CRIFS

Center for Risk and Inclusion in Food Systems

Risk Profiles: Nigerian Small-Scale Producers (+ some early India results)

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What Problem is CRIFS Addressing?

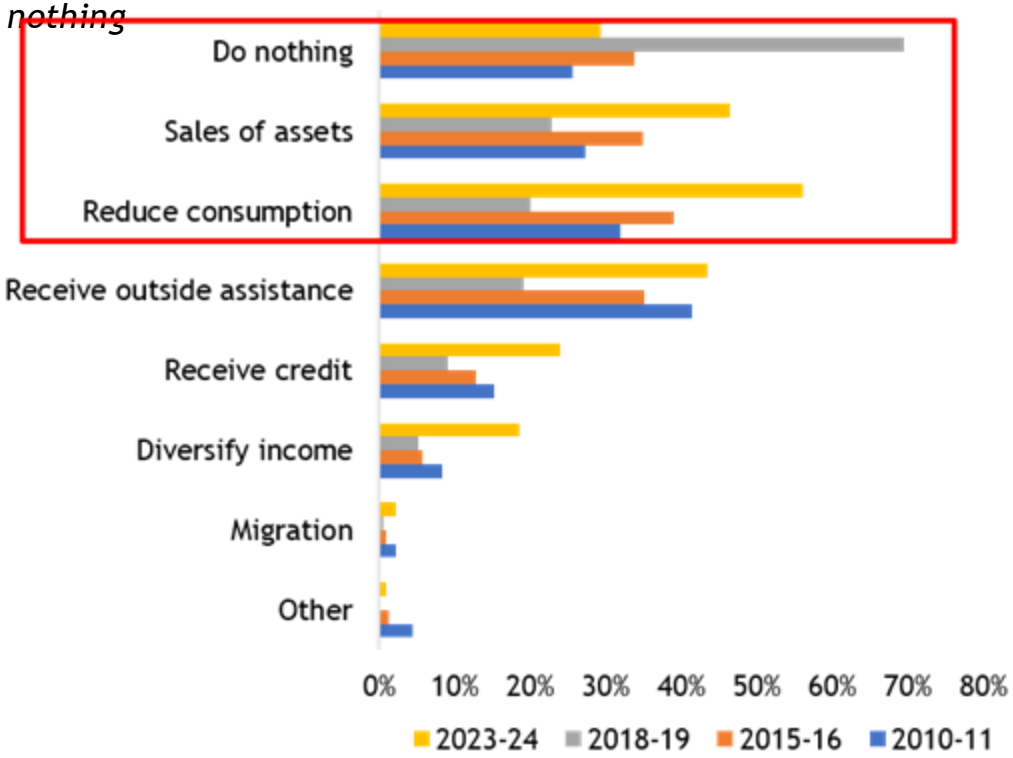
- **From our 2022 Investment**

While there has been a steady supply of innovative agricultural technologies for decades, in many cases, *the rate of sustained uptake has remained stubbornly low*. While provision and delivery are necessary conditions for use, they are not sufficient; only end-line adopters can fully translate innovation into impact and beneficial technologies will not necessarily make their way into small-scale producers' hands or fields. Yet the urgency is increasing.

What accounts for the gap between access and use? Are the technologies inappropriate? Likely not, but perhaps insufficiently bundled. Are they too expensive or unavailable? Again, likely not. As we have seen, even when vaccines are free and readily available, they are under-adopted.

The hypothesis driving CRIFS is that we are missing key elements of end-user decision-making: namely SSP risk perceptions facing market, climate and product uncertainty.

Figure 1: Percentage of households affected by climate shocks reporting the use of different coping strategies, including doing nothing



Notes: Nigeria LSMS-ISA/GHS Waves 2010 and 2015-2023. From 2010-2018, the data captures shocks in the preceding 5 years and in 2023 in the preceding 3 years.

Outline

How do we measure and respond to SSP risk perceptions in a manner that increases the likelihood of technology uptake?

1. Background – RISK, methods
2. NGA Findings - seed, adoption of other adaptation technologies / practices (supply)
3. NGA Findings – weather information (supply)
4. NGA Findings – demand / incentives

- SSP Risk attitudes and Risk Perceptions
- Experienced and expected climate events
- Self reported v measured

1. India (Maharashtra) - preliminary findings

Background: Risk

- DEFINITION: The IPCC defines risk as "**the potential for adverse consequences for human or ecological systems**". In food systems, risks emerge from the interaction of climatic, economic, and institutional hazards with differential exposure and vulnerability across actors.
- SOURCE: Risk stems from **uncertainty and variability**; information can help reduce and manage risk
- RISK ATTITUDES: are based on one's **innate tolerance** for risk in some domain (e.g. physical or financial)
- RISK PERCEPTIONS: are the probability one attaches to a hazard occurring based on its **qualitative dimensions** such as dread, familiarity, control, reversability, and conditioned by underlying risk attitudes. Risk perceptions drive behavior.
- ACTUARIAL RISK: is **statistically or otherwise measured or modelled risk**, and it regularly diverges from risk perceptions (e.g. the fear of flying v. driving)
- SSP RISK PROFILES: are agricultural and economic "**snapshots**" of farmers wrapped in risk assessments and perceptions

Background: Methods Nigeria Risk Profiles

To tease out the relative role of access, economics, information, and risk perceptions in SSPs' adaptation decisions involved:

- Satellite weather and land use data (CHIRPS, CHIRTS, GAEZ)
- Nationally representative household and farming surveys (LSMS-ISA GHS, NLPS), and government statistics and reports (NAERLS, NACS)
- Phone survey of 696 farming households drawn from a nationally representative sample (LSMS-ISA GHS Wave 4)
- Focus group discussions, farm visits, and agro-dealer interviews in 5 villages across Nigeria's three main agroecological zones (AEZs)

Figure 2: Agro-ecological zones (AEZs) and visited enumeration areas (EAs)

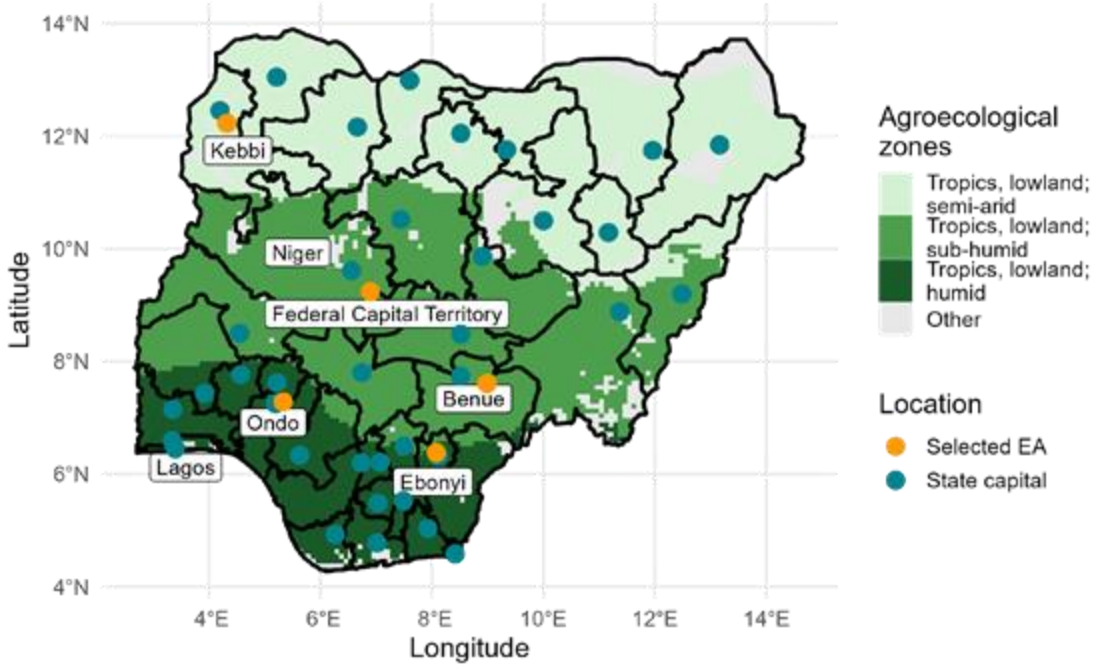


Figure 3: Location of Phone Survey participant households

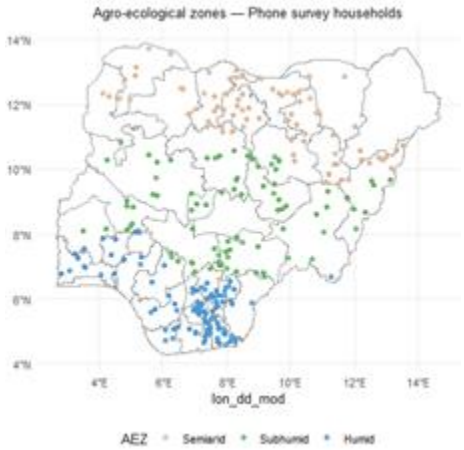


Figure 4: Fieldwork team and some participants in Niger state (March 2025)

Background: Methods India (Maharashtra) Risk Profiles

The last available NSSO state agricultural survey is dated and has limited sex-disaggregated measures, so it was necessary to conduct our own household survey (differences in orange). Otherwise the approach was similar:

- Desk analysis of secondary climate data from satellite imagery (CHIRPS, CHIRTS)
- Household survey of 2034 farming households focused on risk and adaptation from three agroecological zones (AEZs) of Maharashtra state, spanning four districts.
- Women's survey on climate shocks and risk perceptions (n= 800).
- Community infrastructure survey (n=20).
- Agro-dealer surveys in each sampled district (n=9).

Figure 5: Agro-ecological zones (AEZs) and visited districts

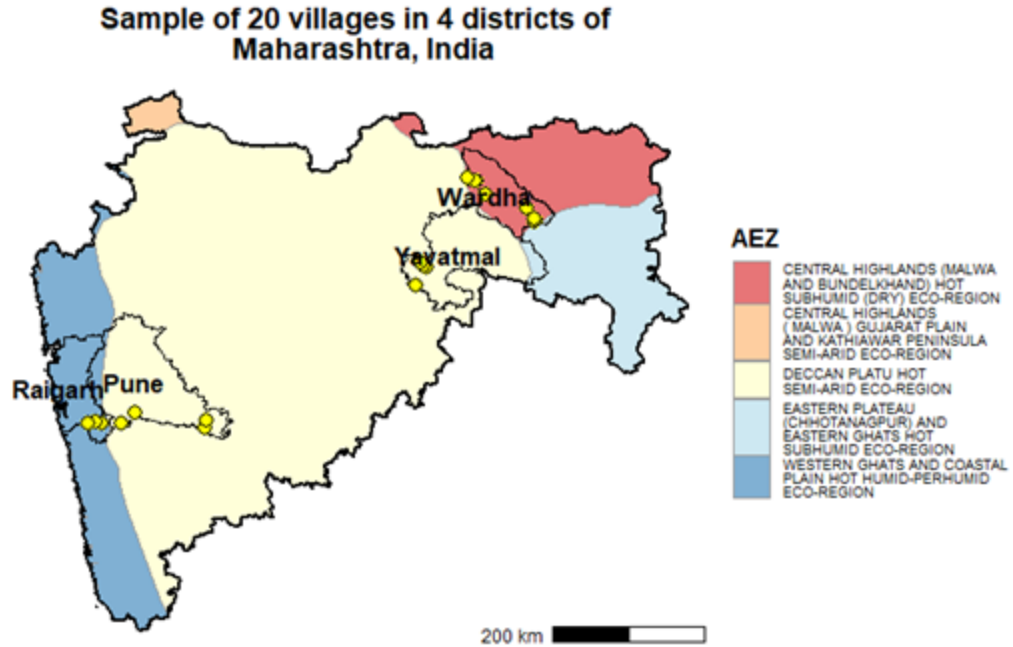


Figure 6: Fieldwork team in Yavatmal district (May 2026)

