



Climate adaptation in Rangpur, Bangladesh

Climate shocks, impacts, responses, and adaptive capacity of local food systems

Data Note 15

December 2023

ABOUT THIS BRIEF | The Transforming Agrifood Systems in South Asia (TAFSSA) district agrifood systems assessment aims to provide a reliable, accessible, and integrated evidence base that links farm production, market access, dietary patterns, climate risk responses, and natural resource management with gender as a cross-cutting issue in rural areas of Bangladesh, India, and Nepal. It is designed to be a district-level multi-year assessment. Using data collected in February– March 2023, this brief describes experiences of climate shocks, perceived impacts and responses, and access to different types of resources that can contribute to the adaptive capacity of households. Here we use the term “climate shocks” to represent manifestations of climate variability and weather extremes that households perceive and respond to. This is one of a set of data notes that, together, provide a holistic picture of the agrifood system in the district.

Figure 1. Map showing surveyed villages in Rangpur, Bangladesh

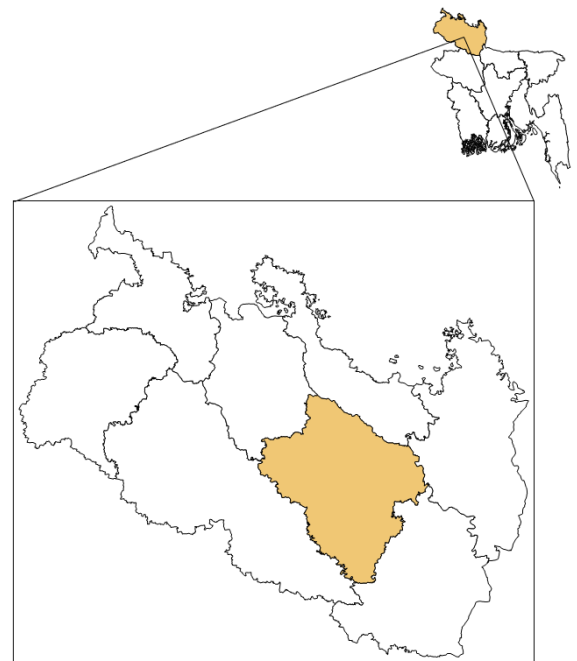


Figure 2. Highlights from this brief



27.0%
households
report impacts
from climate
shocks in past 2
years



80.3%
of impacted
households
adopt response
strategies to
climate shocks



59.8%
households
access weather
forecast
information



44.2%
households do
not own any land



99.8%
of cultivating
households have
access to
irrigation

OVERVIEW OF CONTENTS |

This brief captures the experience and impact of climate shocks on households, along with the responses that households adopt to these shocks. It then provides a picture of access to different types of capitals that constitute the basis of households' adaptive capacity. In this brief we present 'generic' adaptive capacity (Mortreux and Barnett 2017) as an outcome of a households' access to five types of capital:

Natural capital - natural resources required to sustain a livelihood to enable adaptation

Physical capital – infrastructural support and technological solutions to impacts

Financial capital – required to bear the cost of adaptation

Social capital - social bonds and networks to assist adaptation

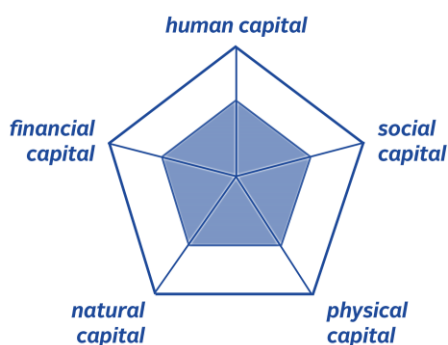
Human capital - the physical and mental resources to adapt

- (Mortreux and Barnett (2017)

This conceptual framework five capitals (Figure) emerges from *the sustainable livelihoods framework*, which is discussed in the Annex section to this brief along with the indicator selection.

Given the climate change focus of the brief, an added emphasis on 'access to climate information' has been included.

FIVE CAPITALS FRAMEWORK



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DISTRICT CLIMATE AND RESOURCE PROFILE

Table 1. Village resource regime

Sample villages (N)	50
LAND	%
Villages reporting land conversion -	
• From agriculture to built-up area	96
• From forest/water-body to agriculture	34
Villages reporting soil texture -	
• Sandy (light soil)	50
• Loamy and silt (medium soil)	98
• Clay (heavy soil)	32
WATER	%
Villages reporting decline in groundwater level over last 5 years	50
Villages reporting water quality issues:	
• Iron	98
• Salinity	6
Predominant source of agricultural water:	
• Groundwater	100
• Surface water	0
• Rainfed	0
Energy source for irrigation in village	
• >50% irrigation pumps in village run by diesel	48
• >50% irrigation pumps in village run by electric	52
• Villages with use of Solar pumps	10
COMMON PROPERTY RESOURCES	%
Villages with community ponds	6
Villages with community forest	6
Villages with pasture/grazing lands	10

Note: The figures in this table are self reported by key village respondents through a structured community level questionnaire

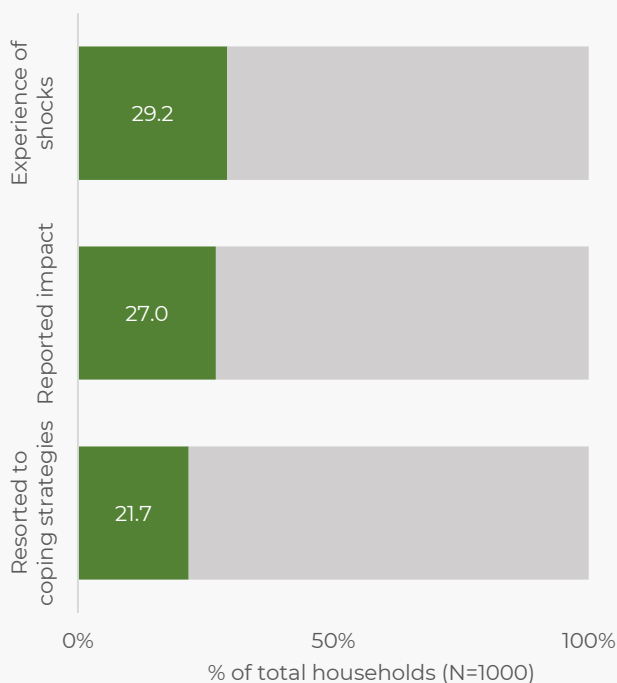
Table 2. Household characteristics

TOTAL HOUSEHOLDS (N)	1000
Owning land %	56
Operating land %	79
Cultivating crops %	76
Irrigating land %	76
Reporting experience of shocks %	29
Main source of income	
• Crop cultivation, %	37
• Business, %	26
• Wages, %	21

ASSESSING ADAPTATION |

Climate adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC) as “the process of adjustment to actual or expected climate and its effects”. Here adaptation assessment is approached through three levels of related questions– whether respondents experienced any climate shocks in last 2 years, how were they impacted by these shocks, and how they responded to these shocks (immediate coping strategies and longer-term changes in farming practices). Perception or experience of shocks, and their impacts are a function of not only the biophysical incidence of climate shocks but also households’ preparedness and capacity to cope and adapt.

Figure 3. Experience, impact, coping to climate shocks



FINDINGS:

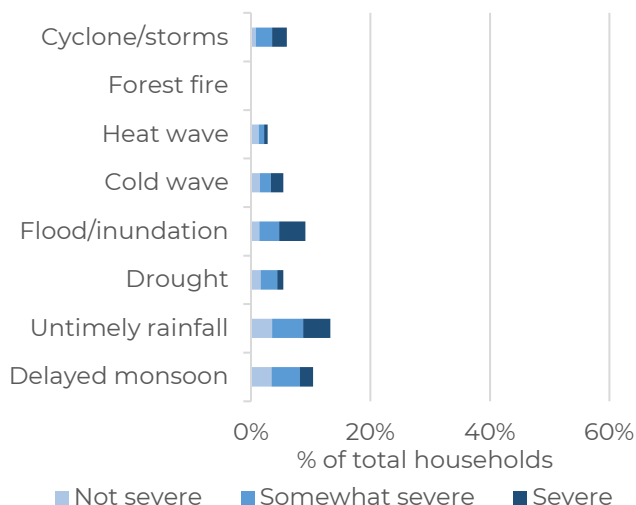
- ✓ Among the surveyed households, 29.2% reported experiencing climate shocks. Within this group, 92.4% indicated some level of impact, which corresponds to 27% of the total sample households. Furthermore, 80.3% of the households impacted by these shocks reported employing various response strategies to cope with and adapt to them, accounting for 21.7% of the total sample households.



