazards. At the same time, steep terrain, fragmented cultivable land, shorter growing season, high transport costs and geographical isolation may limit the applicability of agricultural recommendations developed for lowland and more market-connected farming systems.

We study whether locally tailored, research-driven agricultural recommendations can translate into changes in farming practices in Chando Thalay, a remote mountain village in the Baltistan region of Gilgit-Baltistan, Pakistan. Cultivation takes place between 2,400 and 2,900 metres above sea level and depends heavily on glacier-fed irrigation. Farmers have traditionally relied primarily on accumulated local experience, and systematic soil testing has not previously been used to generate locally tailored agricultural recommendations in this community.

The pilot therefore began with a scientific diagnosis of local agricultural conditions. Soil samples collected in December 2025 were analysed to identify local soil characteristics and provide an agronomic basis for recommendations aimed at improving soil quality, agricultural productivity and resilience.

Generating best-practice advice is only one part of the adoption process. Scientific information can affect agricultural outcomes only if farmers receive it, understand it and ultimately act upon it. This distinction is especially important where unfamiliar practices involve uncertainty about their local performance and where financial, land, water or other constraints may prevent farmers from implementing practices they otherwise consider desirable.

Providing intensive professional extension services to every farmer is also potentially costly in small and geographically isolated communities. The pilot therefore combines professional agricultural training for a subset of farmers with opportunities for farmer-to-farmer transmission. Trained farmers can provide information to other households, while implementation of

recommended practices under the same local environmental conditions can generate observable evidence about their feasibility and returns. Detailed information on personal relationships, professional agricultural-advice networks, and neighboring plot layouts allows us to study the channels through which such information may diffuse. Social networks are therefore an integral part of the intervention.

While baseline survey prior to the training helped us identify local agricultural, a second survey was conducted in August 2026, after all training sessions were finalised. It included incentivised behavioural tasks and repeated social-network measurement, allowing us to compare knowledge and adoption intentions across farmers with different exposure to the training and to farmer-to-farmer information.

Three findings stand out. First, there is a pronounced gap between current practices and stated interest in CSA. Several traditional practices—including heavy reliance on animal manure, seed saving, manual irrigation and inappropriate crop rotation are widespread, whereas composting, greenhouse and tunnel farming, solar drying, mulching and climate-resilient seeds were rarely used at baseline. Yet respondents generally expressed favourable views of CSA technologies and very few rejected them outright.

Second, this adoption gap is accompanied by substantial perceived constraints. For greenhouse farming, tunnel farming, solar drying and new CSA crops, more than four-fifths of respondents reported that they would consider adoption but faced barriers. Financial resources were the most frequently reported constraint, followed by lack of knowledge. The baseline evidence therefore suggests that low adoption in this setting should not automatically be interpreted as lack of demand for agricultural innovation.

Third, early post-training evidence points to the potential importance of information transmission. Farmers directly exposed to professional training report substantially greater knowledge of newly introduced practices and stronger intentions to adopt them. Farmers who report learning from trained farmers also display higher knowledge of several practices. Because exposure to training and farmer-to-farmer information was not randomly assigned, these differences cannot be interpreted as causal effects. They nevertheless provide descriptive evidence consistent with the information and diffusion mechanisms motivating the pilot.

The study contributes to the literature in three related ways. First, it examines agricultural adoption in an unusually remote mountain environment in which local agronomic conditions may be especially important. Second, it focuses on the adoption of recommendations derived from scientific diagnosis of local agricultural conditions rather than the diffusion of a uniform technology derived from experiments conducted elsewhere. Third, it combines direct professional training with detailed social-network measurement, allowing the project to follow how scientific agricultural knowledge may move from professional extension to selected farmers and subsequently through the wider community.

The pilot has important limitations. With one principal intervention village (and if we are successful in obtaining additional funding, one comparison village to be added beyond the life of this SPF), we cannot provide causal identification and our findings are therefore based on descriptive and diagnostic analysis. Our objective is to establish the feasibility and potential of a research-driven, locally tailored model of agricultural extension and to document how recommendations are received and adopted, identify the mechanisms that facilitate or impede adoption, and measure whether knowledge provided to trained farmers diffuses through village networks. These findings will hopefully provide the basis for a larger evaluation across multiple

communities in Gilgit-Baltistan and the wider Hindu Kush–Karakoram–Himalaya region.

2 Literature

A central premise of climate-smart agriculture is that appropriate agricultural responses to climate change are context-specific. Differences in soils, water availability, climate, topography and existing production systems affect both the feasibility and the returns to individual practices (Lipper et al., 2014; Campbell et al., 2014). Empirical evidence finds substantial heterogeneity in the effects of CSA and related sustainable agricultural practices. Tesfaye et al. (2021), for example, find that minimum tillage, cereal-legume intercropping and their combination can reduce rural poverty in Ethiopia, with particularly important effects in rainfall-stressed areas. In Pakistan, Shahzad and Abdulai (2021) find positive but heterogeneous welfare effects of CSA adoption on food and nutrition security and poverty. Such heterogeneity is particularly relevant in mountain agriculture, where cultivable land, soil conditions, water access and microclimates can vary substantially from valley to valley as well as from areas located in lower altitudes. Previous research documents the use of some climate-smart agricultural practices in northern Pakistan, including improved irrigation, crop rotation, manure application, agroforestry and climate-resilient crop varieties (Zulfiqar et al., 2024). However, this evidence does not follow scientific diagnosis of local soil conditions which can substantially differ from valley to valley and region to region and therefore does not generate tailored recommendations for individual mountain communities or how farmers respond to such recommendations.

Identifying an agronomically appropriate practice does not guarantee its adoption. Suri (2011) shows that persistent non-adoption of agricultural technologies can be explained by heterogeneity in returns and adoption costs. Financial and risk constraints can further prevent farmers from undertaking investments they would otherwise value. Karlan et al. (2014), for example, show experimentally that relaxing risk constraints substantially increases agricultural investment. Non-adoption can therefore reflect several economically distinct channels: low household-specific expected returns, inability to finance adoption, exposure to uninsured risk, insufficient information, or uncertainty about how a recommendation will perform under the farmer’s own conditions. This distinction is important when studying the adoption of new agricultural practices: favourable beliefs or intentions need not translate into realised adoption.

Information is especially important when farmers have limited prior experience with a recommended practice. Foster and Rosenzweig (1995) provide foundational evidence that farmers learn about new agricultural technologies through both their own and their neighbours’ experience. Conley and Udry (2010) similarly show that pineapple farmers in Ghana adjust input decisions in response to outcomes experienced by farmers in their information networks. Information obtained through local experience can be particularly valuable because it provides evidence about performance under conditions similar to those faced by the farmer making the adoption decision. Scientific recommendations and local demonstration can therefore provide complementary forms of information.