Kenya: Fieldwork planned in 2027

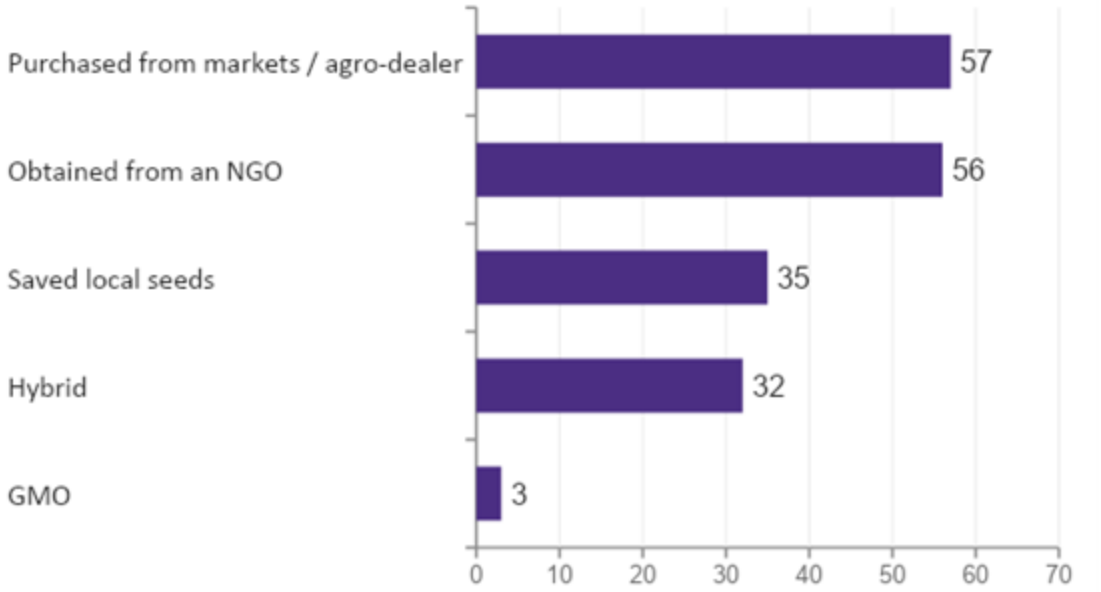
2. Findings (technology options)

Seed (“improved”, hybrid, GMO)
Adoption of other adaptation technologies / practices

NIGERIA: FGD

Measurement, use, and farmer understanding of improved seeds

Figure 7: What is an improved seed to you? (% selecting)



CRIFS FGD, March 2025: "What is an improved seed to you?" (% selecting; n=93, multi-select)

"We have heard about improved seeds but have not used it or been given it… I plant CP [and other rice varieties]."
— Female farmer, Niger state — was using an improved rice variety (CP) but did not identify it as such.

Implication: Trends in self-reported "improved seed" adoption (16% → 5% in male managers, 2015–24) may partly reflect terminology drift, not behavior.

Different definitions of "Improved Seed"

To breeders / surveys:
Seeds sourced from a formal breeding program enhancing genetic traits.

To farmers (FGDs):
Identified by where the seed came from: a market, an agro-dealer, an NGO, a marriage. Only ~1/3 link "improved" to "hybrid."

Nationally representative surveys use the phrase "improved" (LSMS-ISA) or certified (50x2030)

Figure 8: Rice being dried in Niger state (Fieldwork: March 2025)

NIGERIA: Across AEZ results

Measurement, use, and farmer understanding of hybrid seeds

20%

of farmers nationally know about hybrid seeds

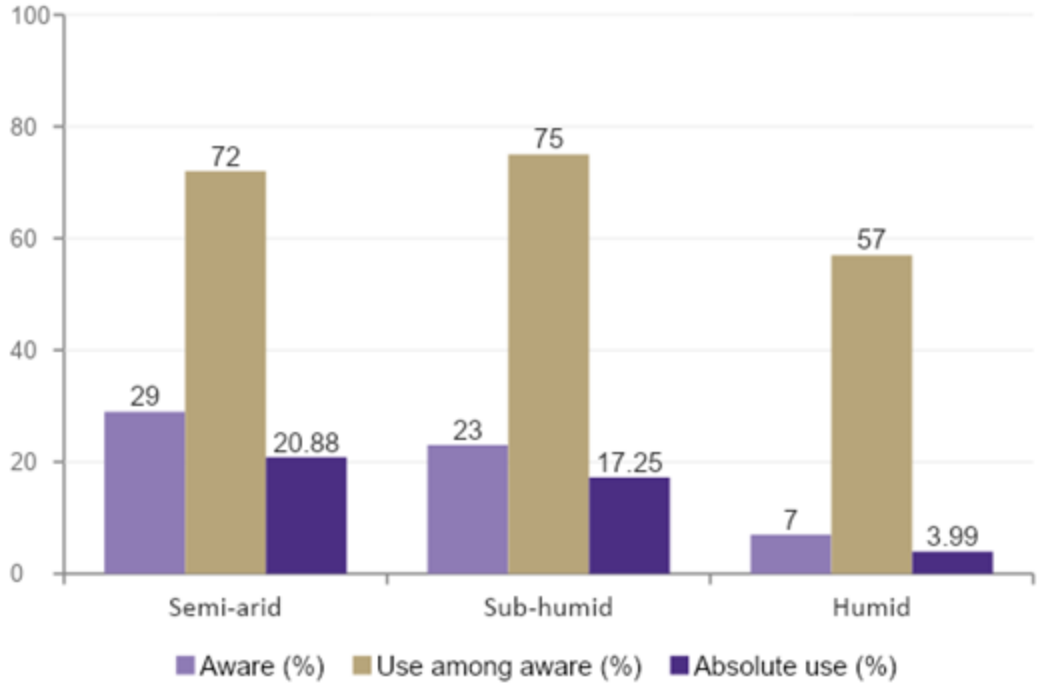
72%

of those aware used hybrids last season

89%

of those aware are planning to use hybrids in the next season

Figure 9: Hybrids awareness and adoption by AEZ



Source: CRIFS Phone Survey, March 2025: "Is hybrid seed something you know about?" "Is your household using or planning to use hybrid seed in this agricultural season?" (% selecting; n=678).

- The hybrid-use rate (~14% nationally, 21% semi-arid and sub-humid) is roughly double the self-reported *improved-seed* rate in LSMS-ISA 2023–24 (~5%). This suggests that terminology may lead national surveys to understate uptake.
- Awareness is much lower in the humid AEZ than the semi-arid and sub-humid. Consultations suggest that local language translation and dominant tuber crops in the humid AEZ may explain the particularly low awareness.

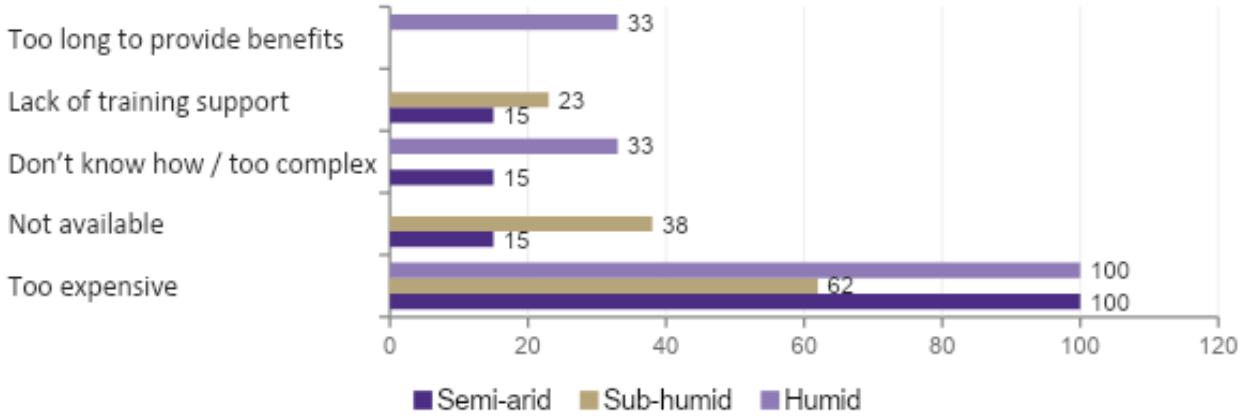
NIGERIA: Across AEZ results

Measurement, use, and farmer understanding of hybrid seeds

96% of the aware expect hybrids to **increase profit.**
Yet 28% of those aware do not use them.
Top stated reason: Too expensive.

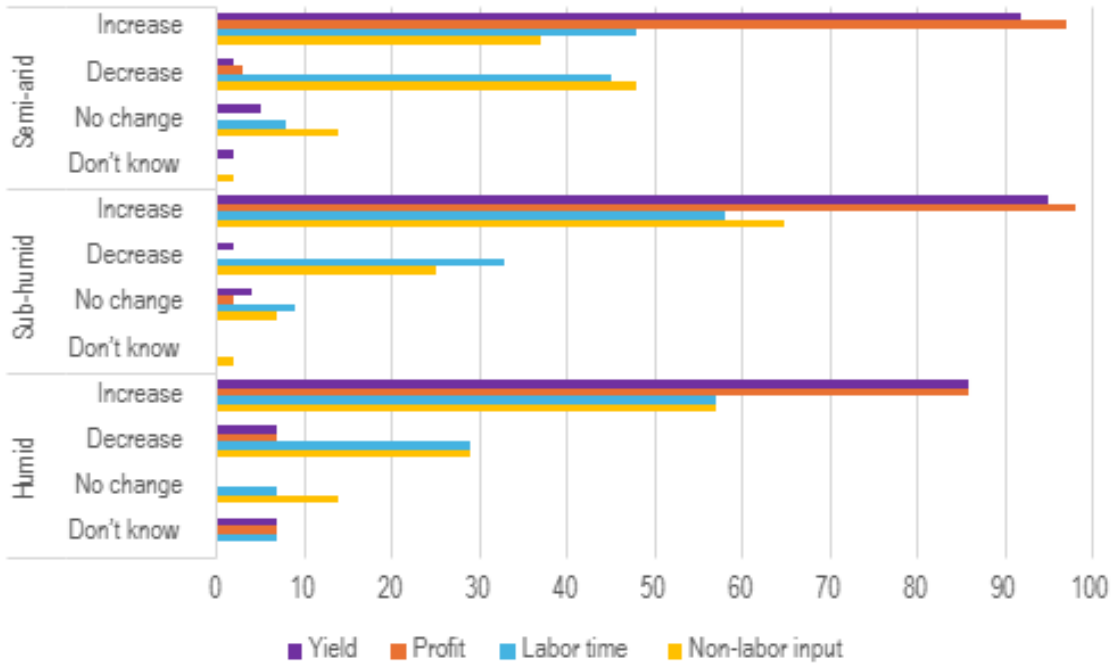
- Cost is relevant in all AEZ's
- Limited availability is an issue in the sub-humid AEZ.
- Complexity and time-to-benefit are important in the humid AEZ.

Figure 11: Reasons for non-adoption among the aware, by AEZ



Source: CRIFS Phone Survey, March 2025: "Why did your household choose not to use [hybrid seeds] in this agricultural season?" (% selecting; n=15, multi-select).

Figure 10: Expectations among the aware (% reporting 'increase')



Source: CRIFS Phone Survey, March 2025: "If you were to use or are using [hybrid seeds], how do you expect it to affect yield, profit, labor time, and non-labor inputs?" (% selecting; n=134).

Languages

The term hybrid is not consistently understood.

Table 1: Primary language spoken in household

Language	% of LSMS Individual Sample
English	0.99
Hausa	30.42
Igbo	12.13
Yoruba	9.47
Fulfulde	3.52
Kanuri	1.09
Ijaw	0.87
Pidgin	0.34
Tiv	1.48
Edo	0.73
Others/ Missing	38.96

*Source: LSMS-ISA Wave 3 (2015-16) : "What language does [name] **primarily speak in the home?**".*

- There are over 500 indigenous languages spoken across Nigeria
- In Nigeria, LSMS-ISA data suggests that there are ~10 local languages primarily spoken across the country and no one common language spoken by SSPs.
- Findings suggest that some local languages have a broader existing category that "hybrid" gets folded into. For example, in Yoruba, the term for hybrid "irugbin arabara" is also used for improved seed. In Hausa, hybrid seeds are "iri dan aure," which translates to "seed sourced from marriage".
- Some local languages lack an equivalent/closely related concept altogether e.g. Pidgin.

NIGERIA: Across AEZ results

Measurement, use, and farmer understanding of GMO seeds

Table 2: Knowledge and use of GMO seeds

Item	Semi-arid	Sub-humid	Humid	National
Knowledge of GMO seeds	35%	24%	9%	**23%**
Willing to plant GMO (if aware)	86%	93%	89%	**89%**
Willing to eat GMO produce (if aware)	92%	91%	71%	**89%**
Would plant "scientifically altered seed for higher resistance"	95%	95%	85%	**91%**

Source: CRIFS Phone Survey, March 2025.
"Are genetically modified organism (GMO) crops something you know about?"
"Are you willing to plan a GMO crop?"
"Are you willing to eat the product of a GMO crop?"
"If you were told that a new seed variety had been scientifically altered in a lab to have higher pest resistance and producea greater yield, would you plant it?"
Humid AEZ "if aware" rows use very small n (18-21).