27% of households report impacts from climate shocks in past 2 years; 22% of households report adoption of specific coping and adaptation strategies

EXPERIENCE AND IMPACT OF CLIMATE SHOCKS

Figure 4. Perceived experience of climate shocks and severity of impact (2021-2022)

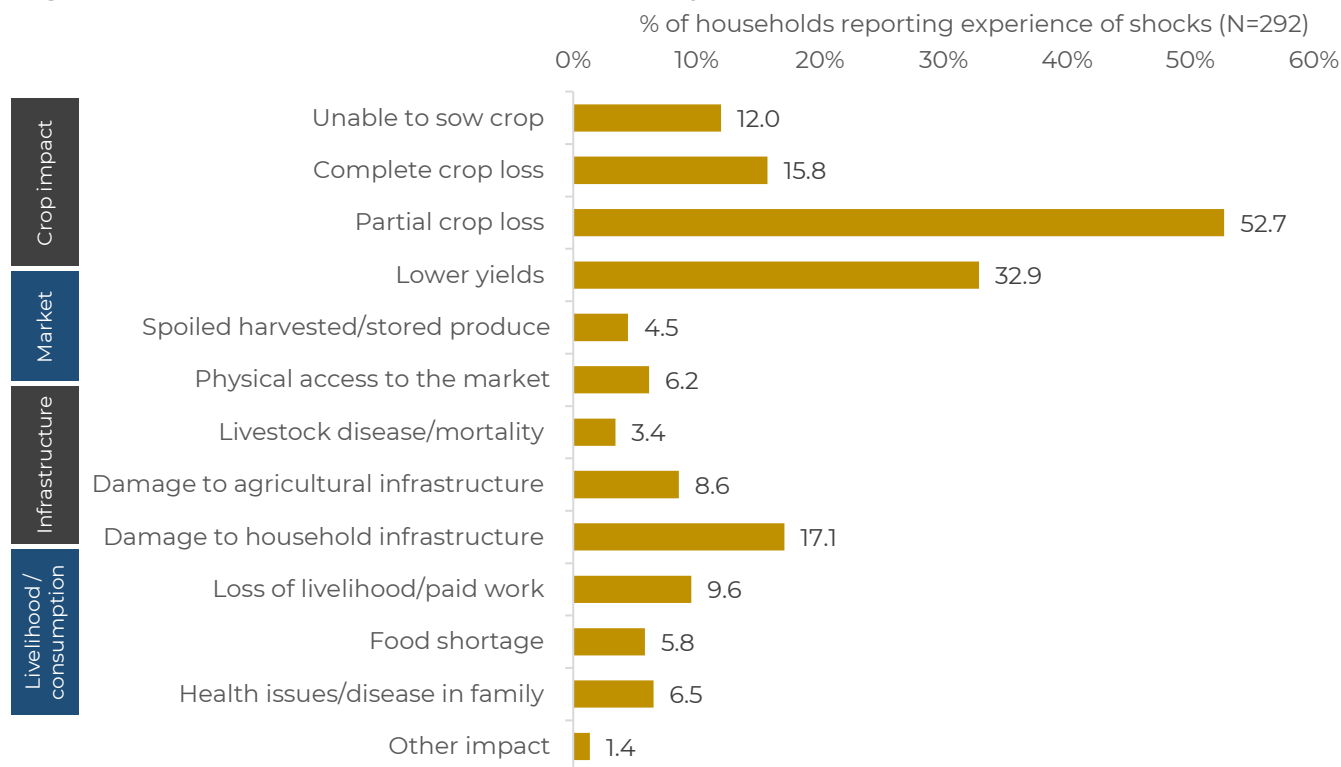


IMPACTS AND RESPONSE |

To explore the impacts of climate shocks, households were asked about (1) the perceived severity level of the impact on the household's economic condition, and (2) the type of impact(s). Response strategies included both immediate coping as well as changes in farming practices. A range of categories of response options were offered to survey participants based on literature and validated surveys.

Impacts and responses are presented at two levels – disaggregated by different climate shocks (Fig. 6 and Fig. 8), and cumulative across different climate shocks (Fig 5 and Fig. 7). The 'cumulative' assessments provide the overview picture for different impact and response categories across all shocks affecting the household i.e. at least one valid response for a particular impact or response strategy across all of the shocks experienced by that household.

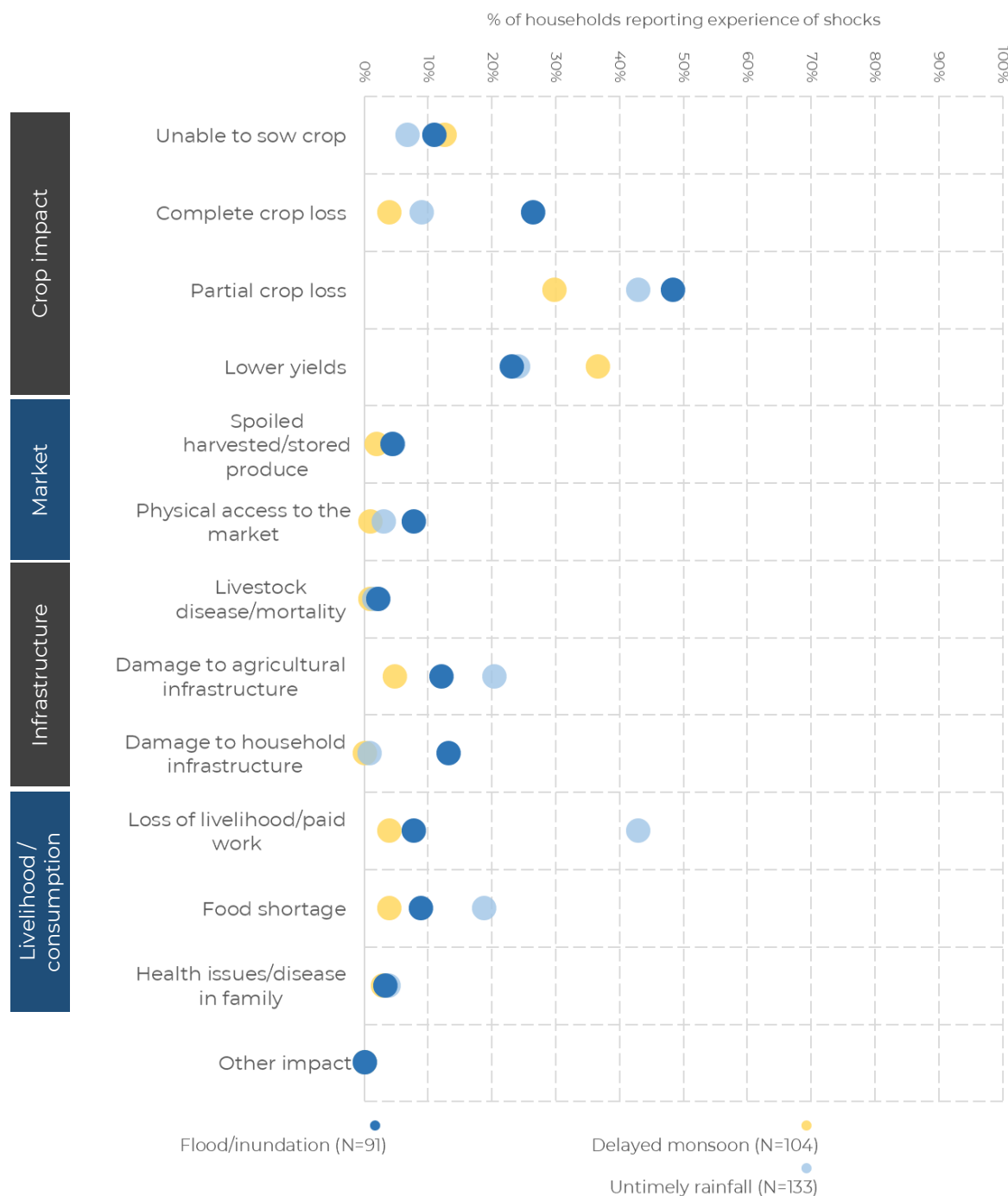
Figure 5. Cumulative impacts reported by households to climate shocks



FINDINGS:

- ✓ The most prevalent impacts of climate shocks reported by households were partial crop loss and reduced crop yields. Additionally, these shocks had significant repercussions on infrastructure and livelihoods, as reported by a substantial portion of the surveyed households.
- ✓ In the past two years, the most frequently experienced shocks were delayed monsoons, untimely rainfall, and flooding or inundation.