This distinction is related to the difference between risk and ambiguity. Risk describes decisions for which outcome probabilities are known or can be reasonably estimated, whereas under ambiguity the probability distribution itself is uncertain (Ellsberg, 1961; Klibanoff et al., 2005). Farmers considering practices without a local history may be uncertain not simply about realised returns but about the distribution from which those returns will arise. Engle-

Warnick et al. (2007) find that ambiguity aversion predicts agricultural technology choices among farmers in Peru, while Alpizar et al. (2011) show that ambiguous environmental risks affect climate-adaptation decisions among Costa Rican farmers. Locally observable implementation may consequently affect adoption not only by providing additional technical knowledge but also by reducing uncertainty about whether recommendations apply under local conditions.

How such information reaches farmers is a separate question. Professional agricultural extension can transmit scientific knowledge directly, but it is costly, particularly in geographically isolated areas. Training selected farmers and relying partly on farmer-to-farmer communication offers a potentially less resource-intensive alternative, but its effectiveness depends on whether information actually diffuses beyond those receiving direct training. BenYishay and Mobarak (2019) show that peer farmers can be effective communicators of agricultural technologies and that incentives and the identity of information providers affect diffusion. Other experimental evidence similarly shows that farmer-to-farmer extension can increase agricultural knowledge and adoption among households not directly reached by formal extension, although such spillovers are not universal. The extent of indirect diffusion is therefore an empirical outcome rather than something that can be assumed when evaluating targeted agricultural training.

Social networks determine both opportunities for such diffusion and the sources from which farmers obtain information. Bandiera and Rasul (2006) show that adoption of a new crop in Mozambique is related to adoption among family and friends, with a non-linear relationship consistent with social learning as well as incentives to delay adoption. Conley and Udry (2010) demonstrate more directly that information transmitted through agricultural communication networks affects farmers' production decisions. BenYishay and Mobarak (2019) further show that locally relevant peer communicators can influence technology diffusion. More recent experimental evidence suggests that the network position of initially informed farmers can itself affect aggregate diffusion: Beaman et al. (2021) find that targeting farmers according to their network position can substantially increase agricultural technology adoption. Learning from trained farmers may be particularly important because research-based recommendations initially provide information about what should work, whereas local implementation provides evidence about what does work under village conditions. Agricultural technologies and practices that have not previously been used locally involve substantial uncertainty. However, farmers can learn from their own experimentation and from the experiences of others (Foster and Rosenzweig (1995); Conley and Udry (2010)), and agricultural information can diffuse through family, friendship and advice networks (Bandiera and Rasul (2006); BenYishay and Mobarak (2019)). Demonstration by locally known farmers may therefore complement scientific recommendations by transforming technical advice into observable local evidence.

Different network relationships may capture different channels of learning. Agricultural advice networks facilitate technical information exchange, personal networks may support informal learning, while neighbouring plots allow farmers to observe practices directly. We collected information about all three types of social networks so that we can look closer to the roles these networks play. Repeated network data also allow us to examine whether trained farmers become more important sources of agricultural advice as new knowledge is introduced.

Responses to the same information may also vary with individual characteristics. Risk, loss and ambiguity preferences may influence willingness to experiment with unfamiliar practices, while cooperative preferences may matter where agricultural practices involve shared resources or environmental spillovers (Ostrom, 1990, 2000; Fehr and Gächter, 2000; Fischbacher and

Gachter, 2010). Cognitive performance may additionally affect farmers’ ability to process technical information and plan implementation, particularly under financial scarcity (Mani et al., 2013). These behavioural measures therefore help explain heterogeneity in how farmers respond to the same recommendations and opportunities for social learning.

Our study brings these strands of literature together by examining the adoption of research-driven agricultural recommendations tailored to local soil conditions. We follow farmers from the scientific diagnosis and provision of recommendations through targeted training, local demonstration and subsequent adoption, while using detailed social-network data to trace how knowledge and experience diffuse to farmers who are not directly trained. This allows us to study not only whether locally tailored recommendations are adopted, but also why adoption differs across farmers and whether farmer-to-farmer learning can extend the reach of professional agricultural extension in remote mountain communities.

3 Data and descriptive baseline evidence

3.1 Study setting

The setting of this study differs substantially from the environments examined in most existing CSA research. Chando Thalay is a small mountain village located approximately 2,400–2,900 metres above sea level in Ghanche District, Baltistan. Cultivation depends heavily on glacier-fed irrigation systems and is constrained by steep terrain, short growing seasons, limited market access and significant transportation costs. Climatic conditions are highly variable and increasingly affected by glacier retreat, changing precipitation patterns and extreme weather events. These characteristics imply that both the profitability and feasibility of CSA practices may differ markedly from those observed in lowland farming systems. They also create an environment in which local information, trust, and community cooperation may be particularly important for the adoption of unfamiliar agricultural practices.

3.2 Soil testing, CSA training and project timeline

The pilot began with a project orientation workshop and the recruitment of 34 farmers from a population of approximately 160 households. This was led by agricultural experts from the Department of Agriculture Skardu, and held in Chando Thalay in December 2025. Logistics were arranged by the Mountain and Glacier Protection Organisation and the Village Committee. 50 soil samples were collected at different depth levels from farms belonging to the 34 farmers and taken to the Soil Testing Laboratory in Skardu for analysis.

The timeline of the project is shown in Table 1.

The 34 farmers were provided seven full-day sessions between April and August 2026. In all sessions, farmers received both theoretical information and hands-on demonstrations covering soil health and fertility management, balanced use of organic and chemical fertilizers, crop diversification (e.g., introduction of tomatoes), inter-cropping and crop rotation, the introduction of buckwheat as a secondary crop, efficient irrigation, preparation of organic Bokashi fertilizer, soil and water conservation, solar drying, grafting and budding, and other topics.

These recommendations were closely linked to issues identified through the agronomic assessment. A greenhouse and three solar dryers were also installed on communal land to provide opportunities for practical learning and shared use.