> *"I have heard of Tela maize but haven't sold it."*
> **— Agro-dealer, Akure, Ondo state**

- Willingness when *not* using the term "GMO" (last row) is similar to willingness *with* the term (row 2).
- The label itself does not appear to be a barrier among those exposed to the concept.
- Of the 23% aware of GMOs, 89% are willing to plant them.

NIGERIA: Across AEZ results

Other climate adaptation technologies and practices

Table 3: Awareness of technologies and practices

Technology / practice	National	Semi-arid	Sub-humid	Humid	Use this season (of aware)
Hybrid seeds	20%	29%	23%	7%	*89% / 91% / 79%*
Inorganic fertilizer	78%	83%	77%	75%	*95% / 93% / 84%*
Herbicides / pesticides	65%	65%	71%	60%	*97% / 94% / 84%*
Changing what to plant	10%	5%	7%	20%	*75% / 88% / 67%*
Changing land / soil management	10%	4%	8%	18%	*88% / 83% / 79%*
Changing water management	3%	4%	4%	5%	*100% / 100% / 80%*

Source: CRIFS Phone Survey, March 2025: "Is [TECHNOLOGY/PRACTICE] something you know about? Is your household using or planning to use [TECHNOLOGY/PRACTICE] in this agricultural season?" (% selecting; n=695).

Pattern: purchasable inputs (top three rows) have **high awareness and high conditional use**. Management practices (shaded) have **low awareness everywhere** and are uniformly limited for water. Water-management adaptation is the most consistently unknown across AEZs.

Table 4: Expectations of Changes due to Technology Use by AEZ (% among aware)

		Inorganic Fertilizer			Herbicide / Pesticide		
Outcome	Change	Semi-arid	Sub-humid	Humid	Semi-arid	Sub-humid	Humid
Yield	Increase	99%	99%	98%	97%	95%	95%
Profit	Increase	100%	99%	96%	97%	95%	94%
Labor time	Increase	67%	70%	64%	51%	42%	48%
Non-labor inputs	Increase	77%	73%	71%	59%	61%	73%

Source: CRIFS Phone Survey, March 2025: "If you were to use or are using this [TECHNOLOGY/PRACTICE], how do you expect it to affect yield, profit, labor time, and non-labor inputs?" ((% selecting).

Figure 12: Urea being sold in market in Kebbi state (Fieldwork: March 2025)

Messaging to increase Technology Uptake

THE MESSAGE

- For **local languages** where "hybrid" gets folded into an existing category, build on this by by adding qualifiers that distinguish hybrids and their specific performance traits (e.g., "improved seed that should be purchased each season" or "improved seed bred by crossing two parent varieties" or "improved seed that increases pest resistance").

- For **local languages** where "hybrid" does not translate meaningfully, may need to rely on descriptions, demonstrations, visuals and/or analogies rather than a single translated word to convey the message.

- **Uptake is likely to be most effective if the message acknowledges the (valid) perceived risks and net returns held by SSPs.** The most recent Agricultural Census survey (NASC, 2024) finds a high literacy rate among agricultural household heads, with 95% having completed primary education or higher. That is, don't market to sell, message to inform. For example:
- Be **upfront about the costs of adoption** and provide clarity around total costs (e.g. annual seed purchases, fertilizer and labor, etc.). Most SSPs agree there are benefits, and while techniques such as small packaging, return policies, and other mechanisms can shift risk from buyers to sellers, our results suggest that expected costs, more than benefits, are primary considerations
- Highlight the risks addressed by the technologies **that SSPs feel some control** over e.g. pests or disease, rather than wind dislodging or drought, that are more associated with adaptive action (Chipfupa et al., 2021; Covello et al., 2001);
- **Calibrate** performance and cost expectations under localized conditions, e.g. soil nutrients and water accessibility, plot slope, household labor, cropping choices. In addition to creating trust, it may create "psychological ownership" to increase uptake (Saccardo, S., Dai, H., Han, M.A. *et al.* 2024);
- **What SSPs need to know and how many times they need to hear it depends on how familiar the technology is (Magruder, 2018 and Takahashi et. al. 2019);**
- When the technology is unfamiliar, SSPs may need to rely on **multiple information sources** before they can adopt to reinforce the message, including agro-dealers, local radios, producer groups and especially farmer social networks which can create highly beneficial spillovers (Carter et. al., 2021);
- For **familiar technologies**, the information gap to be addressed is often narrower and referencing similar technologies already "in-use" for relevant comparisons may be helpful, for instance, pertaining to correct dosage and/or technique.
- **Frame the technology in terms of gains (productivity or resilience) (Ngo et al., 2022; Pope et al., 2018; Yanuarti et al., 2026)**. Evidence suggests that **gain framing** is most effective when adaptation actions are viewed as preventive (avoiding a future problem) or curative (addressing an existing condition to improve outcomes). Loss framing applied to prevention tends to create a 'double negative' that can feel threatening and trigger avoidance rather than action.

THE MESSENGER

Communication via trusted *health/quality certifications* may be a more reliable signal than "improved."

Messaging to increase Technology Uptake by AEZ

**After accounting for observable socio-economic household characteristics and exposure to low rainfall shocks in recent years, across-AEZ differences in attitudes remain

- **Across AEZ, consider significant differences likely affecting risk perceptions (bearing in mind some small sample sizes), and where customization may be more important:**
- The incentive to adopt can be expected to relate to repeat exposure, for which the percent of households reporting "regularly affected over the past 5 years" across semi-arid to humid, the biggest ranges occurred for heat (16% to 40% in humid), drought (9% to 31%), and least in pest/disease (13% to 5%).
- Extent of control was less variable, with most over pests and disease, least over high winds and gusts, followed by torrential rains in sub-humid and heat in humid AEZs.
- Among those reporting past exposure, the percent of households expecting "likely" future occurrences in the next two years varied from almost 25% to about 50% for drought and pests or disease, with heat the most consistent at around 40%.
- *Semi-Arid*
- **farmers in the semiarid region are more likely to believe that climate will be more unpredictable in the future. *yet more likely to believe they cannot avoid misfortune if it is meant to strike their farm,*Easing credit constraints may also be more challenging given social norms in these communities.
- *Semi-Humid*
- *Availability of hybrids an issue: sensitive to timing, including when technologies are available in markets or elsewhere; and on the seller side, given perishability, the ability to stock and adequately store to meet demand, or suppliers erring on understocking to avoid waste.*
- *Humid*
- Knowledge of hybrid seeds was below a third of respondents in semi-arid and sub-humid, but only 7% in the humid AEZ Differential rates of awareness can reflect the extent to which there are available hybrid seed options for the dominant crops planted.
- Hypotheses for particularly low awareness in the humid AEZ are that two of the three largest crops (as measured by hectares planted) are tubers: cassava (86%), maize (43%), and yams (43%) per 2023-24 GHS estimates
- ** farmers in the subhumid and humid AEZs are less likely to say that they want their children to become farmers,technology adoption may need to increasingly compete with exit from farming rather than the status quo alone
- *SSPs perceive climate risk based on past exposure, their sense of control over the particular hazard, their fatalism, and their vulnerability, associated with their asset base.*
- Among the aware and not adopting, the most cited reason across all AEZ's was "too expensive", semi-humid and sub-humid respondents also cited a lack of availability and support for training; and in the humid AEZ, complexity and time to provide benefits.

How to increase the traction of weather info

Attention is a scarce resource. If weather information is too cognitively demanding to use, ignoring it can be a "rational" decision.

The Message

- There is a difference between the perceived value and traction of weather information focused on an immediate decision (e.g. when to plant/harvest given a monsoon onset date) and a seasonal one (e.g. what to plant given a three-month precipitation forecast) (Rosenzweig & Udry; 2014).
- Information-to-action pathways are often clearer for short-run than long-run forecasts, which can be more complex with multiple dimensions of weather risk, including precipitation totals, onset and cessation dates, temperature anomalies, etc.(Carleton et al., 2024).

Insight: Complex, probabilistic forecasts that are pre-processed and contain decision-ready recommendations will likely drive higher uptake.

- There are AEZ differences around trusted sources of weather information, and reasons for not acting on information. Over 20% of respondents in all AEZs reported on limited options to respond (highest in the sub-humid), In the humid AEZ a lack of trust and relevance were also high.

The Messenger

- Radio or television program is the most trusted weather information source across AEZ followed by Farmers' group / association / co-op and Government extension service in the semiarid and sub humid. In the humid AEZ, Nimet is the second most trusted in the humid AEZ

- Consider community leaders or other influential and trusted allies for messaging in rural communities.
- **In Islamic communities, an imam, often appointed by a village chief, may also play a role is risk communication. Our results find that individuals with Quranic or Integrated Islamic education as the highest level of educational attainment are associated with a higher degree of fatalism and autonomy ("I don't want anyone telling me what to do on my farm).

FINAL How do we respond to SSP risk perceptions in a manner that increases the likelihood of technology uptake?

- **Beyond the specific messaging insights, some broad considerations for what might be done are:**

  The risk of adoption: While we consider the risk of non-adoption, SSPs also consider the risk of moving from the status quo

- Scale out rather than across: Given across and within AEZ heterogeneity (language, ethnicity) consider picking high probability success spots as scaling across AEZ and SSP risk profiles may be counterproductive, and leverage local and farmer to farmer channels in digital strategies for spillover.

- Broaden goals from AT to reducing rural poverty: More attention to post-harvest investments supporting livelihood diversity (e.g. agro-processing, business training) and for smoothing income (e.g. post-harvest and cool storage facilities, small-scale electrification, irrigation)

- Know Your Customer: – but behavior stems from SSP's risk perceptions, not ours.
- Messaging is most likely effective if it addresses the issue of control and agency directly, given that the majority of SSPs reported that "if misfortunate is meant to strike my farm, there is nothing I can do about it,"
- *It may not be physically or economically viable to sufficiently offset some agricultural risks with seed or other inputs alone, especially for extreme precipitation or heat events where SSPs feel little control. Technology adoption plus water and soil management may be complementary but have even lower current awareness than hybrids. Rising temperatures may challenge even larger investments, e.g.in irrigation, and investments to benefit SSPs may require more structural livelihood shifts.*

- Especially for FHH, time horizons are short, and messages that emphasize near-term productivity outcomes rather than longer-run adaptation benefits may be more effective. A positive future vision is not the same as a long-term one.
- **Age is positively associated with farming confidence and negatively associated with an interest in changing economic activities.
- **Women are less likely than men to want their children to become farmers.

In theory and design there is a meaningful way to distinguish production and adaptation. But in practice, messaging in terms of maximizing current net returns and productivity potential may be more salient than long-run adaptation to reduce crop loss.

Findings (Weather information)

Trusted Providers

Reasons for not Acting

NIGERIA: Across AEZ results

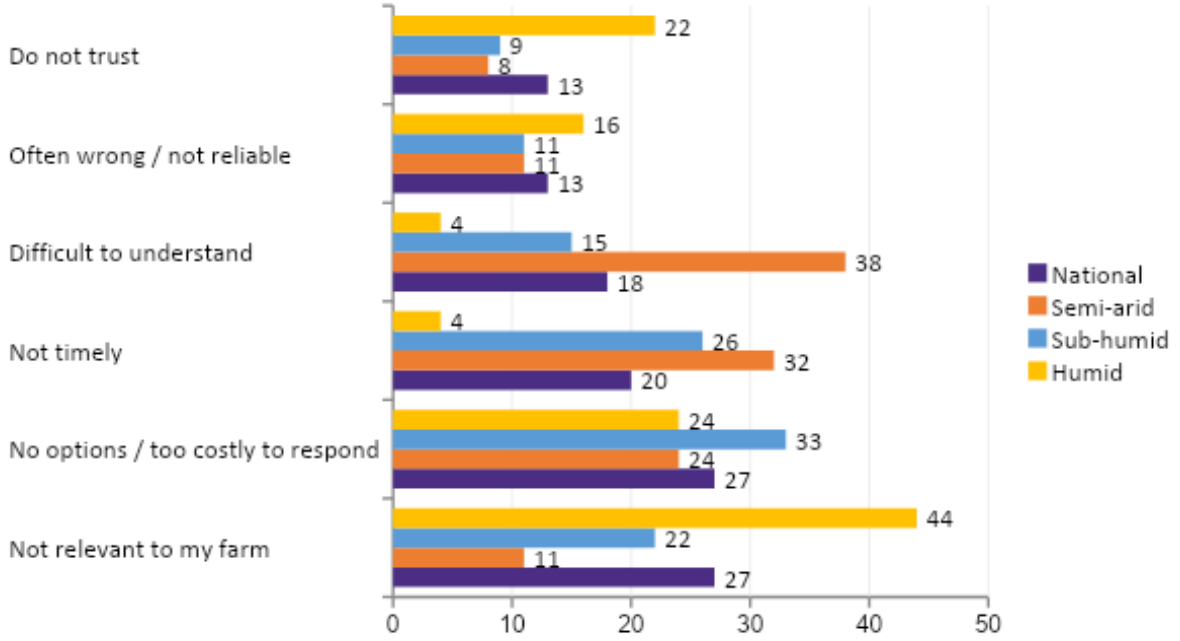
Understanding the Role of Weather Information and Advice on Adaptation

Table 5: Share of Top trusted providers of weather information by AEZ (N=248 respondents)

Source	National	Semi-arid	Sub-humid	Humid
Radio or television program	**54%**	49%	52%	59%
Farmers' group / association / co-op	30%	42%	31%	17%
Government extension service	29%	41%	30%	16%
National Weather Service (NiMet)	17%	16%	13%	23%
Other peer farmers	14%	24%	11%	8%
Farmer field school / lead farmer	10%	19%	9%	3%
NGO	12%	20%	12%	3%

Source: CRIFS Phone Survey, March 2025: "Which of the following providers of weather information do you trust?" (% selecting; n=695, multi-select).