Figure 6. Impacts reported by households under different climate shocks (top 3 shocks by percentage of households experiencing shock)



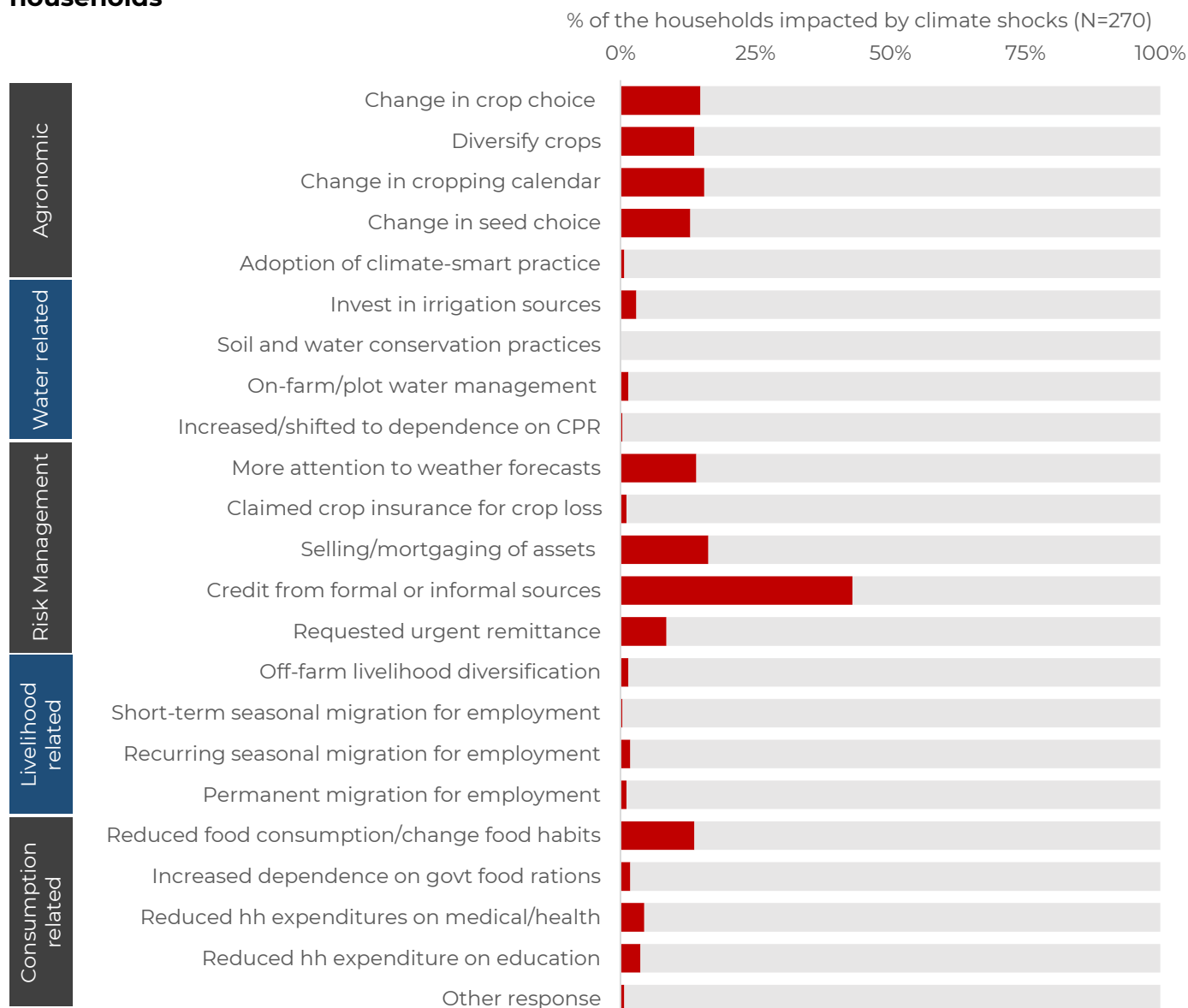
Note: Cyclone/storms, forest fires, droughts, cold wave, heat wave, have not been included in this list since percentage of households reporting experience of these shocks are below 30% of households reporting any experience of a shock.

FINDINGS :

- ✓ Delayed monsoon primarily led to crop yield impacts, while untimely rainfall and flooding or inundation resulted in crop loss.
- ✓ Untimely rainfall had the most significant reported impact on infrastructure damage, livelihood loss, and food shortages.

RESPONSE STRATEGIES TO CLIMATE SHOCKS

Figure 7. Cumulative response strategies to any climate shocks adopted by households



Note: Cumulative: Atleast one valid response for a household for a particular response strategy option for any shock experienced by that household

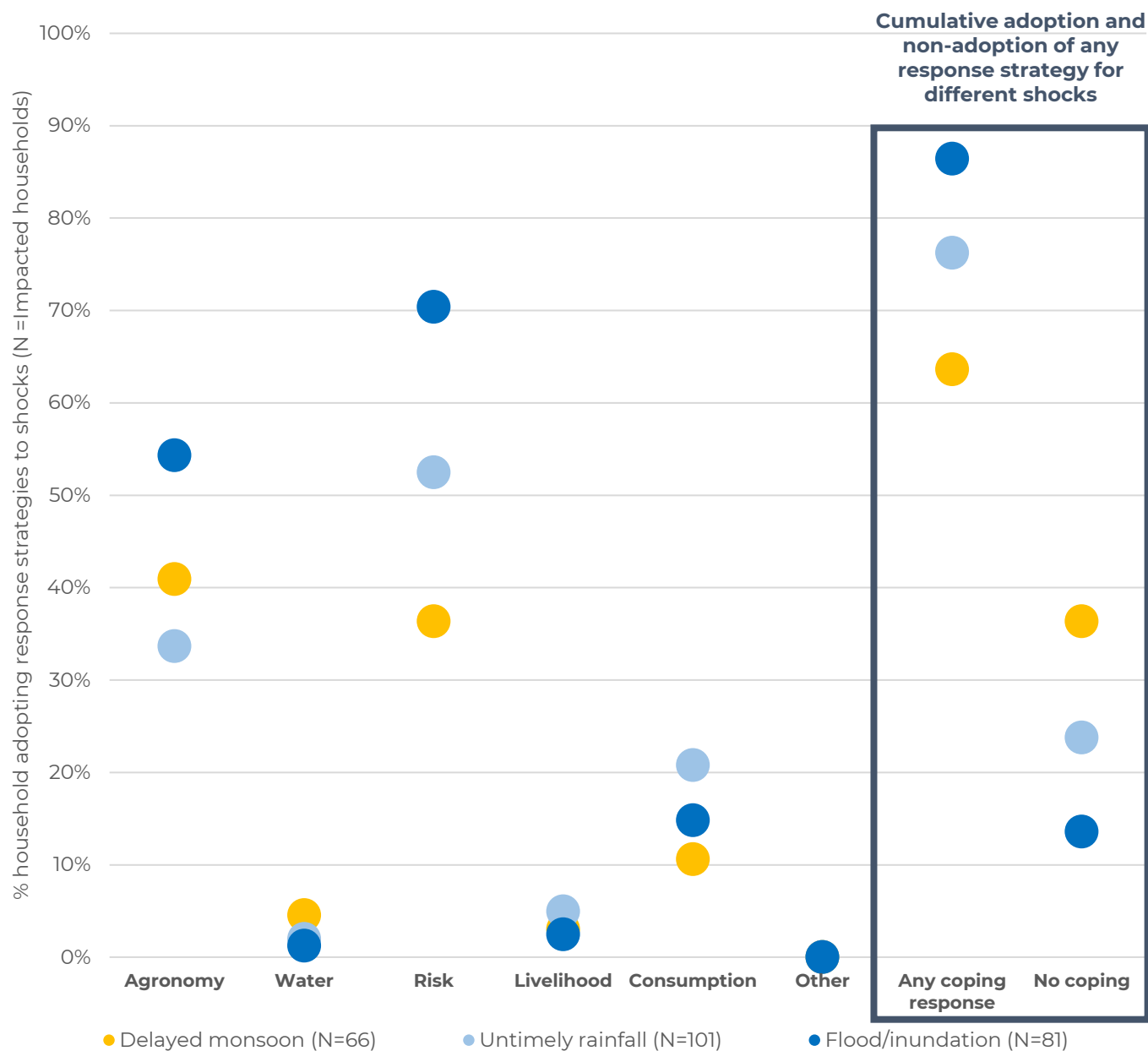
The coping strategies may reflect broader groups of strategies which were highlighted in the questionnaire as examples