Table 1: Project timeline

Period	Activity
December 2025	Introductory workshop and soil sampling
April 2026	Soil testing and agronomic assessment, and identification of locally appropriate CSA practices. One-day introductory workshop on CSA practices, fertiliser use and soil health management.
May 2026	Baseline household survey and network mapping
April – August 2026	Seven intensive training sessions for 34 selected farmers. Theoretical sessions combined with practical demonstrations. Session 1: Introduction to CSA practices and soil health management. Session 2: Crop diversification and efficiency of irrigation, grafting and budding. Session 3: Plant propagation and crop productivity; Bokashi fertilizer. Session 4: Sustainable agricultural activities. Session 5: Greenhouse cultivation techniques. Session 6: Vertical farming technology; pruning techniques. Session 7: Fruit processing techniques with solar dryers.
August 2026	Survey and Behavioural games (public-good game, elicitation of incentivized risk, loss and ambiguity preferences, cognitive-bandwidth measures).
Next plans	Further plans (if further funding is approved):
September–October 2026	Analysis of two surveys and behavioural data; preparation of village-specific CSA recommendations. If further funding, data collection in Burdas village.
March–April 2027	Further training of selected farmers; data collection on csa adoption.
August 2027	Follow-up survey: perceptions, intentions, network evolution and realised adoption.
March–April 2028	Additional follow-up survey and repeated behavioural measures.
August 2028	Final follow-up survey and measurement of medium-run adoption outcomes. Repeated soil tests. Data on yields.

The model therefore combines two forms of information. Scientific assessment provides locally grounded recommendations, while professional training and local demonstration translate these recommendations into practices farmers can observe and potentially implement.

To see potential immediate changes associated with training participation and to complement the baseline survey with additional questions as well as elicitation of respondents' risk, loss, ambiguity aversion and their free-riding tendencies, we conducted our second survey after all training sessions were finalized.

3.2.1 Soil analysis and recommendations

Soil analysis and agronomic assessment were carried out in Spring 2026, once local weather conditions became conducive to renewed cultivation. Recommendations aimed at improving soil health, productivity and resilience were derived from the results of this analysis.

Of the 50 soil samples 22 were found to be loamy and 28 to be sandy loam. pH content and electrical conductivity were reported to be in the normal range but there were generally low levels of nutrients: Organic Matter, Nitrogen, Phosphorus and Potassium.

The weak nutrient profile was attributed to over-irrigation, inappropriate application of fertiliser and poor cultivation practices. Low levels of Organic Matter also weakened water retention by the soil.

Recommendations for restoring soil health were multi-pronged. (i) add two tons of well-rotted animal manure per kanal every year,

(ii) grow buckwheat and/or red beans as second crops for their soil regenerative properties;

(iii) practice crop rotation at least once every two years

(iv) increase the gap between irrigation intervals or irrigate more lightly.

(v) specific recommendations for chemical fertiliser use were made depending on crop and fertiliser type.

(vi) the use of Bukashi fertiliser (a plant-based compost) was encouraged and its method of preparation was covered in the training

3.3 Baseline survey

The study population comprises approximately 161 households (as uncovered by our surveys). The May baseline analysis currently uses 139 cleaned household observations¹, while the August survey covers 161 respondents. The survey records household demographics, education, sources of income, farming practices, crop losses, perceptions of CSA options, adoption intentions, reported constraints, risk attitudes, food-security expectations, migration intentions and social network information. Table 2 describes the baseline socioeconomic profile.

Respondents were on average 44 years old, 46% were female, and 94% were married. Educational attainment was low: 56% reported having no formal education, while 17% and 14% respectively had primary and secondary education.

Households were predominantly smallholder farmers and appeared to face substantial economic constraints. Average annual household income was approximately PKR 629,000, compared with expenditures of PKR 591,000, although both variables exhibited considerable dispersion. Households maintained substantial links outside the village: approximately two family

¹The remaining responses are under review to clarify network information

members per household lived elsewhere on average, and, among 95 households with family members living outside of Chando Thalay, 33% received remittances while 21% sent remittances out of Chando Thalay last year.

Average landholding was approximately 3 units (or *kanals*), with 53% of households holding two units or less and 71% three units or less.²

Agricultural production was concentrated in barley and potatoes, each grown by 96% of households, followed by vegetables (73%) and fruit (60%). The baseline agricultural data show reliance on traditional practices: 89% used animal manure, 88% saved seeds, 75% used manual irrigation. 69% reported practicing crop rotation although according to Department of Agriculture experts this practice is not widely used in the village and should be encouraged to improve soil fertility.

By contrast, adoption of more recent agricultural technologies was very limited, including composting (2%), greenhouses (1%), tunnel farming (1%), solar drying (6%), and CSA seeds (1%). For summary, see Table 11 in Appendix. This provides a useful starting point for studying adoption because several CSA-relevant options are known to households as possibilities for adoption but are not yet widely practiced.

Households also reported substantial agricultural vulnerability and pessimism about the future of farming (see Table 2 and Appendix Table 12). Approximately 68% had experienced crop losses, with an average reported loss of around PKR 64,000 among affected households. Nearly four-fifths of respondents expected farming to become somewhat or much more difficult in the future. Expectations regarding household food sufficiency were similarly pessimistic: 57% reported that they would definitely not be able to meet their household's food requirements, while a further 11% expected that they would probably not be able to do so.

Perceptions of CSA technologies were generally positive (Table 3). Between 54% and 69% of respondents believed that the proposed technologies could increase yields, 59–62% believed that they could reduce costs, and 42–57% associated them with more sustainable farming. At the same time, approximately 28–31% reported that they did not know enough to assess the technologies, indicating substantial uncertainty and scope for information provision.

Stated willingness to adopt reveals a particularly pronounced gap between favourable perceptions and perceived ability to adopt (Table 4). Only 11–14% of respondents reported being able to adopt greenhouses, tunnel farming, solar drying, or CSA crops without qualification. However, outright rejection was rare, at only 3–4%. Instead, 81–84% indicated that they would consider adoption but faced barriers. Among these respondents, lack of financial resources was by far the most commonly reported constraint (85–88%), and lack of knowledge came as a not insignificant second (at 64–71%). Constraints arising from availability of land or water were reported by 21–29%, while lack of labour or time was substantially less common (Table 5). Almost no respondents identified the technologies as too risky.

These patterns directly motivate the design of our intervention. In particular, the prominence of informational constraints, combined with generally favourable perceptions of CSA technologies, suggests that relatively low-cost interventions that improve farmers' knowledge and provide opportunities for practical learning may help translate interest into adoption.

²This is significantly less compared to the national average. According to the 7th Agricultural census (2024), around 26% farmers in Pakistan owned even less than 8 kanals (i.e., one acre) which puts Chando Thalay at the very bottom of land ownership distribution. The national average of the size of cultivated farm size is 4.2 acres, or 33.6 kanals.

That was the main motivation behind combining household-level soil testing, which provides farmers with information on soil quality and appropriate methods for improving it, with practical training in sustainable farming techniques. Importantly, the core components of the intervention – soil testing and farmer training – are relatively inexpensive and potentially scalable, while the communal infrastructure provides an opportunity for knowledge and practices to diffuse beyond directly trained farmers through village social networks.

