Direct Damage, Indirect Costs, and the Design of Disaster Relief

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Abstract: Households in developing countries have built strategies to cope with weather shocks - migrating for work, borrowing from those less affected, and selling assets. But these strategies rely on the shock being localised. We study what happens when it is not, using panel data on 5,100 households affected by Pakistan's 2022 floods and a recentered instrumental variables design that separately identifies the effects of local and regional flood exposure. Households with greater local flooding experience physical damage and displacement, but appear to cope: they receive more aid, travel further for work, and maintain consumption in both years. Conditional on own flooding, however, greater regional exposure tells a very different story. These households receive less aid - consistent with zero-sum allocation of limited relief - and face large reductions in agricultural employment, while the ability to commute to less affected areas appears to be blocked. In year one, they cope by selling assets. By year two, these buffers seem exhausted: households are drawing down savings, taking on new debt, skipping meals, and experiencing worse physical health. Our results suggest that there are considerable medium-term costs of flooding driven not by direct physical damage but by indirect effects that are not considered by standard disaster response policy. As climate change drives floods of increasing scale, these indirect, regional costs are likely to become an increasingly important share of total damage.

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Introduction

Households in developing countries have long faced weather-related risks to their livelihoods, and have developed strategies to cope — migrating to find work, borrowing from those less affected, and selling assets (Townsend, 1994; Rosenzweig and Stark, 1989; Jayachandran, 2006). But climate change is driving floods of unprecedented scale, pushing these strategies towards their limits. When flooding is widespread enough, there may be no one sufficiently less affected to turn to. Moreover, if emergency aid initially fills the gap, the limits of informal coping may only emerge once that aid runs out. Understanding how damage varies with the share of the surrounding area that is hit, and how the picture changes over time, is essential for designing effective disaster response.

We study these questions in the context of Pakistan's catastrophic 2022 floods, which affected one in seven people and left over 10% of the country underwater. Using newly collected panel data on 5,100 households and a recentered instrumental variables research design (Borusyak and Hull, 2023), we separately identify the effects of local flood exposure and of wider regional flooding on household welfare over two years. We find that local flooding causes severe physical damage but is partially offset by aid and the ability to commute to less affected areas. Conditional on own flooding, however, greater regional flood exposure worsens labour market outcomes - particularly for agricultural workers - and is not matched by additional aid; if anything, greater regional flooding reduces the likelihood of receiving assistance. In year one, households in more regionally flooded areas cope by selling assets. By year two, these buffers are exhausted: households are taking on debt, spending down savings, and report worse health and lower income, while those with greater local but less regional exposure are broadly coping.

To trace how extreme weather events affect households over time, we combine several sources of new and existing data. We collect panel data on 5,100 rural households across six districts in Sindh, surveyed one and two years post-flood, measuring employment, wages, migration, assets, and coping strategies. To avoid selection bias from convenience sampling, we randomly sample from a 2017 baseline census of all poor households in our study areas, which also provides a pre-flood snapshot of household composition, employment and assets. We then locate these households wherever they may be post-flooding. To measure flood exposure, we use satellite data on flood extent, rainfall, and topography. Finally, we draw on geo-located government administrative damage records covering nearly 2 million properties.

Using these data, we show that the 2022 floods were exceptional in both scale and nature. In Sindh, 21% of land was flooded, with over 10% remaining inundated for more than two months. Administrative data records 1.96 million homes partially or fully damaged and $14.9 billion in total damages. In our study areas, flooding was particularly severe — 49% of land was underwater at the peak, with households reporting average flood durations of 2.5 months and water depths of 3 feet. Unlike typical seasonal flooding, these floods were driven by extreme rainfall — 531% above Sindh's 20-year average for that period — and most severe in low flood-risk areas.

The rainfall-driven nature of these floods motivates our research design. We measure the severity of flooding experienced by each household using a standardised index derived from satellite imagery. Simply comparing more versus less flooded areas will not identify causal effects: some locations systematically flood more under any plausible rainfall pattern due to their position in the hydrological network, and this is likely correlated with economic fundamentals. We address this by applying the recentered instrumental variables approach of Borusyak and Hull (2023). We run a hydrological simulation model that takes rainfall and topography as inputs and predicts where water flows and accumulates across the landscape. By running the same model under each of the last 25 years of rainfall, we construct each location's expected flooding — the flooding it would experience in a typical year given its position in the watershed. Our instrument is the difference between predicted flooding in 2022 and this expected flooding, isolating variation driven by the 2022 rainfall shock rather than persistent geography. Following Borusyak and Hull (2025), we use machine learning to combine the outputs of the hydrological model into the optimal instrument in the Chamberlain (1987) sense.