- CPR – Common Property Resources (public/community land and water resources)
- Climate-smart practices – crop establishment regimes such as zero-tillage, intercropping, direct seeded rice etc.
- On farm/ plot water management - increase irrigation, decrease irrigation, drip/ sprinkler etc
- Those not reporting any response strategies either depend more on personal savings, increase dependence on production from their own farm for self-consumption, or they did not report severe impacts

FINDINGS :

- ✓ The most frequently reported coping response was a dependence on risk management measures, including reliance on credits, remittances, and selling or mortgaging assets.
- ✓ Additionally, there was a noteworthy reporting of short-term farm-level responses related to crop choice, seed selection, and adjustments in the crop calendar.
- ✓ 13.7% households resorted to reducing food consumption/changing food habits in response to shocks

Figure 8. Response strategies to climate shocks reported by households under different climate shocks (top 3 shocks by percentage of households experiencing shock)



Note: The X-axis represents grouping of detailed response strategies under five broad categories as presented in Figure 5. Please refer to Figure 5. for the different types of responses under these broad categories presented. Cyclone/storms, forest fires, droughts, cold wave, heat wave, have not been included in this list since percentage of households reporting experience of these shocks are below 30% of households reporting any experience of a shock.

FINDINGS :

- ✓ Risk management and agronomic response strategies were the most frequently reported, with a significant portion of these responses being in reaction to the impacts of floods, such as crop loss and infrastructure damage.
- ✓ Livelihood and consumption-related strategies were most commonly adopted in response to the impacts of untimely rainfall, which included crop loss, food shortages, and the loss of livelihoods.

ADAPTIVE CAPACITY – NATURAL CAPITAL

Figure 9. Land access by size of landholding (owned and operational)

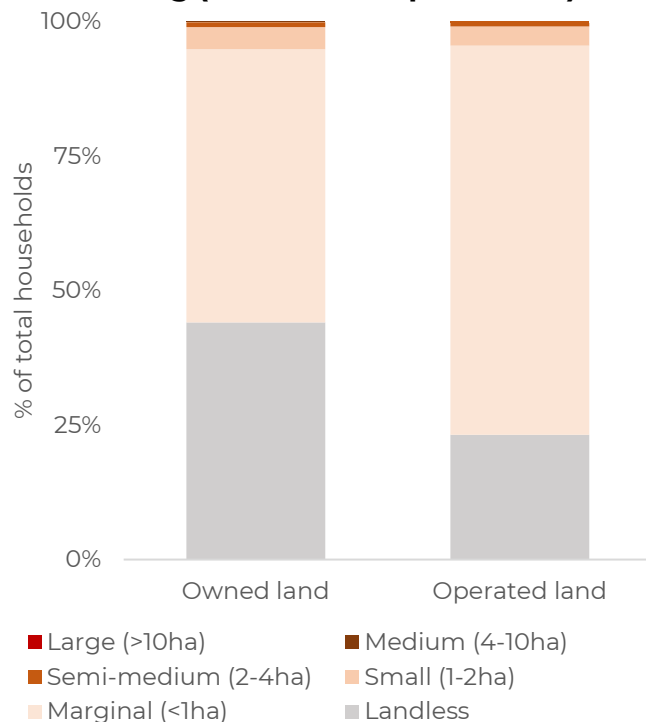


Figure 10. Access to land by type of ownership

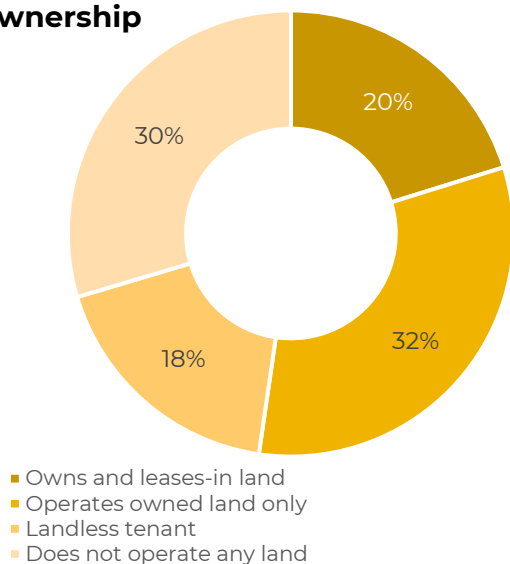
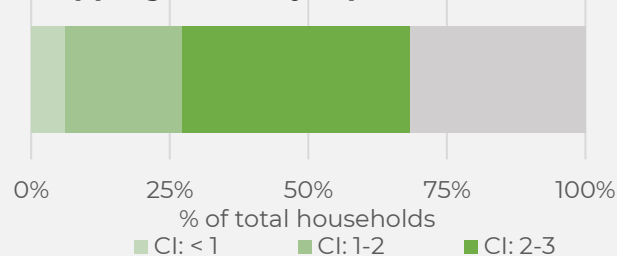


Figure 11. Cultivated land by farm cropping intensity reported



Note: Cropping intensity (CI) = Net Sown Area / Gross Cropped Area

Figure 12. Access to irrigation

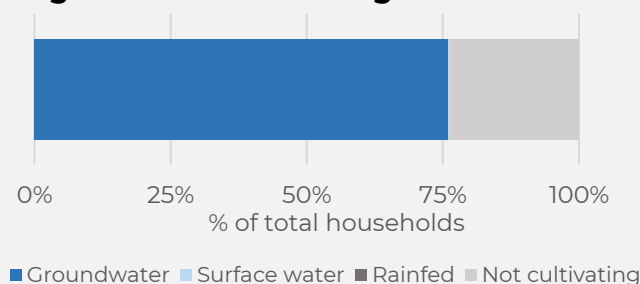


Table 3. Water insecurity

IRRIGATION WATER		% of cultivating households
Cultivating land but not irrigating		0.1
Reporting labor scarcity for irrigation		1.7
Reporting poor access to irrigation among their two most important challenges in agriculture		8.8
HOUSEHOLD WATER		% of total households
Reporting worry about not having enough water for all household needs (sometimes/often/always)*		2.4
Reporting worry about having to change schedules/plans because of problems with water situation (sometimes/often/always)*		2.4

* Variables compiled from HWISE categories: Sometimes (3-10times), Often (11-20 times), Always (>20 times)

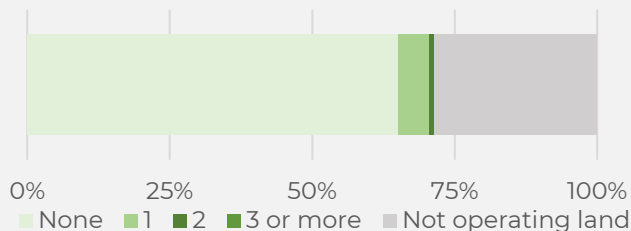
FINDINGS :

- ✓ In the Rangpur region, there is a high incidence of landlessness, with 44% of households facing this situation, which restricts their opportunities for income generation and access to rural loans. Additionally, 18% of households in the area depend entirely on tenant farming for their livelihoods.
- ✓ Land is intensively cultivated.
- ✓ All farm households are irrigating at least some of the time, mostly using groundwater.
- ✓ Water-related constraints are minimal for both irrigation and household water supply in Rangpur.