Overall, the baseline portrays a population of economically constrained smallholder farmers facing substantial agricultural uncertainty, but holding broadly favourable attitudes towards climate-smart agricultural technologies. The low baseline adoption of these technologies therefore appears to reflect constraints on farmers’ capacity to adopt—particularly financial and informational constraints—rather than widespread resistance to the technologies themselves.

Table 2: Family and Household Characteristics

Variable	Obs	Mean	Std. dev.	Min	Max
Age	139	43.597	13.923	0	84
Female	139	0.460	0.500	0	1
Married	139	0.942	0.234	0	1
Family size	139	6.835	8.287	2	16
Girls < 14	139	0.993	1.039	0	5
Boys < 14	139	0.964	1.151	0	7
No education	139	0.561	0.498	0	1
Primary	139	0.165	0.372	0	1
Secondary	139	0.144	0.352	0	1
Tertiary	139	0	0	0	0
Income	139	628893.7	517152.4	0	4380000
Expenditures	139	591008.4	482228.9	0	4800000
Family out	139	1.899	4.239	0	40
Outremit	139	0.144	0.352	0	1
Outremit Rs	20	55750	79674.92	0	300000
Inremit	139	0.223	0.418	0	1
Inremit Rs	31	384225.8	1714695	0	9600000
Crop loss	139	0.676	0.469	0	1
Crop loss Rs	94	64226.06	85186.04	500	500000
Family land	137	3.031	2.230	0	10

Table 3: Perceptions of CSA options

CSA option	Increases yields	Reduces costs	More sustainable	Do not know	Disagree
Greenhouse	69.1	60.4	56.1	28.1	1.4
Tunnel farming	66.2	61.9	54.7	29.5	1.4
Solar drying	53.9	58.9	41.7	30.9	1.4
New CSA crops	62.6	58.9	56.8	29.5	2.2

Notes: Respondents were asked to select statements they agree with regarding CSA options. Entries are percentages of households selecting each perception. The question is multi-select; row percentages do not sum to 100. Disagree shows percentage of respondents who disagreed with any of the statements.

Table 4: Adoption intentions by CSA option

CSA option	Will adopt	May adopt	Barriers	Do not want
Greenhouse	10.8	1.4	84.2	3.6
Tunnel farming	10.8	1.4	83.5	4.3
Solar drying	11.5	1.4	84.2	2.9
New CSA crops	13.7	2.9	80.6	2.9

Notes: Entries are percentages of all households. The table separates households that do not want to adopt from households that would like to adopt but report a constraint.

Table 5: Barriers by CSA option

CSA option	Constrained N	Money	Land/water	Knowledge	Time/labour	Too risky	Other
Greenhouse	117	88.0	26.5	65.8	12.8	0.0	0.9
Tunnel farming	116	87.9	29.3	63.8	11.2	0.0	0.9
Solar drying	117	84.6	20.5	68.4	12.8	0.9	0.9
New CSA crops	112	87.5	21.4	70.5	11.6	0.0	0.9

Notes: The N column reports the number of households who would like to adopt csa practices but were constrained for that option.

3.4 Follow-up survey in August 2026

The purpose of the survey conducted in August (with 161 participants) was to a) complement information collected in the baseline survey about farming practices and farmers' attitudes, b) collect information directly relevant to the content studied during the CSA training session, in order to see if trained farmers have internalised the knowledge and also to see if there are potential spillover effects on other farmers, c) to understand households' well-being and fears, and to elicit respondents' risk, loss, and ambiguity preferences, and their cooperation tendencies, using incentivized behavioural games. Survey measures before and after training also allow us to describe changes in people's attitudes, preferences and knowledge about available CSA practices.

Attitudes towards CSA were generally favourable (Table 6). Approximately 77% of respondents agreed or strongly agreed that introducing CSA practices on their farms was important. When explicitly asked whether they would like to adopt one or more new CSA practices (assuming financial resources are not a constraint), 88% responded yes and a further 11% responded maybe; only one respondent rejected adoption. These responses reinforce the baseline finding that low adoption should not be interpreted as a lack of interest in CSA.

We also asked the respondents about their current ability to finance CSA adoption, 79% reported having sufficient resources, 11% were uncertain, and 10% reported insufficient resources. Among the latter two groups, willingness to borrow was relatively limited: 28% were willing to borrow, 22% were uncertain, and 50% were unwilling. The main reasons or concerns deterring respondents from borrowing were high interest costs, believed repayment difficulties, the burden of debt were prominent among those unwilling to borrow. Where borrowing was considered, informal social networks were important potential sources of finance, particularly family members and neighbours. This is in line with respondents' high level of trust in community (rather than outside institutions such as national or local government).

Respondents perceived their existing soil conditions as particularly poor: 84% reported that crops would grow very poorly on their main field without fertilizer or manure, and a further 9% reported that they would grow poorly (Appendix table 15). Consistent with this, fertilizer

use was widespread, with 83% using animal manure and 47% chemical fertilizers, while 26% reported using compost. It is worth pointing out the increase in usage of compost from 2% in May to 26% in August. Natural fertilizers remained very uncommon, however, at around 2%.

Environmental attitudes reveal a more nuanced pattern. While 65% agreed that maximizing agricultural productivity was more important than protecting the environment, 71% also agreed that protecting the environment was important even if this entailed higher costs or lower agricultural revenues. This suggests that respondents value both agricultural productivity and environmental protection, rather than necessarily viewing the two objectives as substitutes.

Table 6: CSA importance and intentions to adopt

Variable	Category	N	Percent
CSA importance	(Strongly) Disagree	25	15.6
CSA importance	Neutral	12	7.5
CSA importance	(Strongly) Agree	123	76.9
Intention to adopt CSA	No	1	0.6
Intention to adopt CSA	Maybe	18	11.3
Intention to adopt CSA	Yes	141	88.1

Notes: Importance is measured in survey question "To what extent do you agree with the statement: In my opinion, introducing CSA practices in my farming is important." Initially, we collected responses on 5-likert scale but the respondents had hard time distinguishing between strongly (dis)agree and agree and to increase precision, we used 3-likert scale in the end. Intentions to adopt are measured by question "If financial resources are not an issue, would you like to adopt one or more new CSA practices? Select one option."

Survey responses also suggest an interesting distinction between exposure to agricultural hazards and willingness to take agricultural risks. Respondents reported substantial concern about environmental and agricultural threats, including cloudbursts, floods, landslides, temperature changes, droughts, pests and plant diseases (Appendix table 17). Nevertheless, average self-reported willingness to take risks in farming was high. The average response was 4.48 on a five-point scale in August, where higher values indicate greater willingness to take agricultural risks. Exposure to substantial environmental uncertainty therefore does not appear to be accompanied by a general stated reluctance to take risks in farming.