Figure 13: Reason for not acting based on climate information (N=128 or 52% of those who received information)



Source: CRIFS Phone Survey, March 2025: "Why didn't your household make use of the information on weather/extreme weather event risk?" (% selecting; n=128, multi-select).

52% of those who received weather info did not act; relevance, options, and timing are the binding issues

> *"I mostly get weather information from the radio. The forecast for high temperatures this year happened as predicted. I also got information that the rains will start in March, but it did not happen."*
> **— Farmer, Benue state**

Findings (Risk Attitudes and Perceptions)

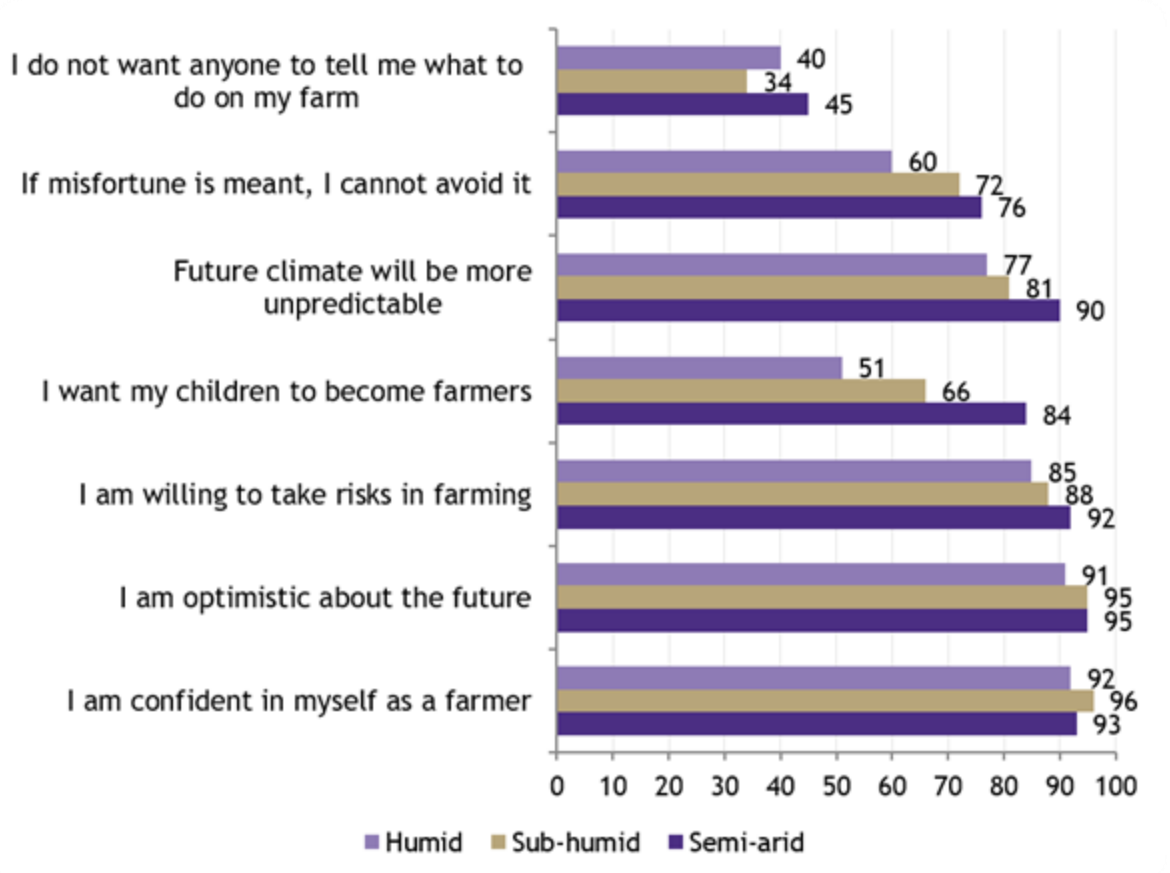
Attitudes, Fatalism and Control

SSP experienced and expected climate events
SSP self reported v measured

NIGERIA: Across AEZ results

SSP attitudes

Figure 14: Percent that agree or strongly agree with statement, by AEZ



- Fatalism (If misfortune is meant to strike my farm, there is nothing I can do about it) is highest in the semi-arid (76%), where measured exposure and expectations of future variability is also highest, and where the desire for autonomy ("do not want anyone to tell me what to do on my farm") and for one's children to be farmers is also strongest.
- The combination may dampen incentives to invest in adaptive technology even where exposure is greatest.

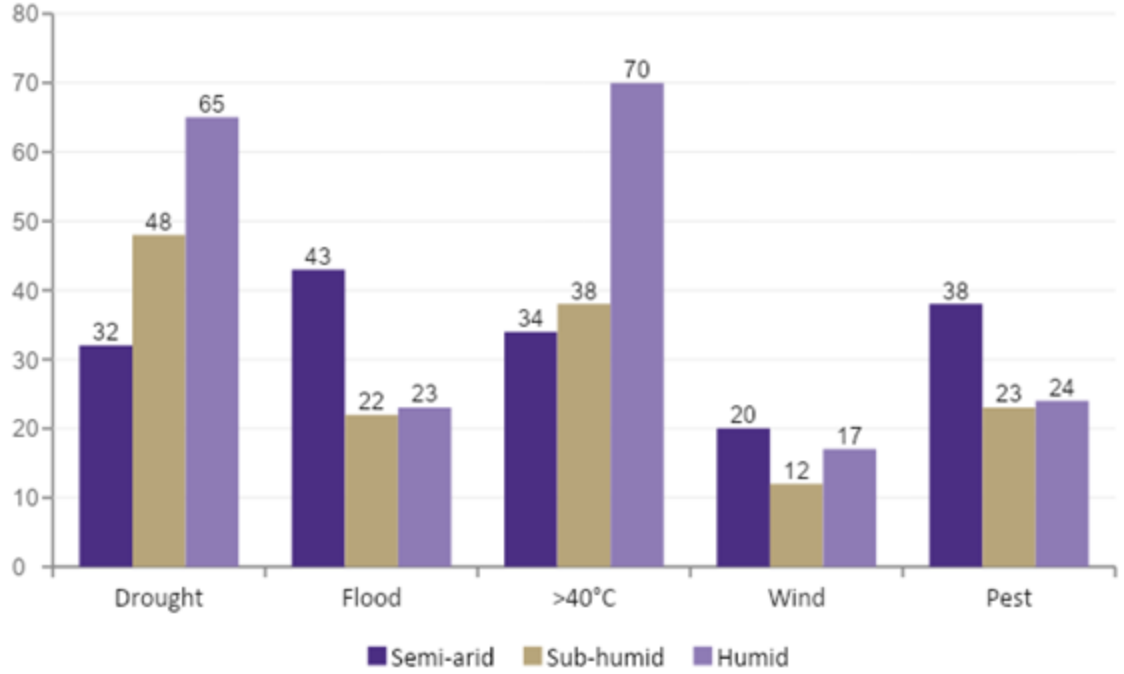
Source: CRIFS Phone Survey, March 2025: "Please indicate your level of agreement with [STATEMENT]?" (% selecting; n=694).

Positive future orientation co-exists with a worldview that limits perceived personal agency over misfortune

NIGERIA: Across AEZ results

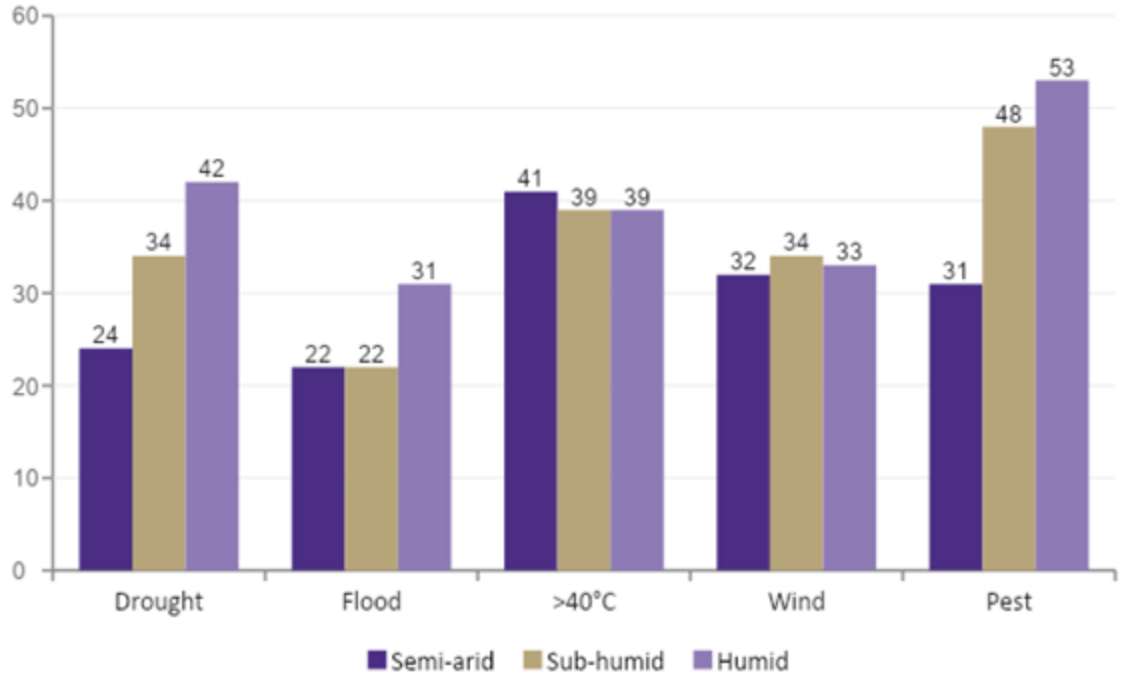
Self-reported exposure and future expectations of weather shocks

Figure 15: % reporting any during past 5 years exposure (Occasional + Regular)



Source: CRIFS Phone Survey, March 2025: "During the past 5 years, how frequently did your household experience [EVENT]?"

Figure 16: % expecting "likely" occurrence in next 2 years, among past-affected



Source: CRIFS Phone Survey, March 2025: How likely do you think [EVENT] is to occur in the next 2 years?"

Patterns:

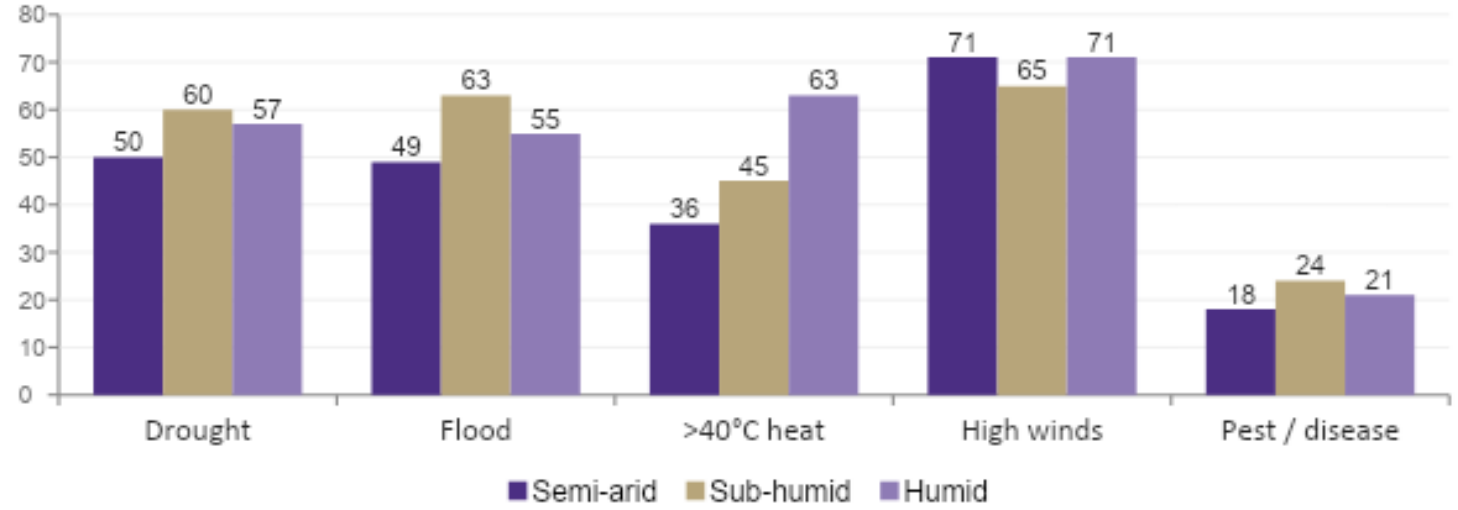
- Past-year reporting of heat ranges from 34–70% and drought from 32-65% across AEZs (from semi-arid to humid). Semi-arid reported exposure is highest for floods, wind and pests.
- Forward-looking expectations are more compressed than past exposure for heat, wind and flooding, with more expected wind and pest exposure on average.