ADAPTIVE CAPACITY – PHYSICAL CAPITAL

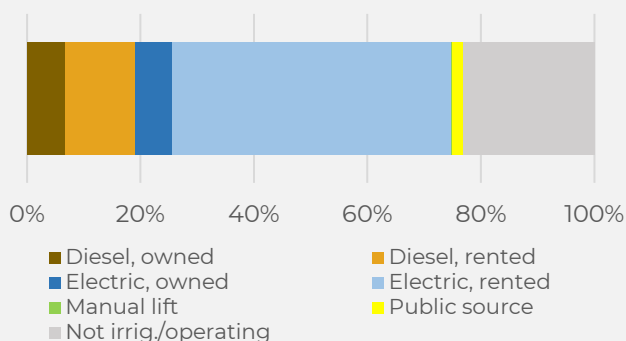
Figure 13. Ownership of productive assets

13a. AGRICULTURAL EQUIPMENT

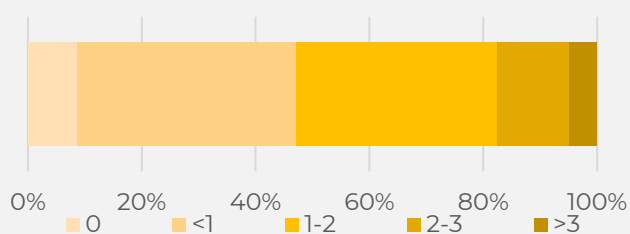


Note: The legend categories show how many types of key agricultural machines are owned by the household among the following: 2-wheel tractor / 4-wheel tractor with rotavator / 4-wheel tractor with cultivator / Thresher / Combine harvester / zero tillage/seed drill with 4-wheel tractor / Potato transplanter

13b. IRRIGATION ENERGY SOURCES

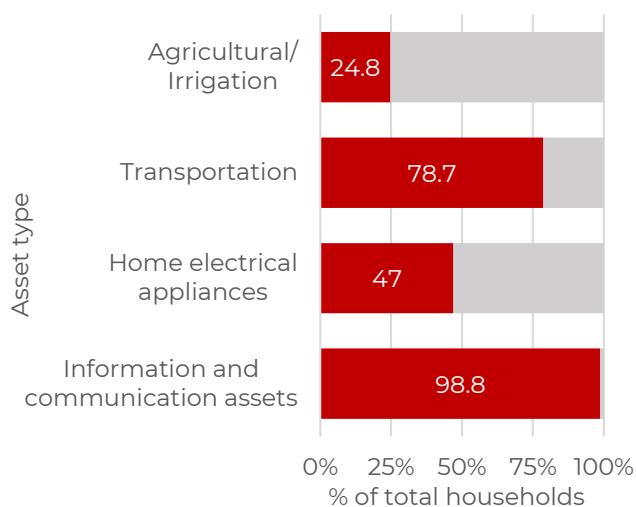


13c. LIVESTOCK UNITS



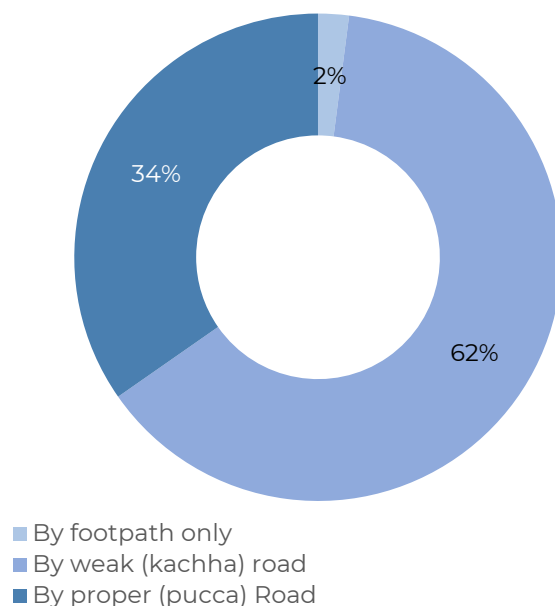
Note: Livestock Units - an 'exchange ratio' among livestock species and obtained by converting the body weight into the metabolic weight, which is multiplied by the units of animals owned by the household (Chilonda and Otte, 2006; FAOSTAT, 2022). Cow in USA is used as the reference species

Figure 14. Ownership of household assets



Note: Agricultural - include thresher, tractor and water pump
Transportation - bicycle, motorcycle/scooter, animal drawn cart, rickshaw, car
Communication - radio, TV, phone, internet, computer

Figure 15. Road connectivity



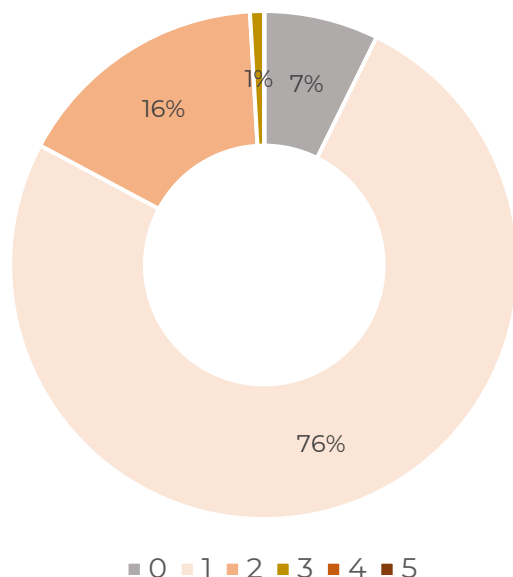
Note: The chart presents % of households in villages at different distance categories from nearest market

FINDINGS :

- ✓ Ownership of agricultural and irrigation assets is relatively low in the Rangpur region. Due to the low ownership of agricultural and irrigation assets, there is a significant and well-developed service provision market for irrigation in the Rangpur.
- ✓ The majority of households own livestock, which serves as a source of income as well as a form of insurance during shocks and adverse events.
- ✓ Road connectivity in the region is moderately poor, with over 60% of the sampled households, located in villages with limited access to poorly maintained or unpaved roads.

ADAPTIVE CAPACITY – FINANCIAL CAPITAL

Figure 16. Household occupational/livelihood diversity



Note: Number of different **primary** occupations (longest time spent during last 365 days) household members are involved in