The hydrological model produces predicted flooding at fine spatial resolution, giving us considerable flexibility in how we define treatment. We can construct instruments for flooding within any radius around a household, trace how impacts evolve with the spatial scale of exposure, and decompose flooding into local and regional components. We show that there is sufficient independent variation in our setting to separately instrument for both, allowing us to estimate the relative importance of direct physical damage and wider disruption to local economies in driving the costs of flooding.

Using this research design, we first confirm what we would expect: satellite-measured flooding predicts self-reported flooding, causes physical damage, and displaces households; and these effects are driven by flooding in the household's local area.

Despite the physical damage they experience, households with greater local flood exposure appear to find ways to navigate this shock without drastically cutting consumption. We find no significant impacts of local flooding on consumption, health, or mental health in either year. Two factors appear to explain this. First, locally flooded households are 19 percentage points more likely to receive formal flood relief. Second, they travel farther to find work — the probability of commuting or temporarily migrating increases by 8 percentage points. They do not seem to resort to selling assets or drawing down savings; if anything, they are 11 percentage points less likely to take on new loans. By year two, these households are working more hours and have somewhat depleted savings, but their consumption is intact and their asset stocks have recovered.

Conditional on own flooding, greater regional flood exposure tells a very different story. These households experience the same physical damage, but receive less aid — regional flooding reduces the probability of receiving relief by 19 percentage points, consistent with zero-sum allocation of limited assistance. Agricultural labour markets appear substantially affected: regional flooding re-

duces paid work for agricultural workers by over 30 percentage points in the wider ring, with no such effects for non-agricultural workers. The commuting channel that helps locally flooded households is blocked — when surrounding areas are also inundated, there is nowhere nearby to travel for work. In year one, households cope by selling assets, including productive assets. By year two, these buffers are exhausted: households are 13 percentage points more likely to draw down savings, 14 percentage points more likely to take on new debt, and report significantly worse physical health. These indirect costs of flooding — transmitted through labour markets and aid allocation rather than direct physical damage — are not addressed by the current relief system and deepen over time.

This paper contributes to a large literature estimating the economic costs of natural disasters on households. This literature ranges from studying many moderate events (e.g. Patel (2024)) to single catastrophic events such as Hurricane Katrina (Deryugina et al. (2018); Groen and Polivka (2008); Gallagher and Hartley (2017)), landslides in Uganda (Baseler and Hennig, 2023), and volcanic eruptions in Iceland (Nakamura et al., 2022). It identifies at least two factors that shape how costly disasters are for affected households. First, prior experience: Patel (2024) shows that Bangladeshi households with prior flood exposure suffer smaller impacts, consistent with reduced fixed costs of coping strategies such as migration. Second, the availability of formal insurance. The Katrina literature finds remarkably benign medium-term outcomes — income recovers within three years and often exceeds that of controls (Deryugina et al. (2018)) — but this is a context where many households had access to federal flood insurance, unemployment insurance, and disability benefits. Billings et al. (2022) provide evidence that insurance is the key mediating factor, finding that after Hurricane Harvey uninsured households fared dramatically worse than insured households. We study a setting with neither of these advantages — an unprecedented event in communities with limited historical experience of catastrophic flooding and essentially no formal insurance of any kind. Nonetheless, our results are suggestive of a similar message — that external assistance, in our context flood relief, plays a key role in mitigating the impacts of disasters.

Our results also point to a third factor that has received less attention: the scale of the shock relative to the economy. As a share of the national population, Pakistan's 2022 floods affected far more people than Hurricane Katrina. A consistent finding in the rich-country literature is that migration to unaffected areas is a key recovery mechanism — non-returners eventually earn more (Deryugina et al. (2018)), and forced movers access better opportunities (Nakamura et al. (2022)). But this depends on the existence of functioning, unaffected labour markets to absorb displaced workers. Our results suggest that when flooding is sufficiently widespread, these adjustment margins are unavailable. Local flooding increases commuting to less affected areas, but this effect is cancelled out by regional flooding, and it is the regional disruption — not direct physical damage — that drives the worst medium-term outcomes.