NIGERIA: Across AEZ results

Risk perceptions

At the national level, 71% feel unable to control wind losses, 57% drought losses, but only 20% feel unable to control pest losses

Figure 17: Percent reporting "No control" over losses from each hazard, by AEZ



Source: CRIFS Phone Survey, March 2025: "If you knew about the [EVENT] in advance, to what extent could your household contrd or avoid losses to crops or livestock when exposed?".

Figure 23: Cassava storage in Ebonyi state (Fieldwork: March 2025)

- **Perceived control: less against weather, confident against pests**

> *"If torrential downpours come early in the planting season, I replant. But around September, I don't plant again."*
> **— Farmer, Niger state**

> *"I have had insect infestation … I buy insect killer powder from Jega market to kill the insects."*
> **— Farmer, Kebbi state**

NIGERIA: Across AEZ results

Measured (i.e. satellite) ≠ self-reported (i.e. survey)

Over half of households exposed to meteorological drought do not report being affected: False "Negative" does not report the meteorologically measured shock & False "Positive" reports experiencing a shock that is not measured meteorologically

Table 6: Self-reported and measured low-rainfall shocks

Panel A: LOW Cumulative rainfall (more than 1 sd below avg)*		
Measured	**No self-report**	**Self-report drought**
No (n=297)	75.4%	**24.6% ← false positive**
Yes (n=351)	**55.0% ← false negative**	45.0%
$\chi^2(1) = 29.3, p < 0.001$		**z-score < -1*

Panel B: HIGH Consecutive dry days (more than 1 sd above avg)*		
Measured	**No self-report**	**Self-report drought**
No (n=490)	68.6%	**31.4% ← false positive**
Yes (n=158)	**51.3% ← false negative**	48.7%
$\chi^2(1) = 15.6, p < 0.001$		**z-score > 1*

What predicts the mismatch?

- Larger households and more diversified livestock holdings → fewer false positives: asset bases appear to buffer hazard sensitivity
- Extension access → fewer false negatives: extension may help farmers recognize drought impacts when they occur
- Female-headed households show marginally higher false-positive rates for rainfall-based drought

Source: CRIFS Phone Survey, March 2025 + CHIRPS, 2024 growing season; full regressions in Appendix 5.

NIGERIA: Across AEZ results

AEZ Risk Snapshot: Technology, Attitudes, Vulnerability, Exposure

Panel A: Semi-Arid AEZ (n=223)

Indicator	Estimate
Adaptation technology	
Aware of hybrid seeds	29%
→ of which, using this season	72%
Aware of inorganic fertilizer	83%
Worldview (Add all)	
"If misfortune is meant, I cannot avoid it"	76%
"Future climate will be more unpredictable"	90%
Livelihoods	
Avg. landholding (ha)	1.26
Avg. livestock (TLU)	1.09
Avg. daily consumption ($2021 PPP)	$2.55
Avg. distance to nearest market (km)	62.5

Panel B: Sub-Humid AEZ (n=242)

Indicator	Estimate
Adaptation technology	
Aware of hybrid seeds	23%
→ of which, using this season	91%
Aware of inorganic fertilizer	77%
Worldview	
"If misfortune is meant, I cannot avoid it"	72%
"Future climate will be more unpredictable"	81%
Livelihoods	
Avg. landholding (ha)	1.41
Avg. livestock (TLU)	0.94
Avg. daily consumption ($2021 PPP)	$3.07
Avg. distance to nearest market (km)	73.6

Panel C: Humid AEZ (n=230)

Indicator	Estimate
Adaptation technology	
Aware of hybrid seeds	7%
→ of which, using this season	79%
Aware of inorganic fertilizer	75%
Worldview	
"If misfortune is meant, I cannot avoid it"	60%
"Future climate will be more unpredictable"	77%
Livelihoods	
Avg. landholding (ha)	0.56
Avg. livestock (TLU)	0.20
Avg. daily consumption ($2021 PPP)	$4.75
Avg. distance to nearest market (km)	53.1

- ***SSPs perceive climate risk based on past exposure, their sense of control over the particular hazard, their fatalism, and their vulnerability, associated with their asset base.***

Forecasts (NiMet GSF) 2026 growing season:

- Borno: Late onset of rains, shorter than normal rainy season, but more than normal rainfall. Severe dry spell (>21 days) June-August
- Warmer than normal (avg. 1˚C): > 34˚C in Feb, 37˚C in March, and in some regions >40˚C in April
- Ogun State is predicted to have a severe dry spell from March to May 2026.
- Between 34˚C and 40˚C in April and May. Most states are expected to experience daytime temperatures up to 0.6˚C above normal in May.
- Moderate ˚C dry spells predicted for Oyo and Kogi states Mar-May 2026.
- Means 28˚C - 31˚C in March-May. Expected daytime temps 0.2˚C-0.6above normal in March.

Source: CRIFS Phone Survey, March 2025 and LSMS-ISA W5.

MAHARASHTRA, INDIA: Preliminary results

Maharashtra has an estimated population of 126.4 million and represents 9.1 per cent of India's total population. It is the 3rd largest state by land area (over 300,000 sq. km) and has the highest nominal GDP. Among 29 Indian states, Maharashtra ranks #3 in climate vulnerability.

Source: *Technical Group on Population Projections, National Commission on Population, Ministry of Health and Family Welfare, Government of India*; *Council on Energy, Environment and Water*

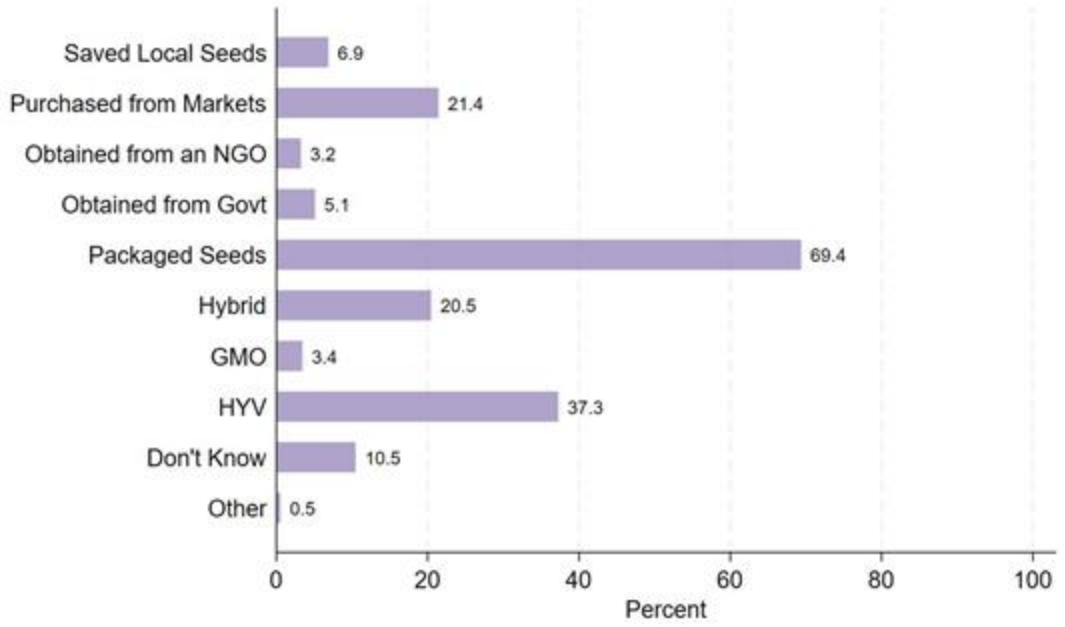
The cultivated area (17.43 million ha) is 55-60% of the total geographical area and the irrigated area is about 17% of the cultivated area (2.94 million ha). With large dependence on rainfall, the cropping intensity is around 127%. The soils are shallow and deficient in nitrogen, phosphorus, zinc and sulphur. The important crops of the state are sugarcane, cotton, sorghum, pearl millet, chickpea, soybean, sunflower and safflower.

Source: *Indian Council of Agricultural Research*

MAHARASHTRA: Full sample results

Measurement, use, and farmer understanding of improved seeds

Figure 3: Understanding of improved seed



CRIFS India Household Survey: "What is an improved seed to you?" (% selecting; n=2034, multi-select)

Patterns: The figure here shows that most respondents associated improved seeds with packaging (69%), followed by High-Yielding Varieties (37%), purchased from markets (21%) and hybrids (20.5%).

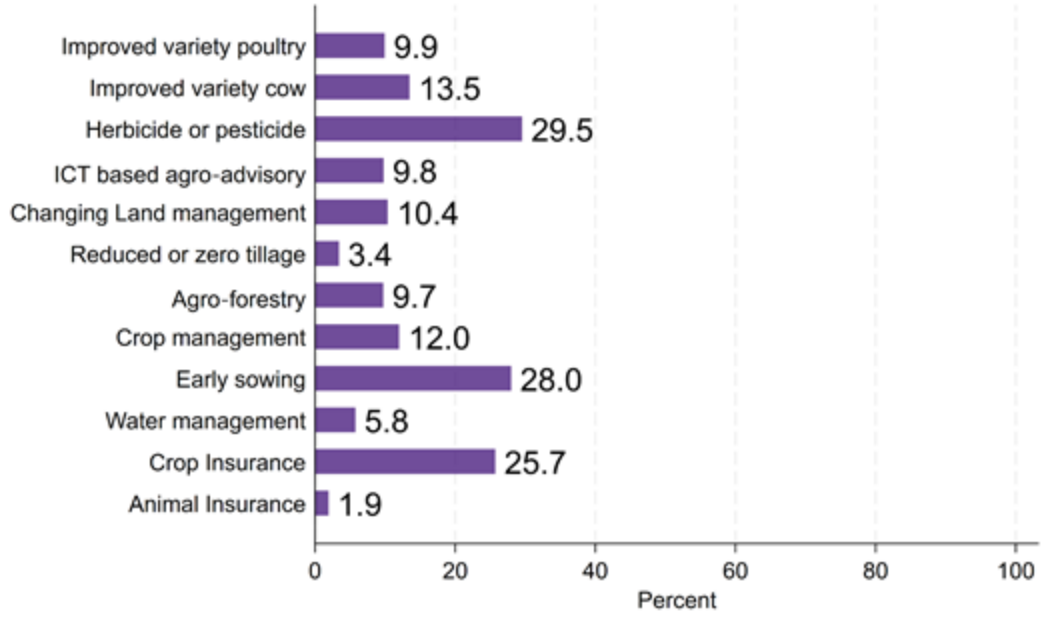
Farmers identify improved seeds mostly by observable cues (packaging, market purchase) than by performance traits (hybrid, GMO).