Figure 17. Primary and secondary sources of income of household

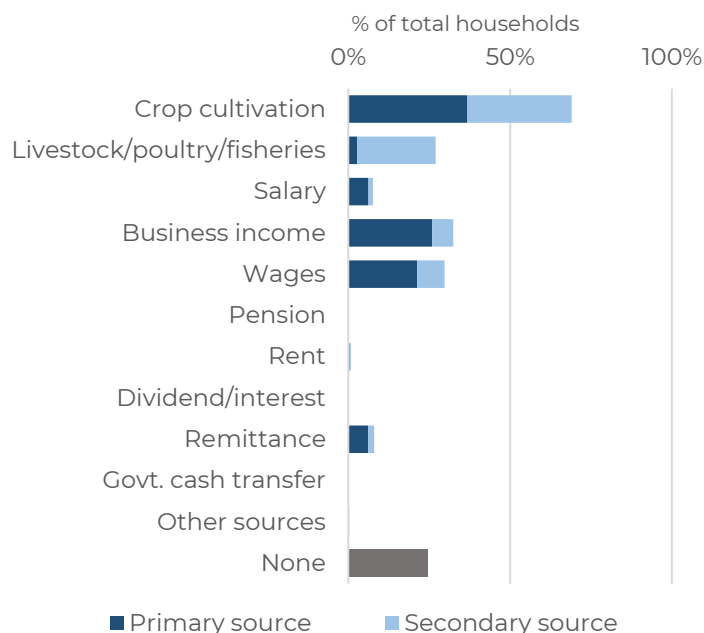


Figure 18. Outstanding loan and credit source

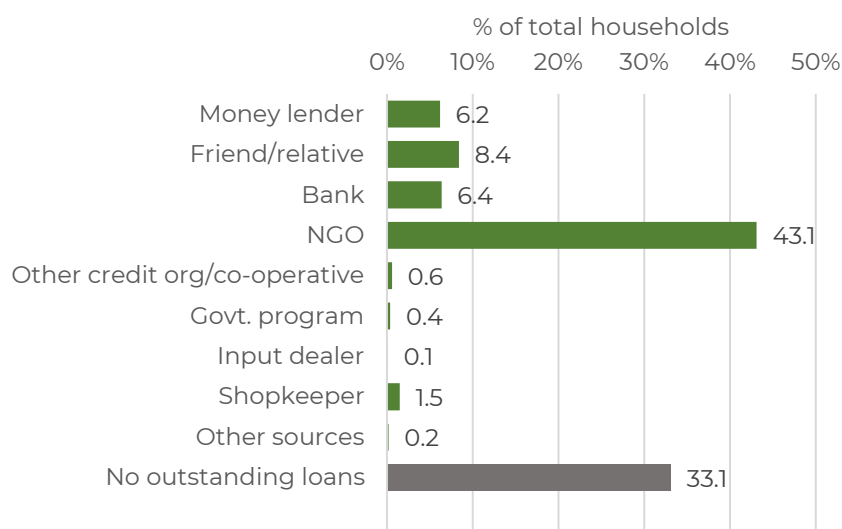


Table 4. Access to formal credit and insurance services

	% hhs
Bank account	31.0
Kisan credit card	2.5
Life insurance	4.2
Crop insurance	0.2
Livestock/poultry/fish insurance	0.1
Health insurance	0.9

FINDINGS :

- ✓ A significant majority of households, over 80%, have low occupational diversity. Specifically, around 7% of households have no primary occupation. Over 76% of households rely on one primary occupation.
- ✓ Wage labor, business, and crop cultivation are the most predominant sources of income among households.
- ✓ Microfinance provided by NGOs is the most important source of credit, with most other key credit sources being informal local providers.
- ✓ Access to formal banking and insurance services is very limited.

ADAPTIVE CAPACITY – HUMAN CAPITAL

Figure 19. Education level of household

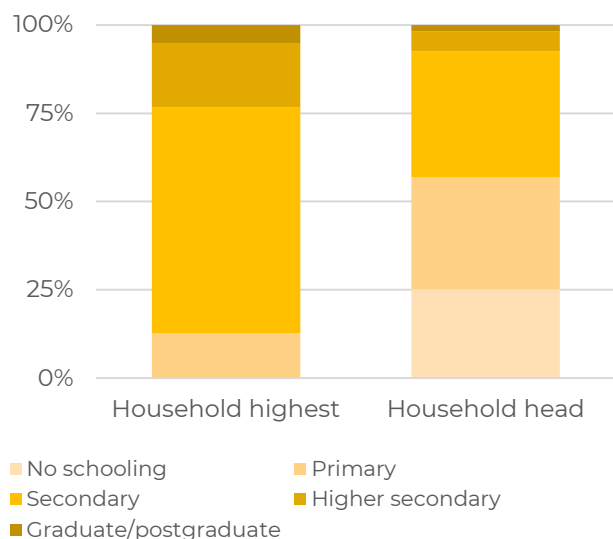
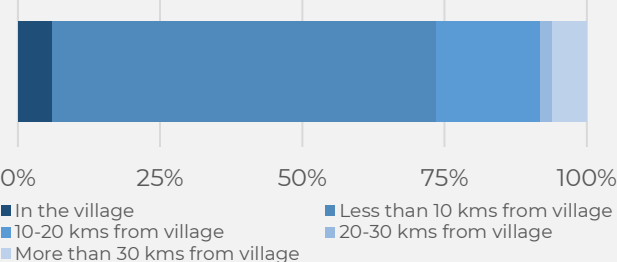
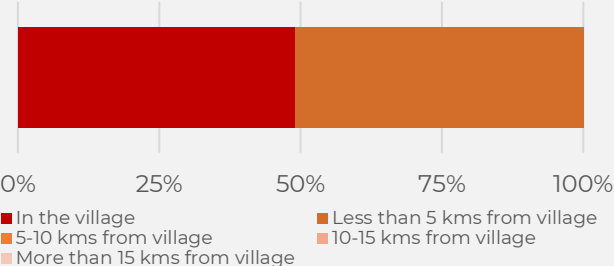


Figure 20: Access to Health facilities

20a. DISTANCE TO GOVERNMENT HOSPITAL

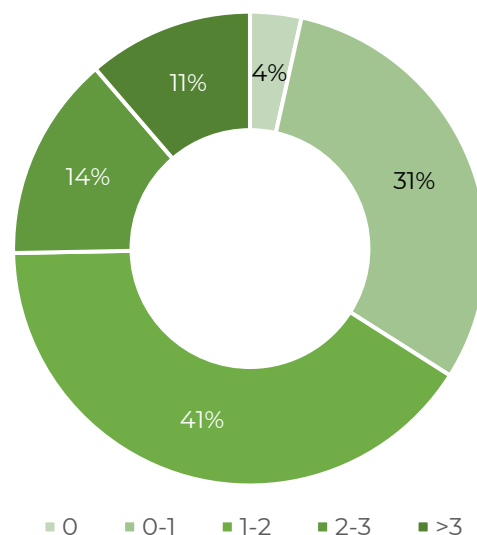


20b. DISTANCE TO PRIMARY HEALTH CENTRE



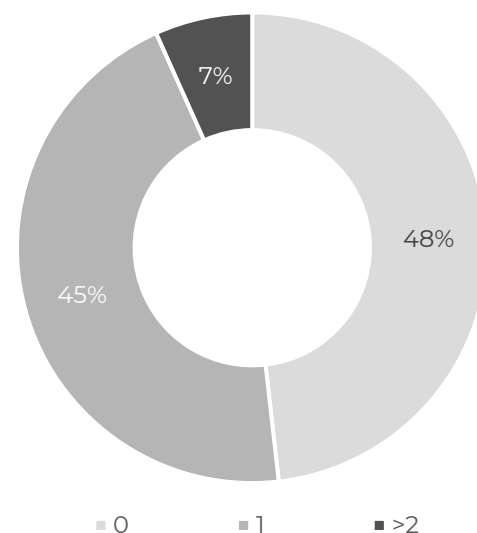
Note: The two charts present % of households in the villages in different distance categories from nearest hospital/PHC

Figure 21. Working members dependency



Note: The dependency ratio is calculated as the number of non-working members in the household per working member.