Trust is strongly concentrated at the local level (Appendix Table 13. Average trust in the community (4.48 out of five) and the Department of Agriculture (4.43) was substantially higher than trust in either national (2.43) or local government (2.58). Together with the reported sources of information about Bokashi, this pattern highlights the potential importance of trusted agricultural institutions and farmer-to-farmer networks as channels through which information about new agricultural practices can diffuse.

Finally, the well-being measures reveal substantial heterogeneity within the community (Appendix Table 16). While 54% of respondents placed themselves on the highest step of the five-point life ladder, representing the best possible life, almost one in five (19%) placed themselves on the lowest step, representing the worst possible life. This suggests that favourable average levels of reported well-being coexist with a sizeable group experiencing very low life satisfaction.

A similar, although less pronounced, pattern emerges when asked about recent well-being: 69% agreed that they had felt happy and in good spirits during the previous two weeks, while 23% were neutral and 8% disagreed. The results therefore point to considerable differences in well-being within the village and, importantly, identify a non-negligible group of households reporting low subjective well-being despite generally positive responses in the wider sample.

3.5 Descriptive evidence on the effect of CSA training

While we wait confirmation of the official attendance, in the second survey conducted in August 2026 we asked the respondents whether they received CSA training either directly from the Department of Agriculture or from trained farmers. We will use these two variables to see descriptively whether the (in)direct training is associated with differences in various outcome variables.

In the August survey, we also included three questions that tested awareness of certain key recommendations derived from soil tests that were communicated as part of the training. First, we asked respondents about their knowledge of Bokashi fertiliser and willingness to adopt it in the next cropping season. The Department of Agriculture experts tell us that prior to their dissemination there would have been no previous knowledge or usage of this particular type of fertilizer in the village. Second, we asked about respondents' knowledge of and willingness to adopt buckwheat as the secondary crop to promote inter-cropping. And third, we asked about respondents' knowledge of grafting and budding, techniques for increasing crop variety and quality that were also taught during the training sessions.

Approximately 61% of respondents were aware of Bokashi fertilizer (which was not known in the region before). And 85% of all respondents planned to use Bokashi in the following season, with only 4% reporting that they did not intend to do so. Knowledge of grafting and budding was also relatively widespread, with 56% reporting familiarity with these techniques.

Respondents also held generally favourable beliefs about the introduction of buckwheat as a secondary crop. Around 64% believed that buckwheat would improve soil quality, 71% that it would permit more productive use of land during crop rotation, and 67% that its relatively high market price could make its cultivation profitable.

Nevertheless, respondents also identified potential economic trade-offs: 38% were concerned that the role of middlemen would prevent farmers from receiving a fair price and 41% believed that growing buckwheat could reduce the availability of fodder for livestock. Thus, farmers appear to recognize both the agronomic benefits and the opportunity costs associated with introducing a new crop. From the policy perspective, these are important indications of what needs to be addressed before buckwheat is widely used as a secondary crop.

To go one step further, we ask how much do the responses about knowledge and intentions to adopt between farmers who finished the official CSA training and those who did not attend the official training but reported that they learned from the trained farmers.

We first check the selection of farmers into training (Table 7). Farmers selected for training are very similar in many aspects to the ones not selected for training, including income, gender, age, risk and time preferences, size of owned land and many attitudes to csa practices. Based on our discussion with MGPO and local committee, the main criterion for the selection was their network position, which we cannot evaluate at this point and we will come back to that once social network data is finalised.

Table 8 shows the difference in knowledge and intention to adopt Bokashi fertiliser or budding in the next cultivation season as well as differences in CSA importance and intended adoption. The descriptive results show clear differences in knowledge and intentions across farmers with different exposure to training. Compared with farmers who received neither official training nor information from trained farmers, those who attended training provided directly by the agricultural department report significantly greater knowledge of both Bokashi and budding, as

Table 7: Balance / Summary Statistics

Variable	CSA participation (Department)			CSA participation (Farmer2Farmer)		
	No training	Training	p-value	No training	Training	p-value
Age	44.169 (1.468)	42.580 (2.000)	0.521	43.959 (1.277)	41.167 (3.105)	0.429
Female	0.461 (0.053)	0.460 (0.071)	0.994	0.479 (0.046)	0.333 (0.114)	0.249
Household income	650800.101 (59648.600)	589900.320 (60349.266)	0.507	636952.273 (48225.116)	574722.222 (100299.154)	0.636
Expenditures	626028.809 (60181.705)	528672.000 (37370.157)	0.255	583045.983 (44593.995)	644533.333 (101574.285)	0.616
Family members (N)	6.461 (0.252)	7.500 (1.911)	0.480	6.909 (0.804)	6.333 (0.518)	0.784
Impatient	0.831 (0.040)	0.860 (0.050)	0.661	0.835 (0.034)	0.889 (0.076)	0.560
Present bias	0.045 (0.022)	0.060 (0.034)	0.699	0.058 (0.021)	0.000 (0.000)	0.298
TP Inconsistent	0.045 (0.022)	0.020 (0.020)	0.452	0.041 (0.018)	0.000 (0.000)	0.383
Patient	0.079 (0.029)	0.060 (0.034)	0.686	0.066 (0.023)	0.111 (0.076)	0.494
Land ownership	2.865 (0.239)	3.320 (0.315)	0.252	3.088 (0.204)	2.653 (0.537)	0.442
Experienced crop loss	0.618 (0.052)	0.780 (0.059)	0.051	0.686 (0.042)	0.611 (0.118)	0.530
Crop loss (in Rs)	71009.091 (11363.022)	54660.256 (13874.536)	0.362	63460.843 (8942.417)	70000.000 (34404.017)	0.812
Farming outlook	0.163 (0.036)	0.246 (0.058)	0.209	0.221 (0.035)	0.000 (0.000)	0.016
Food requirements met	0.192 (0.039)	0.263 (0.059)	0.300	0.236 (0.036)	0.095 (0.066)	0.147
Consider leaving CT	0.058 (0.023)	0.070 (0.034)	0.755	0.064 (0.021)	0.048 (0.048)	0.770
No formal education	0.573 (0.053)	0.540 (0.071)	0.709	0.595 (0.045)	0.333 (0.114)	0.037
Primary education	0.146 (0.038)	0.200 (0.057)	0.415	0.157 (0.033)	0.222 (0.101)	0.491
Secondary education	0.180 (0.041)	0.080 (0.039)	0.109	0.132 (0.031)	0.222 (0.101)	0.314
Risk aversion	3.640 (0.153)	3.720 (0.234)	0.768	3.678 (0.139)	3.611 (0.344)	0.863
Greenhouse adopt: Yes	0.146 (0.038)	0.040 (0.028)	0.054	0.107 (0.028)	0.111 (0.076)	0.963
Greenhouse adopt: No	0.045 (0.022)	0.020 (0.020)	0.452	0.025 (0.014)	0.111 (0.076)	0.067
Greenhouse adopt: Barrier	0.798 (0.043)	0.920 (0.039)	0.059	0.851 (0.032)	0.778 (0.101)	0.429
Greenhouse adopt: Maybe	0.011 (0.011)	0.020 (0.020)	0.680	0.017 (0.012)	0.000 (0.000)	0.586
TunFarming adopt: Yes	0.124 (0.035)	0.080 (0.039)	0.430	0.107 (0.028)	0.111 (0.076)	0.963
TunFarming adopt: No	0.045 (0.022)	0.040 (0.028)	0.892	0.033 (0.016)	0.111 (0.076)	0.130
TunFarming adopt: Barrier	0.809 (0.042)	0.880 (0.046)	0.283	0.843 (0.033)	0.778 (0.101)	0.491
TunFarming adopt: Maybe	0.022 (0.016)	0.000 (0.000)	0.289	0.017 (0.012)	0.000 (0.000)	0.586
Solar drying adopt: Yes	0.124 (0.035)	0.100 (0.043)	0.678	0.116 (0.029)	0.111 (0.076)	0.955
Solar drying adopt: Barrier	0.045 (0.022)	0.000 (0.000)	0.130	0.017 (0.012)	0.111 (0.076)	0.025
Solar drying adopt: Maybe	0.809 (0.042)	0.900 (0.043)	0.161	0.851 (0.032)	0.778 (0.101)	0.429
Solar drying adopt: No	0.022 (0.016)	0.000 (0.000)	0.289	0.017 (0.012)	0.000 (0.000)	0.586
CSA crops adopt: Yes	0.157 (0.039)	0.100 (0.043)	0.349	0.124 (0.030)	0.222 (0.101)	0.261
CSA crops adopt: No	0.034 (0.019)	0.020 (0.020)	0.646	0.017 (0.012)	0.111 (0.076)	0.025
CSA crops adopt: Barrier	0.764 (0.045)	0.880 (0.046)	0.099	0.835 (0.034)	0.611 (0.118)	0.025
CSA crops adopt: Maybe	0.045 (0.022)	0.000 (0.000)	0.130	0.025 (0.014)	0.056 (0.056)	0.470
N	104	57		140	21	