Figure 16: Seeds at an agrodealer shop in Raigad district (Fieldwork: May 2026)

MAHARASHTRA: Full sample results

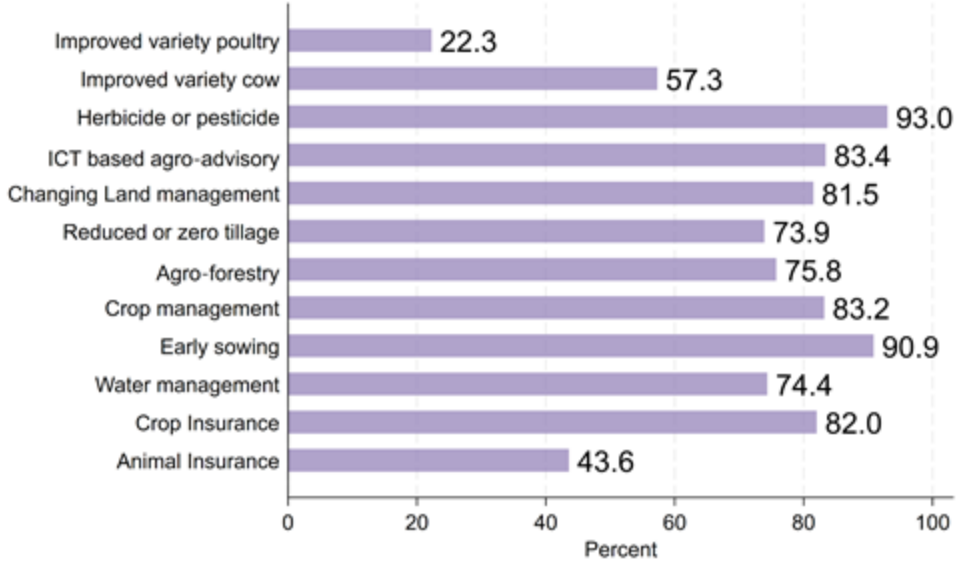
Non-seed climate adaptation technologies and practices

Figure 4: Awareness of technologies and practices



CRIFS India Household Survey: "Which of these technologies do you know about?" (% selecting; n=2034, multi-select)

Figure 5: Use last year (of aware)



CRIFS India Household Survey: "Did your household use [technology] in the last year?"

MAHARASHTRA: Full sample results

Non-seed climate adaptation technologies and practices

Figure 6: Expectations of Increase in Farm Labor Time due to Technology Use (% among aware)

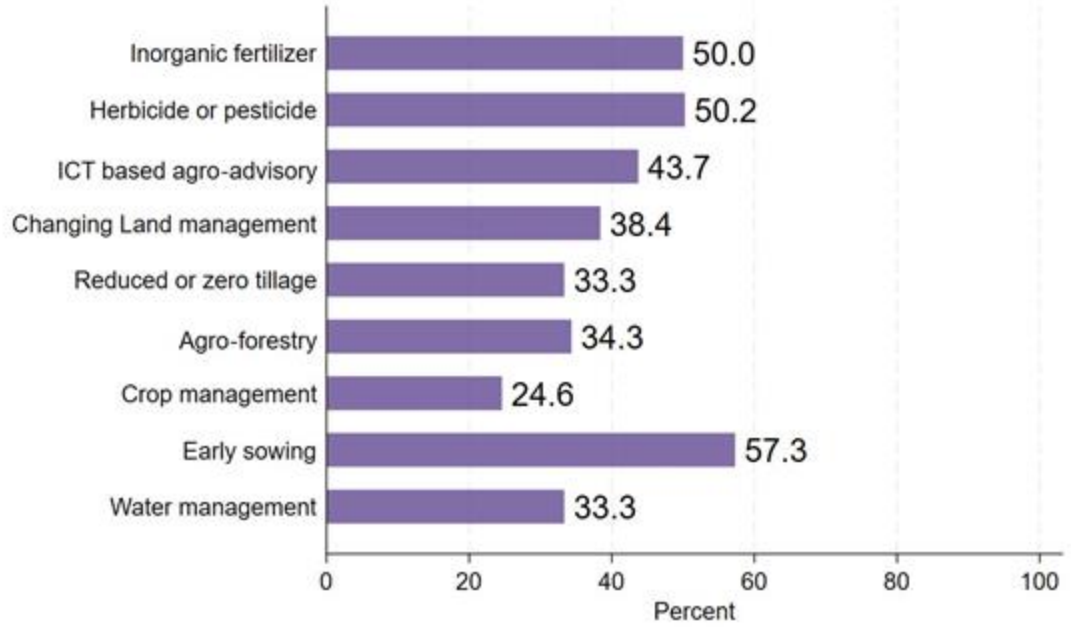
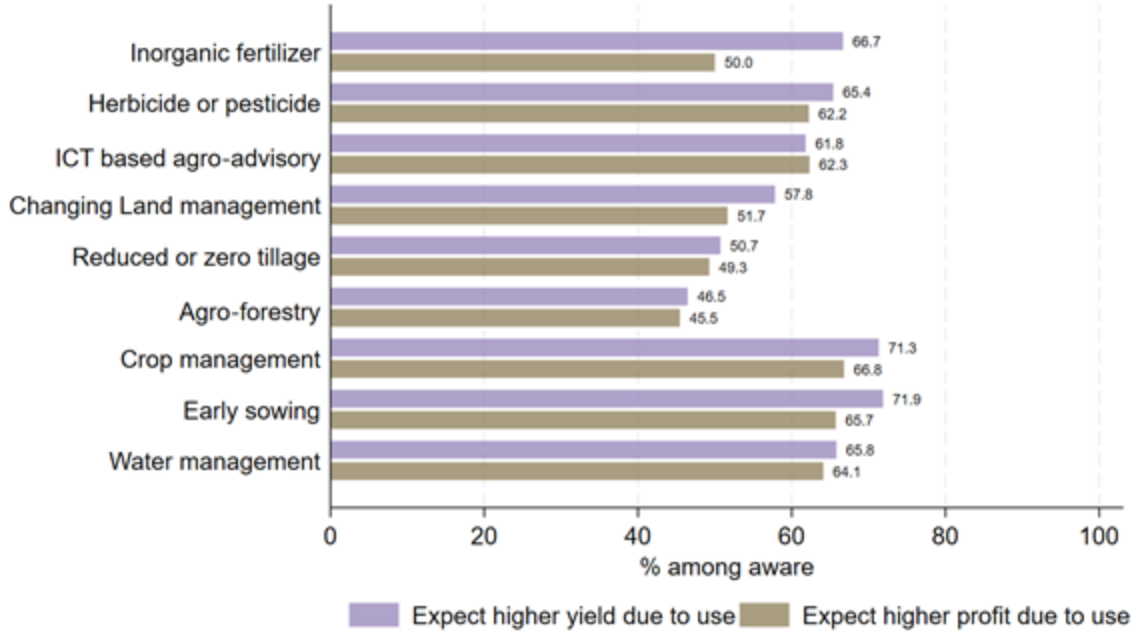


Figure 7: Expectations of Increase in Yield & Profit due to Technology Use (% among aware)

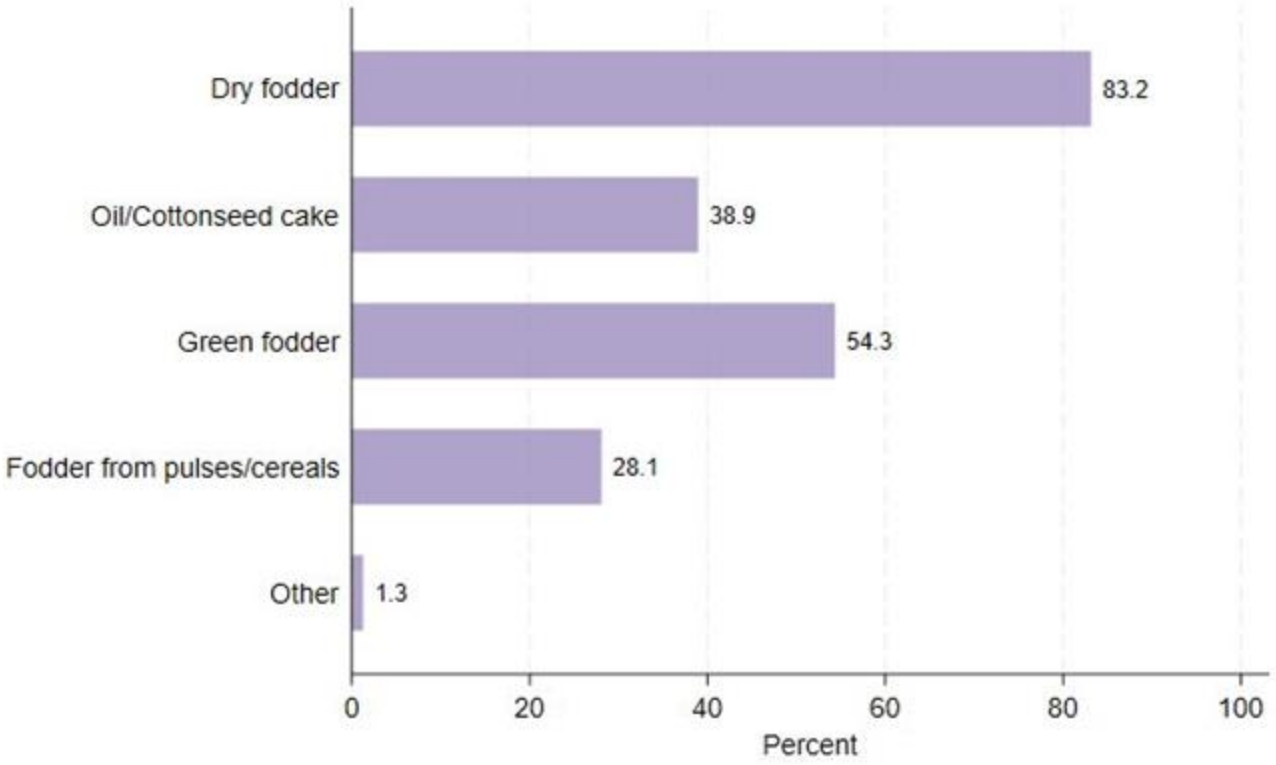


For a majority of technologies, 30-40% of households expect an increase in the cost of non-labor inputs.
Notable exceptions: early sowing (48.5% expect increased cost due to use) and crop management (25%).

Among the aware, inorganic fertilizer use had the highest discrepancy between expected higher yield and profit due to use.

Big Bets (India focused): Livestock feed sources

Figure 25: What is the source of feed for your household's livestock? (n = 552, multi-select)



Source: CRIFS India Household Survey.

Figure 26: Cowshed in Yavatmal district (Fieldwork: May 2026)

MAHARASHTRA: Full sample results

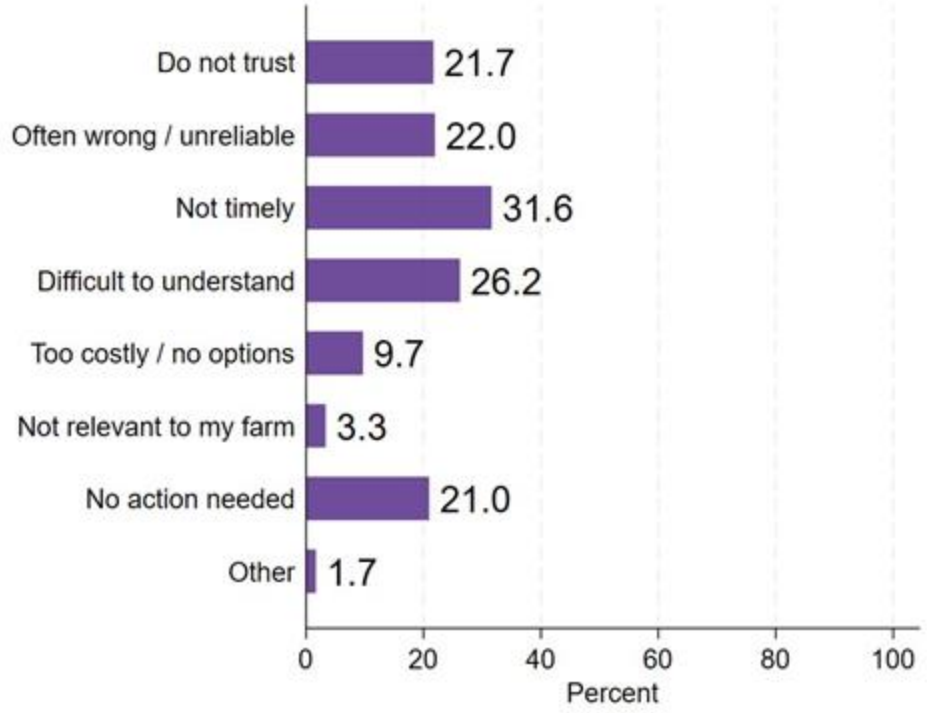
Understanding the Role of Weather Information and Advice on Adaptation

Table 1 : Top trusted providers of weather information (N= 2034 respondents)

Source	Share
Radio / TV / newspaper	39%
Government extension service / KVK	37%
WhatsApp / YouTube / Google	28%
Farmers' group / association / co-op	17%
National Weather Service	13%
Farmer call center	8%
Input dealer / trader	5%
Other	5%
NGO	1.5%

Source: CRIFS India Household Survey.