Figure 22. Family labour in agriculture



Note: The chart shows the number of family members in the household involved in agriculture as their primary occupation

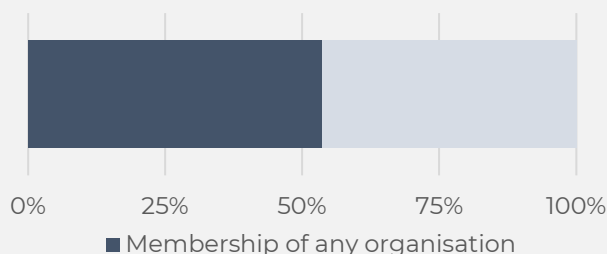
FINDINGS :

- ✓ More than 50% of households have heads with very low education levels, with either no schooling or education only up to the primary level.
- ✓ Over 60% of households have dependency ratios of more than 1 non-working members per working member, relying heavily on working members
- ✓ Nearly half of households have no family members engaged in agriculture as their primary occupation.
- ✓ Access to health services within or close to the village is high

ADAPTIVE CAPACITY – SOCIAL CAPITAL

Figure 23. Membership of village/community organizations and groups

23a. MEMBERSHIP STATUS



23b. TYPE OF ORGANISATION/GROUP

% of total households

0% 25% 50% 75% 100%

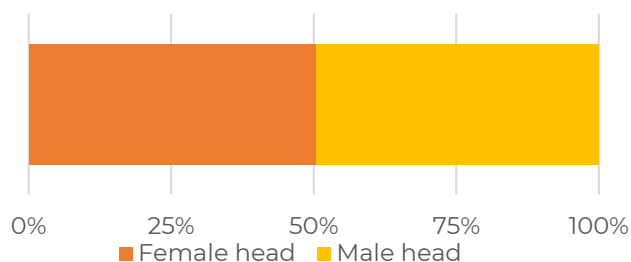


Note: The categorisation of organisation/group types include the following:

- Agri marketing - Farmer producer organization or collective (FPO/FPC); Agricultural, milk, or another co-operative
- Ethnic - Religious or social group or festival society; Caste association
- Socioeconomic - Youth club, sports group, or reading room; Development group/NGO
- Micro-finance - Self Help Group (Women Groups); Credit or savings group
- Special interest - Trade union, business, or professional group; Community forest user group; Farmer's union

Figure 24. Social category of household

23a. WOMEN-HEADED HOUSEHOLDS



23b. SOCIAL GROUP OF HOUSEHOLD

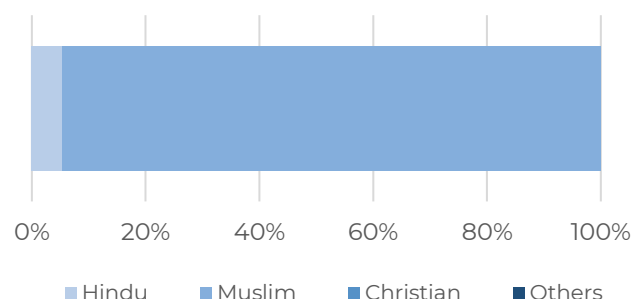
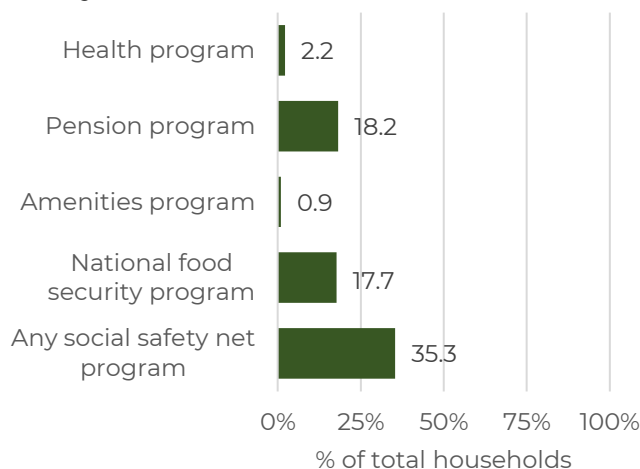


Figure 25. Access to government social safety nets



FINDINGS :

- ✓ Membership in community groups is limited, primarily consisting of micro-finance groups.
- ✓ Religion serves as the primary axis of social group identification.
- ✓ Access to government support is minimal, with over 60% of households having no access to any social safety net programs.

ADAPTIVE CAPACITY – CLIMATE INFORMATION SERVICES

Figure 26. Access to weather forecast, technical advisory, and adoption

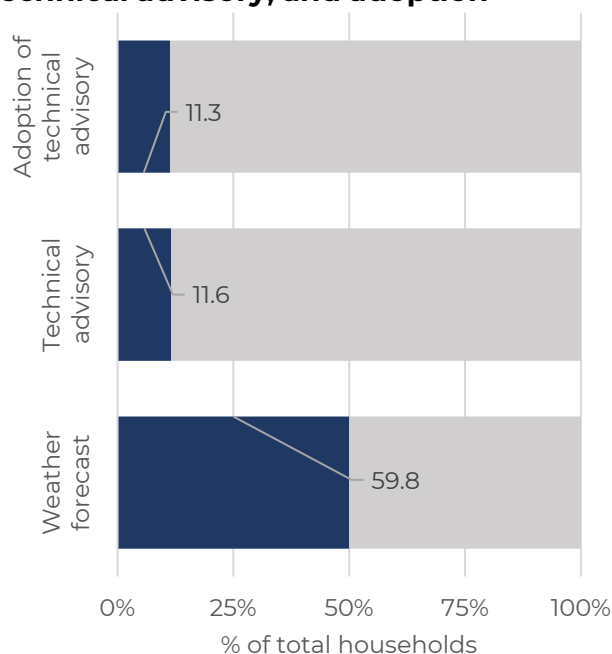


Figure 27. Source of weather information

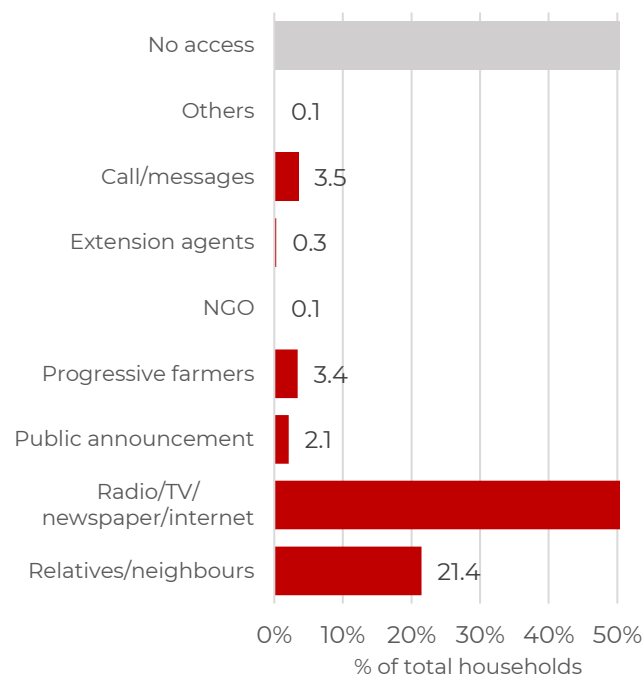
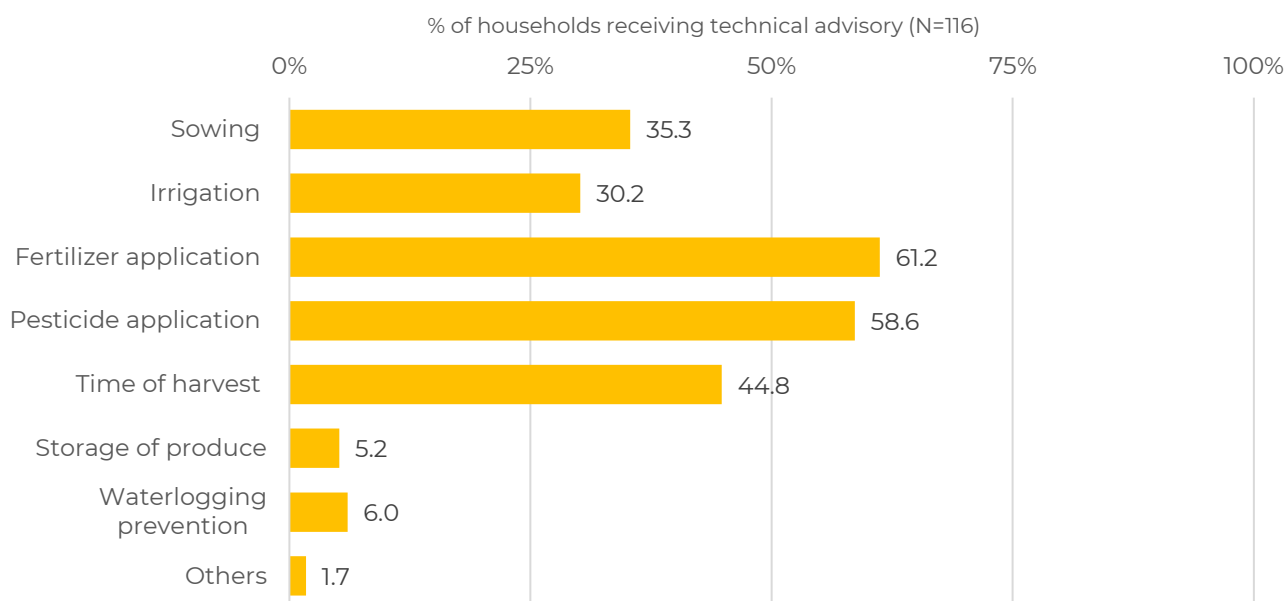