Methodologically, we contribute to a vast literature that exploits quasi-random weather variation for causal identification across a wide range of settings — including temperature shocks (Dell et al.

(2012); Burke et al. (2015); Deschênes and Greenstone (2011)), rainfall and drought (Jayachandran (2006); Shah and Steinberg (2017)), flooding (Guiteras et al. (2015); Patel (2024); Balboni et al. (2025)), tropical cyclones (Hsiang and Jina (2014)), and wildfire smoke (Borgschulte et al. (2024)). See Dell et al. (2014) and Carleton and Hsiang (2016) for reviews. We show how combining physical simulation models with the recentered instrumental variables framework of Borusyak and Hull (2023) helps formalise what is randomised, how treatment is determined, and gives us testable identification assumptions. A practical advantage is that our approach requires no pre-disaster outcome data, making it feasible to study unexpected disasters using purpose-built household surveys even when no baseline exists. Because physical simulation models exist for a wide range of environmental hazards — tropical cyclones, wildfires, volcanic eruptions — this framework extends beyond our setting.

The rest of the paper proceeds as follows. Section 1 describes our data sources. Section 2 documents the scale and nature of the 2022 floods. Section 3 presents our research design. Section 4 reports results. Section 5 concludes.

1 Data

Given the data challenges inherent in studying disasters, we begin by describing our unique combination of sources that allows us to track households before, during, and after the floods. To trace how disasters affect households over time, we combine multiple data sources, as summarised in Table 1.1. First, we use satellite data on flooding extent to construct our measure of flood intensity. Second, we feed daily rainfall data and a digital elevation model into a hydrological simulation model to construct our instrumental variables. Third, we randomly sample 5,100 rural households from 2017 baseline administrative data and track these same households through panel surveys conducted one and two years post-flood to measure employment, wages, migration, assets, and coping strategies. Finally, we match this panel data to administrative property damage records covering nearly 2 million properties.

Treatment: To measure flooding, we use the NOAA VIIRS 5-day composite maps at 375m resolution, which provide daily measures of flood extent over the second half of 2022 and into 2023. We combine multiple measures of flood extent and duration into a standardised index, as described in Section 3.

Instrumental variables: Our instrumental variables strategy requires predicting where flooding occurs given rainfall and topography. This is precisely what hydrological models are designed to do. These models take rainfall and a digital elevation model as inputs, "pour" the water onto the landscape, and track where it flows and accumulates over time. We use LISFLOOD-FP, a widely used hydrodynamic model. We feed in daily July–August rainfall from NASA's IMERG product at 0.1° resolution and bare-earth elevation data from FABDEM at 30m resolution. The model returns daily predicted flood depth at each 30m grid cell from July to November, capturing both the initial

Table 1.1: Data sources

Data Type	Source	Years	Resolution
Panel A: Flood Exposure Measurement			
Flood extent	NOAA VIIRS	2022-23	375m, daily
Panel B: Instrumental Variables			
Rainfall	NASA IMERG	1998-2025	0.1°, daily
Topography	FABDEM	Static	30m
Panel C: Household Panel Data			
Baseline census	NGO admin records	2017	GPS coordinates
Follow-up surveys	Primary collection	2023-24	GPS coordinates
Village census	Pakistan census	2020	Village level
Property damage	Sindh govt	2022-23	Property level

inundation and the subsequent recession. We run this for each year from 1998 to 2025 across our six study districts, producing a 28-year panel of simulated flood exposure from which we construct both the 2022 instrument and the expected flooding measure required for recentering. Details are in Section 3.

Household and individual-level outcomes: Our individual-level data come from both baseline administrative records and follow-up surveys. For baseline data, we have access to a 2017 census of all households in six districts of Sindh. The data were collected by a local NGO to determine eligibility for various local development and poverty alleviation programmes. The six districts correspond to the areas of operation of our NGO partner. These administrative data contain the address of the household, a list of household members (including their age, sex, education and occupation), household asset holdings across 21 asset classes and a 'poverty score' constructed based on these asset holdings. We use these data as a sampling frame and for balance tests. Where possible, we also use these data to control for baseline characteristics of the household and its members. We sample only low-income households from these data — setting the cut-off such that approximately 50% of households are poor enough to be eligible for the main cash transfer programme in Pakistan (BISP), while the remaining 50% are ineligible.