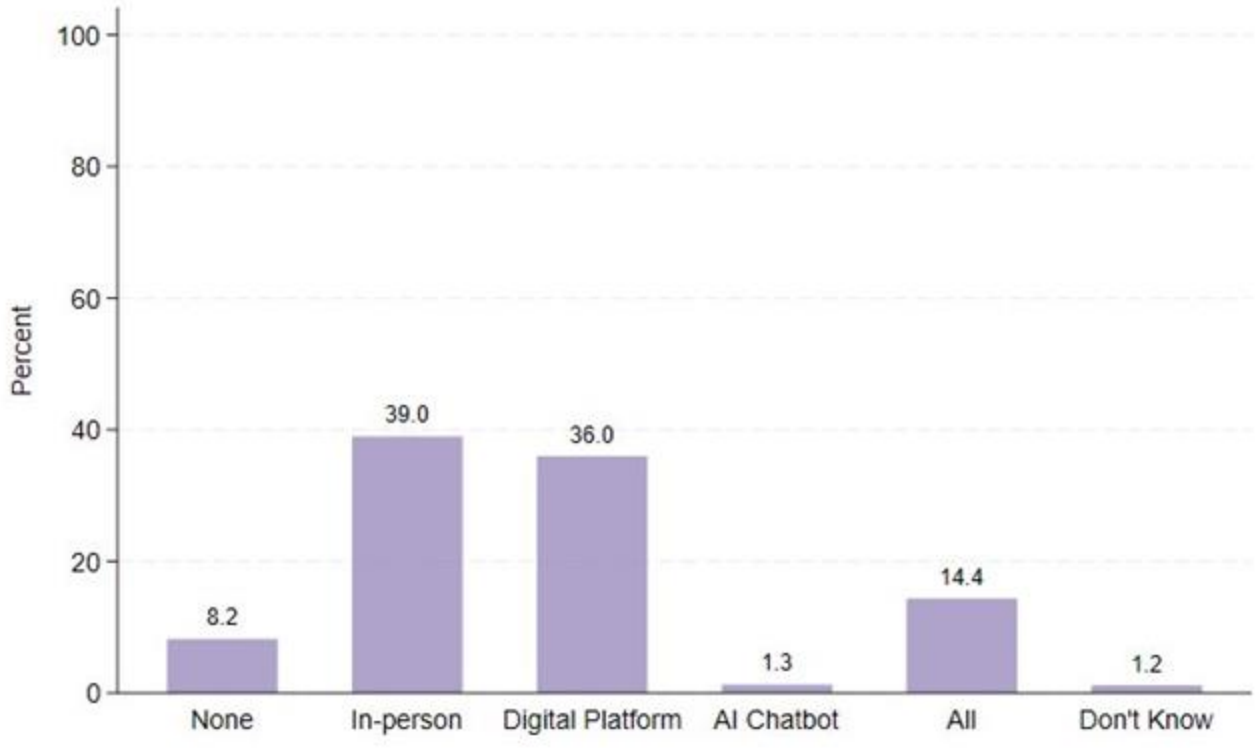
Figure 10: Reason for not acting based on climate information (N= 1617 or 79% of those who received information)



79% of those who received weather info did not act; difficulty in understanding, timing, trust are the binding issues

Big Bets (Maharashtra focus): Trust in AI / in person / digital agro-advisory

Figure 23: Which type of agricultural advisory do you trust most? (n = 2,034, single-select)

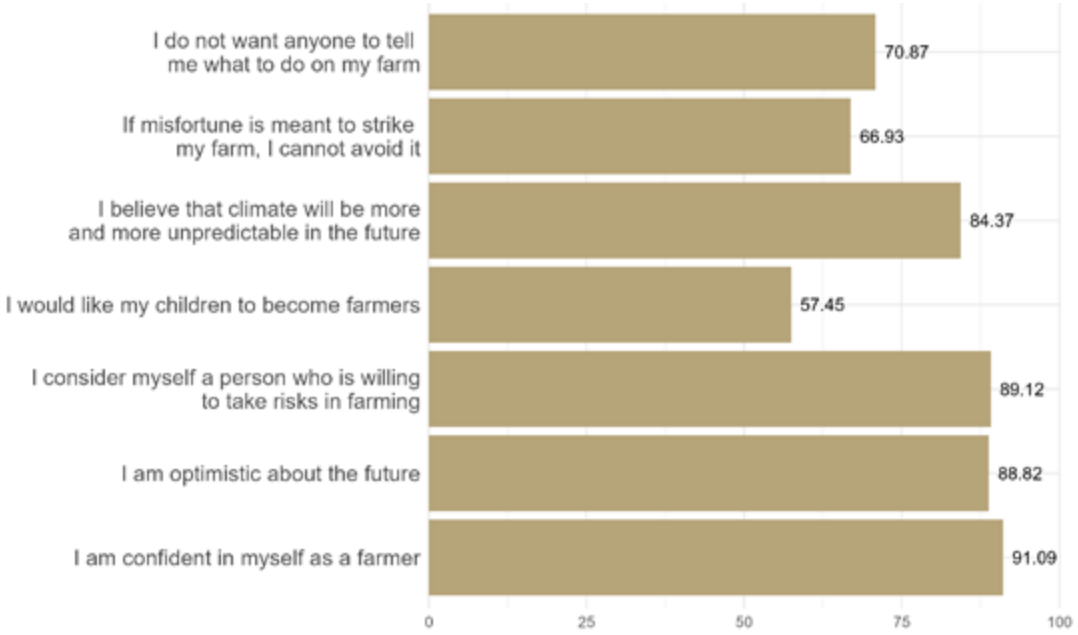


Source: CRIFS India Household Survey.

Figure 24: Fields in Pune district (Fieldwork: May 2026)

SSP attitudes

Figure 12: Percent that agree or strongly agree with statement



Source: CRIFS Household Survey, May 2026

- In general, higher autonomy but otherwise falls within ranges of NGA AEZs.
- While most farmers are optimistic (89%) and risk-tolerant (89%), many still feel that misfortune is beyond their control (67%).
- Farmers exhibit strong personal confidence (91%) but are less certain about wanting the next generation to be farmers (57%).

Positive future orientation co-exists with a worldview that limits perceived personal agency over misfortune

MAHARASHTRA: Full sample results

Self-reported exposure and future expectations of weather shocks

Figure 1: % reporting any during past 2 years exposure (Occasional + Regular)

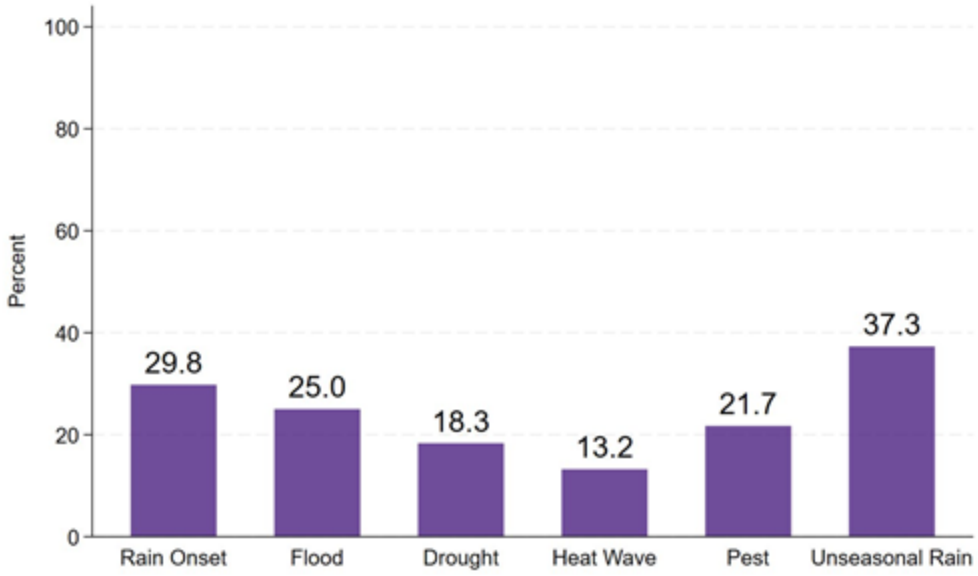
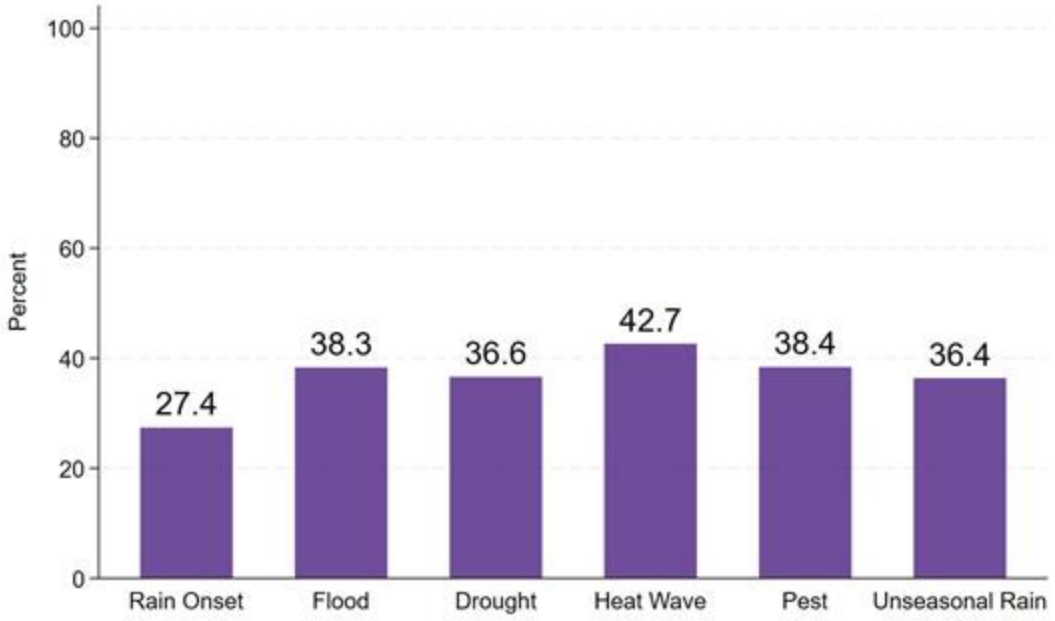


Figure 2: % expecting "likely" occurrence in next 1 or 2 years, among past-affected



Patterns:

- Past two-year reporting of untimely rain is 37% in the full sample; early or late onset of rains is reported by ~30% of households.
- As in NGA, forward-looking expectations are more equally spread out: Despite the lowest past exposure among climate events, a heat wave is the most anticipated (over 40%) among those exposed in the past, followed by ~39% pests and ~37% expecting drought and unseasonal rain.

MAHARASHTRA: Full sample results

1. Measured (i.e. satellite) ≠ self-reported (i.e. survey)

Common meteorological indicators can fail to capture farmers' experience

Table 4: Self-reported and measured rainfall shocks

Panel A: High Variation in Daily Rainfall Shock (z-score>1)		
Measured	**No self-report**	**Self-report untimely / unexpected rain**
No (n=984)	51%	**49% ← false positive**
Yes (n=1050)	**26% ← false negative**	74%
$\chi^2(1) = , p < 0.001$		

There is a small correlation between plot size and self-reporting high variation in daily rainfall. This suggests that

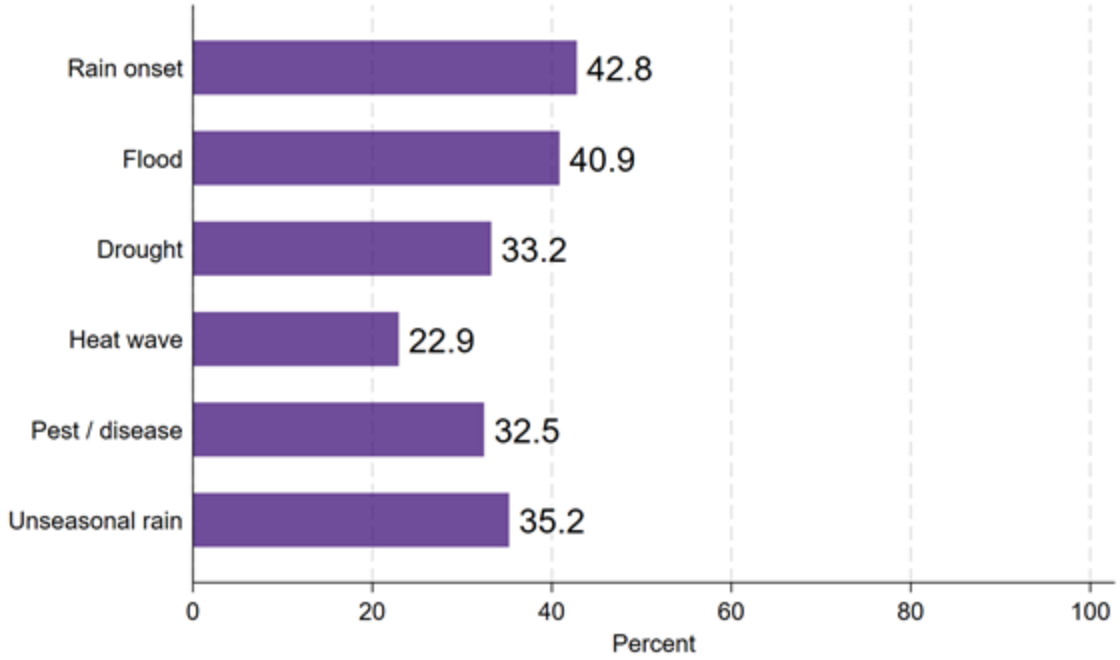
Source: CRIFS Phone Survey + CHIRPS, 2024 growing season

MAHARASHTRA: Full sample results

Risk perceptions

42 % feel unable to control losses from early or late rain onset, 33 % drought losses, and 41% feel unable to control flood losses

Figure 11: Percent reporting "No control" over losses from each hazard



Source: CRIFS India Household Survey.