Figure 28. Subject of technical advisory based on weather forecast



FINDINGS :

- ✓ There is moderate access to weather forecast information, and only about 11% households receive any technical advisory based on forecasts.
- ✓ Despite low access to technical advisory, the adoption of advisory by these households is high
- ✓ Most weather forecast information are received from media and informal sources
- ✓ Technical advisory is mostly focussed on information related to fertiliser/pesticide application and harvest schedule



60% of households receive weather forecasts through various sources, but only 12% households receive technical advisories for agriculture based on weather forecasts

KEY TAKEAWAYS

1. Around 30% of households in Rangpur report an overall experience of climate shocks. Household perception of these shocks is closely associated with preparedness and sensitivity to them. Several key aspects of capital access could play a role in enhancing adaptive capacity and reducing sensitivity to shocks in the region.
 - Nearly full coverage of irrigation among farming households
 - High water security (both for irrigation and household water)
 - High cropping intensity of cultivated land
 - High access to credit through micro-finance NGOs
 - Moderate access to weather forecasts
2. Approximately 27% of rural households report experiencing shocks, and among these, 45.2% indicate severe impacts from at least one of the shocks. These households could potentially benefit from well-planned development substantial support to strengthen their adaptive capacities and reduce sensitivity to shocks. Several aspects of low capital access could constrain the adaptive capacity of these households, including:
 - High incidence of landlessness among households
 - Low ownership of agricultural assets and high dependence on rental markets for irrigation
 - Poor road connectivity
 - Access to banking and insurance services is very low
 - Low levels of membership in community organizations and groups
 - Very low access to government social safety net programs

KEY AREAS FOR ACTION: QUESTIONS FOR CONSIDERATION

1. What are the potential policy provisions for secure employment opportunities in the face of loss of agricultural labour opportunities due to climate and market uncertainties?
2. How can access to banking and insurance services be improved to provide more secure options for risk management in the face of climate shocks?
3. How can weather forecast services be integrated with associated technical advisories be improved?
4. How can market linkages be improved under conditions of poor road connectivity?
5. NGOs have high reach in the district for credit services. Is there potential for these institutions to supplement government programs for providing social safety nets?
6. How do social inclusion and community structure influence adaptability to climate shocks? What social and community actions that play a protective role?

ANNEXURE: CONCEPT OF ADAPTIVE CAPACITY

ADAPTIVE CAPACITY |

Adaptive capacity is defined as “*The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.*” In this data note, we present adaptive capacity through an assessment of access to different types of capital (Five Types of Capital Framework): natural capital, physical capital, financial capital, human capital, and social capital. These five types of capital form the basis of ‘generic’ adaptive capacity to a range of threats (Mortreux and Barnett 2017). In addition, because of the climate change focus of this brief, we emphasized access to climate information.

This framework is often used as the basis for adaptive capacity assessments. However, research initiatives employ different indicators depending on the particular context, level of assessment (household/local/sub-national/national), and availability of information, and different methods for prioritization of sub-indicators (Prabhakar and Srinivasan 2011, Siders 2018). Therefore, in this brief, the goal is not to produce a final set of sub-indicators, but to provide a picture of the access to each type of capital through several indicators that the TAFSSA local food systems assessment offers. Common indicators/groups of similar indicators were categorized based on a review of the literature on adaptive capacity assessments at the household scale and focused on the South Asia context.

FIVE CAPITALS FRAMEWORK FOR SUSTAINABLE LIVELIHOODS

The *sustainable livelihoods framework*, building on the work of Chambers and Conway (1992), provides a structure of ‘five capitals’ pentagon, access to which are linked to sustainability of livelihood outcomes in a vulnerability context. Mortreux and Barnett (2017) summarize their role in adaptation as:

“ **Natural capital** - to provide the natural resources necessary to sustain a livelihood to adapt (such as land, water, and vegetation for farming practices)

Physical capital – to provide the necessary infrastructural support (such as roads and irrigation) and technological solutions to impacts.

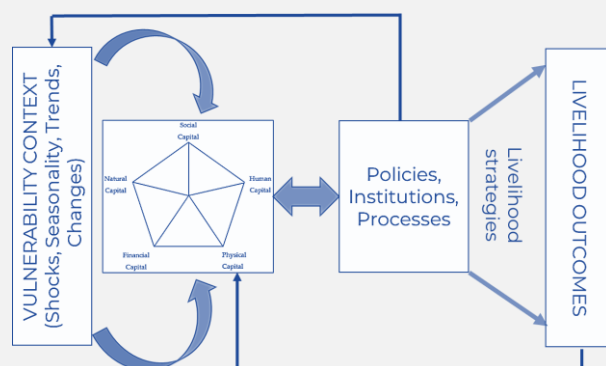
Financial capital - to pay for adaptation

Social capital - to provide the social bonds and networks to assist adaptation,

Human capital - to provide the physical and mental resources to adapt (education and health). “

- Mortreux and Barnett (2017:2)

SUSTAINABLE LIVELIHOODS FRAMEWORK



ANNEXURE: INDICATOR DOMAINS OF ADAPTIVE CAPACITY

Based on reviewed literature (Datta & Behera, 2022; Sardar et.al.2019; Brown et.al 2019; Maharjan et.al 2021; Khanal & Wilson 2019; Sam et.al 2019; Venus et.al 2022; Aryal et.al 2021; Devkota et.al 2021) we identified numerous household level variables that are used to represent the access to different capitals for the assessment of adaptive capacity in South Asia. These may be grouped under the following common and recurring indicator categories:

NATURAL CAPITAL

- Land size
- Type of land ownership
- Land/soil quality/fertility
- Cultivated area
- Irrigation/water resources

PHYSICAL CAPITAL

- Type of irrigation
- Road access
- Distance to markets
- Household asset ownership
- Agricultural equipment
- Livestock ownership

FINANCIAL CAPITAL

- Income source diversification
- Access to credit/insurance
- Total income/Household expenditure

HUMAN CAPITAL

- Farming experience/Family labour
- Education level
- Health access
- Dependency ratio/working members
- Age of Household head

SOCIAL CAPITAL

- Membership/leadership in networks/groups
- Dependence on family and friends
- Access to government/NGO/market services and support
- Social category of Household (gender, caste)
- Training access and information

CLIMATE SPECIFIC KNOWLEDGE AND INFORMATION

- Belief/perception of climate change
- Access to information about climate change and weather forecast
- Access to extension/training

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AUTHORS

Shreya Chakraborty, Researcher, IWMI
Anurag Banerjee, Research Officer, IWMI
Saral Karki, Research Associate, CIMMYT
Avinash Kishore, Senior Research Fellow, IFPRI
Samuel Scott, Research Fellow, IFPRI
Neha Kumar, Senior Research Fellow, IFPRI
Tek Sapkota, Senior Scientist, CIMMYT
Timothy J. Krupnik, Regional Director, Sustainable Agrifood Systems Program (Asia), CGIAR Country Convener, CIMMYT Country Representative for Bangladesh
Purnima Menon, Senior Director for Food and Nutrition Policy, CGIAR & IFPRI

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To learn more, contact: t.sapkota@cgiar.org

To learn more about TAFSSA, contact:

t.krupnik@cgiar.org; p.menon@cgiar.org

ABOUT TAFSSA

TAFSSA (Transforming Agrifood Systems in South Asia) is a CGIAR Regional Integrated Initiative that supports actions improving equitable access to sustainable healthy diets, that boosts farmers' livelihoods and resilience, and that conserves land, air, and water resources in a climate crisis..

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