Note: Standard errors are reported in parentheses next to the corresponding means. TunFarming stands for tunnel farming.

well as stronger intentions to adopt both practices.

Farmers who received information from trained farmers also report significantly greater Bokashi and budding knowledge, although the difference in budding intention is smaller and not statistically significant. For CSA more broadly, neither direct training nor information from trained farmers is associated with significantly higher perceived importance of CSA. This could be because due to ceiling effect as the overall average importance is 4.386 out of 5.

However, intentions to adopt CSA are higher among both groups, with the association particularly strong for farmers who received information from trained farmers. Overall, these patterns are consistent with knowledge and intentions being higher among farmers exposed to the official training and indication of spillover effects through trained farmers to untrained farmers. The descriptive comparisons should not be interpreted as causal effects of training or information diffusion.

Table 8: Differences in knowledge and intentions by training

	Bokashi		Budding		CSA	
	Knowledge	Intention	Knowledge	Intention	Importance	Intention
Direct training from the department	0.678*** (0.069)	0.353*** (0.097)	0.456*** (0.082)	0.268*** (0.097)	0.305 (0.257)	0.145** (0.065)
Training from trained farmers	0.639*** (0.081)	0.342*** (0.088)	0.237** (0.096)	0.122 (0.098)	0.310 (0.301)	0.252*** (0.069)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.215 (0.349)	1.784*** (0.590)	-0.514 (0.431)	1.007 (0.626)	4.386*** (1.663)	2.010*** (0.413)
Observations	136	136	136	136	136	136

Notes: Robust standard errors in parentheses. Other controls included respondents income, expenditures, time, risk, loss, and ambiguity preferences, fears, well-being measures, opinion on soil quality. Results remain very similar if we account also for age, gender, and education. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4 Behavioural games and social networks

The August survey complements the household data with incentivised behavioural measures of general risk, loss and ambiguity preferences, cooperative behaviour and cognitive performance.

These measures are relevant because households exposed to the same agricultural recommendation need not respond identically. Adoption of an unfamiliar practice may require experimentation under uncertain returns, making risk and ambiguity preferences potentially important.

Loss preferences may matter when households are particularly sensitive to downside outcomes. Cooperative preferences may be relevant where agricultural practices involve shared resources or generate benefits beyond the adopting household. Finally, cognitive-bandwidth measures provide information on the extent to which scarcity and financial stress may limit households' ability to process information and plan long-term investments. The current analysis examines whether these characteristics are associated with CSA perceptions and stated adoption intentions; subsequent follow-ups will allow us to examine whether they predict realised adoptions.

The results point to a consistent role for behavioural preferences and attitudes in shaping farmers' perceptions of and intentions to adopt climate-smart agricultural practices (Tables 9

Table 9: Attitudes and Preferences

Variable	Obs	Mean	Std. dev.	Min	Max
Willingness to take risks in farming (May)	139	3.669	1.519	1	5
Willingness to take risks in farming (Aug)	160	4.481	1.058	1	5
Impatient (May)	139	0.842	0.366	0	1
Impatient (Aug)	160	0.775	0.419	0	1
Present bias (May)	139	0.050	0.219	0	1
Present bias (Aug)	160	0.031	0.175	0	1
TP Inconsistent (May)	139	0.0359	0.187	0	1
TP Inconsistent (Aug)	160	0.013	0.111	0	1
Patient (May)	139	0.072	0.259	0	1
Patient (Aug)	160	0.181	0.386	0	1
Risk tolerant (general)	161	0.671	0.471	0	1
Loss tolerant	161	0.752	0.433	0	1
Ambiguity tolerant	161	0.229	0.422	0	1
Ambiguity mix	161	0.224	0.418	0	1
Ambiguity averse	161	0.547	0.499	0	1
PBG: Average contribution	161	169.876	170.961	0	1
PBG: % of zero contribution	161	42.24%			

and 10). Farmers who report greater willingness to take risks specifically in farming are more likely both to regard the introduction of CSA practices as important and to express an intention to adopt them.

In contrast, the experimentally elicited general risk measure is not a significant predictor, although its coefficients for perceived CSA importance generally have the expected sign. This distinction suggests that domain-specific risk attitudes may be more informative for agricultural decisions than abstract measures of risk preference.