Figure 12: Onion harvest in Yavatmal district (Fieldwork: May 2026)

- **Perceived control: less against rain onset, flood; confident against heat waves**

Differences and similarities: Nigeria vs. India (Maharashtra)

Weather information

- Nigeria: **52%** of those who received weather information did not act on it. Top reasons for not acting were relevance, cost, timing.
- Maharashtra: **79%** did not act on weather info; trust and understanding were important alongside timing.

Radio / TV / newspaper is the top trusted source for both.

Seed, adoption of other adaptation strategies/practices

- Nigeria (FGD): **56-57%** describe improved seeds as seeds purchased from the market/agro dealer or obtained from NGOs. Awareness and conditional use of fertilizer and herbicide/pesticide are high.
- Maharashtra: **69%** define improved seeds as packaged seeds. For fertilizer and herbicide / pesticide, awareness is low (3.8% & 29.5% respectively), but conditional use is high (80 - 93%).

Less than a third of both samples describe improved seeds as hybrid seeds.

SSP Risk attitudes and Risk Perceptions

- Nigeria: 34-45% do not want anyone to tell them what to do on their farm (autonomy).
- Maharashtra: SSPs exhibit much higher autonomy (~71%)

Both have high optimism, confidence as farmers, and willingness to take risks, but around two-thirds believe major misfortunes are beyond their control.

Implication for AgDev: Push-style extension may be less effective; Maharashtra SSPs may respond better to peer learning, demonstrations/farmer-led experimentations and digital advisory that support independent learning

Perceived control over hazards

- Nigeria: More perceived control over pests / disease (79%) and lowest for high wind, drought and floods (30%)
- Maharashtra: More perceived control for heat waves (77%) and lowest for rain timing (57%)

Implication for AgDev: Pair climate advisories with hazard-specific adaptation options to increase farmers' ability and confidence to respond, especially for hazards where perceived control is low.

Semi-arid AEZ

- Nigeria's northern belt
- The two largest ethnic groups, the Hausa and Fulani, are Muslim, and Islamic culture is embedded within the region
- Low and variable rainfall, recurrent heat, and short growing seasons
- Most commonly planted crops: sorghum (71% of farmers), cowpea (55%), and millet (54%)

Table 1: Semi-arid AEZ snapshot

Panel A: Measured exposure & livelihoods (n=223)

Indicator	Estimate
Precipitation (2005–24)	
Harmful (<480 mm)	0.5%
Borderline (480–880 mm)	82.0%
Favorable (>880 mm)	17.5%
Temperature	
Locations with high HDD	32.3%
Locations with medium-high HDD	62.8%
Livelihoods	
Avg. landholding (ha)	1.26
Avg. livestock (TLU)	1.09
Avg. daily consumption ($2021 PPP)	$2.55
Avg. distance to nearest market (km)	62.5

Panel B: Self-reported exposure & perceptions

Indicator	Estimate
Past-year exposure	
Late onset of rains	19%
Flood or torrential downpour	32%
Temperatures above 40°C	27%
Pest / disease outbreak	30%

Figure 13: Millet plantation in Kebbi state (Fieldwork March 2025). Millet is a heat-resistant crop that is well suited to the high temperatures of the semi-arid AEZ

Forecasts (NiMet CSP) 2026 growing season:

- Borno: Late onset of rains, shorter than normal rainy season, but more than normal rainfall. Severe dry spell (>21 days) June-August
- Warmer than normal (avg. 1°C): > 34°C in Feb, 37°C in March, and in some regions >40°C in April

> *"I have not done anything different to adapt to climate change. I just trust God."*
> **— Farmer, Kebbi state (semi-arid)**
>
> *Source: CRIFS Phone Survey (Mar 2025)*

Sub-humid AEZ

- Nigeria's Middle Belt and parts of the southern Guinea savanna belt, including states such as Benue, Niger, Kogi, and Oyo.
- The ethnic composition of the zone is highly diverse, with Yoruba particularly prominent, and Hausa-Fulani populations found across several states as both crop producers and pastoralists.
- The main crops planted include maize (62%), yam (37%), sorghum (36%), and cassava (35%).

Table 2: Subhumid AEZ snapshot

Panel A: Measured exposure & livelihoods (n=242)

Indicator	Estimate
Precipitation (2005–24)	
Harmful (<480 mm)	0.0%
Borderline (480–880 mm)	64.0%
Favorable (>880 mm)	36.0%
Temperature	
Locations with medium HDD	55.8%
Locations with high HDD	2.1%
Livelihoods	
Avg. landholding (ha)	1.41
Avg. livestock (TLU)	0.94
Avg. daily consumption ($2021 PPP)	$3.07
Avg. distance to nearest market (km)	73.6

Source: Phone Survey (Mar 2025) and CHIRPS/CHIRTS.

Panel B: Self-reported exposure & perceptions

Indicator	Estimate
Past-year exposure	
Late onset of rains	35%
Flood or torrential downpour	14%
Temperatures above 40°C	33%
Pest / disease outbreak	19%

Source: hone Survey (Mar 2025).

Figure 14: Cassava mounds in Benue state before 1-2 months before the beginning of the planting season (Fieldwork, March 2025). Cassava is planted year-round in the subhumid AEZ of Nigeria.

Forecasts (NiMet CSP) 2026 growing season:

- Ogun state predicted to have a severe dry spell March-May 2026.
- Between 34°C and 40°C in April and May. Most states expected to experience daytime temperatures up to 0.6°C above normal in May.

"The traditional rice variety usually takes about 8 months to mature… With improved [hybrid] seeds, we can plant rice in May and harvest in June or July, within 3 months."
— Farmer, Niger state (sub-humid)

Risk Profiles: Snapshots by AEZ

Humid AEZ

- Covers much of southern Nigeria's forest and coastal belt, including states such as Ebonyi, Ogun, and Rivers
- Characterized by high rainfall, dense vegetation, and generally favorable moisture conditions for crop production.
- Mains crops: cassava (86%), maize (43%), and yam (43%)

Table 3: Humid AEZ snapshot

Panel A: Measured exposure & livelihoods (n=230)

Indicator	Estimate
Precipitation (2005–24)	
Harmful (<480 mm)	0.0%
Borderline (480–880 mm)	10.4%
Favorable (>880 mm)	89.6%
Temperature	
Locations with low-medium HDD	100.0%
Locations with high HDD	0.0%
Livelihoods	
Female-headed households	30%
Avg. landholding (ha)	0.56
Avg. livestock (TLU)	0.20
Avg. daily consumption ($2021 PPP)	$4.75

Source: Phone Survey (Mar 2025) and CHIRPS/CHIRTS.

Panel B: Self-reported exposure & perceptions

Indicator	Estimate
Past-year exposure	
Late onset of rains	50%
Flood or torrential downpour	7%
Temperatures above 40°C	59%
Pest / disease outbreak	16%

Source: Phone Survey (Mar 2025).

Figure 15: Mango and palm oil trees in Ebonyi state (Fieldwork, March 2025)

Forecasts (NiMet CSP) 2026 growing season:

- Moderate dry spells predicted for Oyo and Kogi states Mar-May 2026.
- Means 28°C - 31°C in March-May. Expected daytime temps 0.2°C-0.6°C above normal in March.

> *"I have been experiencing very high temperatures … I harvest cassava earlier. There is nothing I can do for yam and cassava plants that are not ready for harvesting."*
> **— Farmer, Ebonyi state (humid)**

Conclusion

Implications: message, target, time

Phrasing aside, a lack of awareness, limited availability, financial constraints, inadequate climate information services, and perceived limited agency over climate-related risks appear to contribute to decreasing technology adoption in among Nigerian SSPs.

Message

Don't market to sell — message to inform.

- Lead with risks farmers believe they control (pests, disease) before extreme weather.
- Provide total cost (seed + fertilizer + labor + annual repurchase), not seed price alone.
- Use trusted health/quality certifications as a vehicle for communicating stress resistance.

Targeting

Use observable proxies for risk perception.

- Customize for the dominant hazard, perceived control, and trusted info source by AEZ.
- Where fatalism is highest (semi-arid, 76%), consider imams and community allies in messaging.
- Where time horizons are short, emphasize near-term yield rather than long-run adaptation benefits.

Timing

Information value depends on timing.

- Leverage NiMet's 2026 SCP LGA-level forecasts, onset and cessation dates.
- Align input availability and credit windows with planting; under-stocking causes structural rationing.
- Be explicit about "testing" phases, as trust is easy to lose, hard to win back.

- *Upstream measured risk and downstream perceived risk are partially misaligned, and it is the perceived risk that ultimately drives uptake.*
- *That gap can be closed through technology and information design, even though some attitudes such as fatalism and natural variability may be more difficult to overcome.*

Across AEZ results

What do farmers really want?

Figure 25: Ondo state women farmers telling the research team that they want "women's empowerment"

- In fieldwork visits across 5 enumeration areas, farmers expressed aspirations beyond what structured surveys could capture
- Needs ranged from education about improved seeds to fertilizer availability and rural infrastructure investment
- Most striking: women farmers in Ondo state approached the research team unprompted to announce that what they wanted was "women's empowerment"
- Climate adaptation can advance this empowerment if resources reach both female and male SSPs who currently lack access to credit, inputs, or productive assets

Summary of findings

- **Climate extremes are becoming more frequent but Self-reported ≠ measured.** Over half of households exposed to meteorological drought do not report being affected. Larger households and more diversified livestock holdings may buffer hazard sensitivity.
- **Technology awareness is low.** Only 20% of respondents reported knowing about hybrid seeds.
- **Adoption conditional on awareness is high:** Among the aware, 72% reported using hybrid seeds in the last agricultural season.
- **Measurement limitations likely mask actual adoption rates.** Key agricultural surveys ask about "improved variety" seed adoption, with use estimates among male plot managers falling from 16% (2015-16) to 5% (2023-24). We find that SSPs commonly define "improved" by where seed was obtained (e.g. market or NGO). Only about a third of respondents identified a hybrid as an improved seed.
- **The term hybrid is not consistently understood.** "Hybrid" does not similarly translate to consumers or suppliers across local languages. For example, in the Yoruba language, the term for hybrid "irugbin arabara" is also used for improved (non-traditional) seed more broadly.
- **Misidentification remains a problem:** we found non-improved seed identified as improved and visa versa.
- **High upfront costs and persistent liquidity constraints constrain adoption despite high expected returns.** Among farmers aware of hybrid seeds, 96% expect them to increase profits, yet 28% don't use them, citing cost as a top barrier to uptake.
- **More uncertainty around costs than benefits**: SSPs are more homogeneous in their beliefs around technology benefits than in their beliefs around technology costs, including labor and other inputs.
- **Farmers report feeling helpless against weather shocks but confident against pests.** 71% and 59% feel unable to control high wind and drought losses, respectively. Yet only 20% feel unable to control crop losses to pest outbreaks.
- **Climate information often doesn't translate to action.** 52% of farmers who received weather information didn't act on it. Top reasons were that the information wasn't relevant to their farm (27%), that they had no affordable way to respond (27%), or that it arrived too late (20%).
- **Fatalism:** While being generally optimistic despite beliefs in a worsening climate, over two-thirds of respondents felt that "if misfortunate is meant to strike my farm, there is nothing I can do about it."
- **AEZ variability:** across expectations of future climate risk; awareness and use of production technologies and crop and soil strategies (with water management consistently the least known across regions); and SSP attitudes towards risk and the future. There are AEZ differences around trusted sources of weather information, but reasons for not acting on information (timeliness and relevance) are more common.