Present bias is also negatively associated with intended CSA adoption, particularly after controlling for other farmer characteristics, consistent with the possibility that farmers who place greater weight on immediate outcomes are less willing to undertake practices whose benefits may accrue in the future. Loss-tolerant respondents tend to attach less importance to introducing CSA practices, although loss preferences do not systematically predict adoption intentions.

Ambiguity preferences display a particularly notable pattern: farmers exhibiting stronger ambiguity aversion (*i.e.* preferring gambles with known over unknown probabilities, the latter being reflective of the returns to unfamiliar new technologies) are substantially less favourable towards CSA and less likely to intend to adopt it. This accords with a growing literature showing that risk, ambiguity and time preferences can influence agricultural technology adoption, although their effects vary considerably across technologies and informational environments.

Better mental well-being is also associated with viewing CSA practices as more important, while participation in CSA training is positively associated with intended adoption.

Finally, farmers expressing stronger pro-environmental preferences—specifically, attaching importance to environmental protection even when it entails higher costs or lower farm revenues—are considerably more likely to regard CSA practices as important, but this favourable attitude does not translate into significantly stronger adoption intentions. This distinction is consistent with the broader CSA literature emphasising that favourable attitudes and environmental motivations need not be sufficient for adoption when farmers continue to face uncertainty, information constraints and economic or practical barriers.

Trust is associated with adoption intentions in contrasting ways, depending on the object of trust. Greater trust in local government is positively associated with intended CSA adoption, whereas greater trust within the community is consistently associated with lower adoption intentions. One possible interpretation is that trust in local government increases confidence in externally introduced information and practices. In contrast, in communities characterised by strong interpersonal trust, farmers may rely more heavily on one another and on established local knowledge and practices, potentially making them more resistant to externally introduced changes. These mechanisms cannot be established from the present descriptive analysis, however, and the associations should therefore be interpreted cautiously.

Table 10: Behavioural characteristics, trust, training and CSA outcomes

	CSA importance			CSA intended adoption		
	(1)	(2)	(3)	(4)	(5)	(6)
Impatient	0.694** (0.300)	0.285 (0.321)	-0.101 (0.402)	-0.080 (0.055)	-0.090 (0.056)	-0.088 (0.081)
Present bias	0.490 (0.619)	0.263 (0.541)	0.957 (0.647)	-0.167 (0.167)	-0.177 (0.174)	-0.836*** (0.178)
Risk tolerance (farming)	0.181* (0.095)	0.092 (0.104)	0.114 (0.139)	0.084** (0.035)	0.111*** (0.036)	0.100** (0.041)
Risk tolerance (general)	0.356 (0.261)	0.169 (0.254)	0.149 (0.291)	-0.006 (0.067)	-0.035 (0.067)	-0.042 (0.077)
Loss tolerance (general)	-0.650** (0.250)	-0.679*** (0.244)	-0.456* (0.261)	0.043 (0.067)	0.056 (0.071)	-0.018 (0.077)
Ambiguity tolerance mix	-0.130 (0.274)	-0.150 (0.307)	-0.355 (0.341)	-0.128 (0.085)	-0.147* (0.078)	-0.164* (0.085)
Ambiguity aversion	-0.098 (0.212)	-0.232 (0.209)	-0.609** (0.285)	-0.109** (0.055)	-0.139** (0.054)	-0.164** (0.077)
PBG: contribution	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Life satisfaction: ladder		0.189* (0.100)	-0.052 (0.149)		0.012 (0.023)	0.004 (0.029)
Mental well-being		0.277 (0.212)	0.598* (0.303)		0.016 (0.036)	0.027 (0.044)
Trust in national government		-0.071 (0.100)	-0.083 (0.140)		-0.036 (0.025)	-0.048* (0.025)
Trust in local government		-0.061 (0.092)	0.025 (0.129)		0.054** (0.022)	0.049* (0.028)
Trust in CT community		0.050 (0.113)	-0.070 (0.156)		-0.108*** (0.038)	-0.098** (0.037)
Trust in Department of Agriculture		-0.114 (0.148)	-0.052 (0.213)		0.015 (0.052)	0.051 (0.061)
CSA training (direct)	0.045 (0.256)	0.172 (0.247)	0.280 (0.317)	0.181*** (0.064)	0.180*** (0.065)	0.144* (0.082)
CSA training (indirect)	0.220 (0.214)	-0.009 (0.217)	0.126 (0.330)	0.202*** (0.054)	0.207*** (0.054)	0.249*** (0.087)
Environmental tendency			0.553*** (0.202)			0.054 (0.044)
Constant	2.589*** (0.456)	2.719*** (0.763)	0.746 (1.742)	1.564*** (0.177)	1.770*** (0.191)	1.700*** (0.405)
Observations	158	158	134	157	157	134
R-squared	0.126	0.228	0.368	0.172	0.253	0.403

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Social networks constitute a second important component of this study. Information about new agricultural practices can potentially reach farmers through several channels. Relationships based on sharing agricultural information and advice can facilitate deliberate transmission of newly gained farming information; personal relationships provide opportunities for informal communication, and neighbouring plots allow farmers to observe each others' agricultural practices first-hand.

Since networks can evolve over time, repeated measurement of the agricultural-advice network is particularly valuable. While the May data describe information relationships before the main training programme, the August network captures relationships following the introduction of new agricultural knowledge. This allows us eventually to examine not only whether farmers connected to trained households acquire information, but also whether trained farmers themselves become more prominent sources of agricultural advice.

The combination of these measures allows the pilot to distinguish several stages of the adoption process. Farmers may first learn that a practice exists, then update beliefs about its suitability, form an intention to adopt and finally implement it. Financial and resource constraints may prevent movement from intentions to behaviour, while network exposure, uncertainty and individual preferences may influence earlier stages. Following the same households and networks over time will allow these transitions to be observed directly.

5 Conclusions

The literature supports three conclusions. First, CSA is needed because climate change threatens agricultural productivity and welfare, especially among poor rural households with limited adaptive capacity. Second, CSA can improve productivity, income, food security and poverty-related outcomes, but the evidence is highly context-dependent and concentrated in accessible lowland settings. Third, adoption is shaped by more than agronomic profitability: public-good incentives, ambiguity, social learning, liquidity constraints and cognitive bandwidth all matter.

Our Chando Thalay project is well positioned because it studies these mechanisms together in a context where evidence is scarce and policy relevance is high. Its immediate contribution is descriptive and diagnostic: documenting constraints, intentions, perceptions and behavioural mechanisms before CSA adoption unfolds. Its longer-run contribution will be methodological and substantive: showing how to study CSA adoption in remote mountain communities using repeated surveys, network data, games and locally grounded agronomic information. If successful, the pilot will provide the foundation for a larger, better-powered design across multiple villages in the wider Gilgit-Baltistan and Himalaya-Karakoram-Hindukush region.

The baseline evidence suggests that willingness to adopt is high but constraints are pervasive. Understanding whether these constraints arise from liquidity, information, ambiguity, collective-action failures, or cognitive scarcity is the central objective of the next project phase. The evidence also points to several policy implications for agricultural extension in remote mountain communities.

First, knowledge transfer and information provision appear particularly important where farmers are considering unfamiliar technologies and have limited local experience from which to assess their suitability and returns.

Second, the soil analysis reveals meaningful heterogeneity even within a single village, implying that uniform recommendations may be inappropriate. The agronomic assessment also

identified practices such as excessive irrigation and inappropriate fertilizer choice or application that can contribute to poor soil conditions, strengthening the case for combining extension with locally specific soil testing and recommendations.

Third, financial constraints remain relevant even for farmers interested in CSA. In particular, among those without sufficient existing resources to adopt their desired CSA practices, half were unwilling to borrow, suggesting that simply expanding access to credit may not be sufficient to overcome financial barriers.

In addition, some of the reasons given for unwillingness to borrow, such as "high interest costs" and "repayment difficulty" suggested uninformed pre-conceptions on the part of the respondent about the nature of available financing opportunities. Thus, enhanced access to credit needs to be accompanied by informational campaigns that raise awareness of schemes such as the one cited by the Department of Agriculture experts: farmers willing to introduce new CSA-inspired crops to their farms are provided interest- and markup- free loans to purchase the necessary seeds.

Finally, adoption of buckwheat as a secondary crop may depend not only on its agronomic benefits but also on farmers' ability to market it profitably: 38% of respondents expressed concern that middlemen would prevent them from receiving a fair price. Given the high level of trust within the community and the village's Organising Committee, collective marketing or coordinated price negotiation could therefore be explored as a way of strengthening farmers' bargaining position.

The substantial heterogeneity in reported well-being, with almost one-fifth of respondents placing themselves on the lowest step of the life ladder, also suggests that agricultural and rural development programmes should be attentive to household well-being and consider targeted support for particularly vulnerable households. Together, these findings suggest that effective CSA policy in this setting may require a combination of locally tailored agronomic information, practical learning, appropriate responses to financial constraints, and collective solutions to market-access barriers rather than a uniform technology-promotion strategy.

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6 Appendix

Table 11: Current agricultural practices

Practice	N	Percent
Animal manure	124	89.2
Seed saving	122	87.8
Manual irrigation	104	74.8
Crop rotation	96	69.1
Inter-cropping	42	30.2
Solar drying	8	5.8
Composting	3	2.2
Green houses	2	1.4
Tunnel farming	2	1.4
Mulching	2	1.4
Climate-resilient seeds and varieties	1	0.7

Notes: This is a multi-select question; households may report more than one practice, so percentages do not sum to 100.

Table 12: Food security, farming outlook, risk and migration

Variable	Category	N	Percent
Able to produce enough food	No, I will definitely not meet the requirements	79	56.8
Able to produce enough food	I do not think I will meet the requirements	15	10.8
Able to produce enough food	I am not sure	10	7.2
Able to produce enough food	I should be able to meet the requirements	16	11.5
Able to produce enough food	Yes, I will definitely meet the requirements	14	10.1
Able to produce enough food	Not applicable, as we buy all our food for family consumption	5	3.6
Outlook for farming	It will become much more difficult	89	64.0
Outlook for farming	It will become somewhat more difficult	19	13.7
Outlook for farming	I do not expect any change	16	11.5
Outlook for farming	It will become easier	8	5.8
Outlook for farming	It will become much easier	7	5.0
Considering leaving village	Not at all	129	92.8
Considering leaving village	I think so	8	5.8
Considering leaving village	Strongly yes	2	1.4

Notes: Percentages are calculated within each survey question.

Table 13: Trust

Trust	N	National Gvt	Local Gvt	CT community	DPT of agri
Not at all	160	35.0	29.4	0.6	0.0
A little	160	18.1	23.8	5.6	13.8
Moderately	160	28.8	23.1	11.9	13.8
A lot	160	5.6	6.9	9.4	8.8
Fully	160	12.5	16.9	72.5	70.6

Notes: Subjective measure of trust.

Table 14: Beliefs about buckwheat as a secondary crop

Growing buckwheat as a secondary crop ...	N	Percent
will allow more productive use of land.	79	56.8
will allow more productive use of land.	79	56.8
is profitable because of the market price.	15	10.8
is not profitable because of the middlemen role.	10	7.2
will make it harder to produce fodder.	16	11.5

Notes: Percentages are calculated within each survey question.

Table 15: Soil fertility - subjective measure

How well do you think crops grow on it?	N	Percent
Very poorly	134	83.8%
Poorly	15	9.4%
Neutral	3	1.9%
Well	4	2.5%
To the full potential	4	2.5%

Notes: The full question: *Think about your main field: without adding any fertilizer or manure to it - how well do you think crops grow on it?*

Table 16: Life ladder and Well-being

Question	Details	N	Percent
Life ladder (1=worst possible life, 5=best possible life)	Step 1	30	18.8%
Life ladder (1=worst possible life, 5=best possible life)	Step 2	5	3.1%
Life ladder (1=worst possible life, 5=best possible life)	Step 3	33	20.6%
Life ladder (1=worst possible life, 5=best possible life)	Step 4	5	3.1%
Life ladder (1=worst possible life, 5=best possible life)	Step 5	87	54.4%
I have felt happy and in good spirits in the last two weeks.	Disagree	13	8.1%
I have felt happy and in good spirits in the last two weeks.	Neutral	36	22.5%
I have felt happy and in good spirits in the last two weeks.	Agree	111	69.4%

Notes: The full question: *Imagine a ladder with steps from 1 at the bottom to 5 at the top. The top represents the best possible life for you; the bottom, the worst possible life. Which step do you feel you are standing on right now? and 33. How much do you agree with the following statement: "I have felt happy and in good spirits in the last two weeks."*

Table 17: Fear

31. How much do you fear the following disasters? (5-likert scale)	N	Mean
Shortage of water	160	3.79
Cloudbursts	160	4.76
Temperature changes	160	4.50
Droughts	160	4.43
Floods	160	4.79
Land slides	160	4.77
Insect infestations	160	4.48
Plant diseases	160	4.60

Notes: How much do you fear the following disasters? In each row, select one option. Options: Extremely/Very much/A lot /Not so much/Not at all.

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