We combine our household data with village ("Mouza") census data from 2020. The survey is at the village level and contains information about the presence of various infrastructure around the village (e.g. metalled road, market, primary school).

For follow-up data, we collect panel data on a random sample of 5,100 low-income, rural households across six districts of Sindh. These households are drawn based on pre-flood characteristics from the 2017 dataset described above. We surveyed these households one and two years after the 2022 floods. The first wave of surveys took place in July–September 2023, with the second wave in July–September 2024. With the assistance of local community members, we successfully located 92% of households in 2023 or 2024; of those located, almost all were in their 2017 village. This

is the opposite of the usual concern that those most impacted by disasters migrate away from their original locations and therefore cannot be tracked. In total, we have 5,120 households and 33,202 people in 2023, and 4,902 households and 33,645 people in 2024. Our main analysis is undertaken with the balanced panel of households (and their constituent members) that we survey in 2023 and 2024.

We collect data on a vast range of outcomes including damage to assets, lost income, drawdown of savings, sale of assets, new loans, changes in labour supply and educational or nutritional investments, as well as migration and occupational change. Our surveys also capture flood exposure measures including duration of flooding, depth of flood waters, evacuation decisions, and damage to property and productive assets. Additionally, we are able to match 2,103 households in our panel to government administrative data on property damage which recorded 1.96 million damaged properties (of which 1.37 million were 'fully damaged') across Sindh.

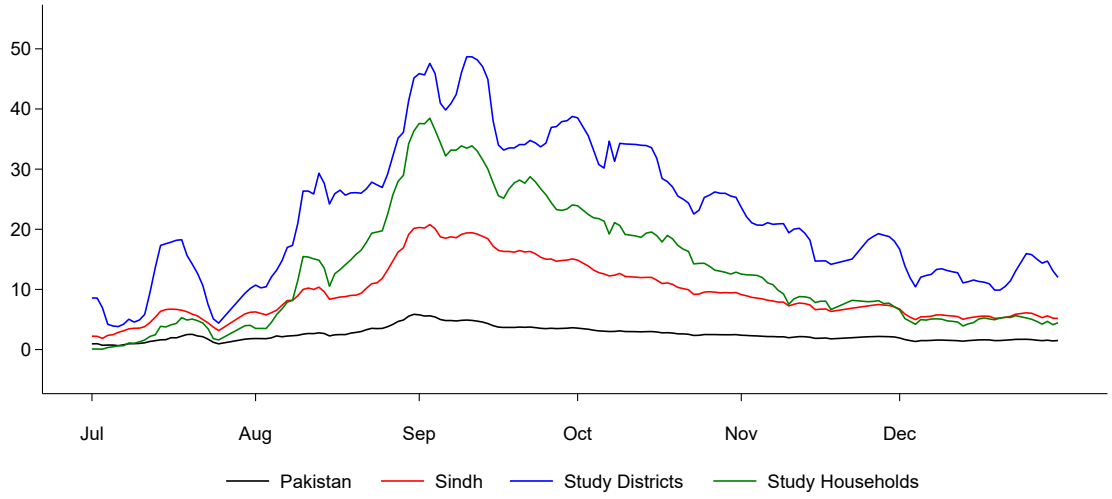
2 The 2022 Floods

On July 27, 2022, the Pakistani Meteorological Department (PMD) declared that the monsoon was almost over — weakening and moving northwards.[1] Two weeks later, an average of 1,200mm of rain fell over one week across Sindh — one of the five provinces of Pakistan, located in the south of the country. As a consequence, the province — which is predominantly low-lying and flat — faced widespread flooding.

Across the whole country these floods were of catastrophic proportions: the Government of Pakistan estimated that one in seven people were affected, and officially designated more than half of all districts as impacted (GoP et al., 2022). Sindh was particularly affected: according to satellite data, flood extent in Sindh rose steadily throughout July and August, peaking at 21% of normally dry land being inundated at the start of September. The waters slowly receded over the next four months — with 15%, 9% and 7% still inundated at the start of October, November and December respectively.

[1] Express Tribune, Jul 27 2022

Figure 1: Percentage of Land Flooded (Year 2022)



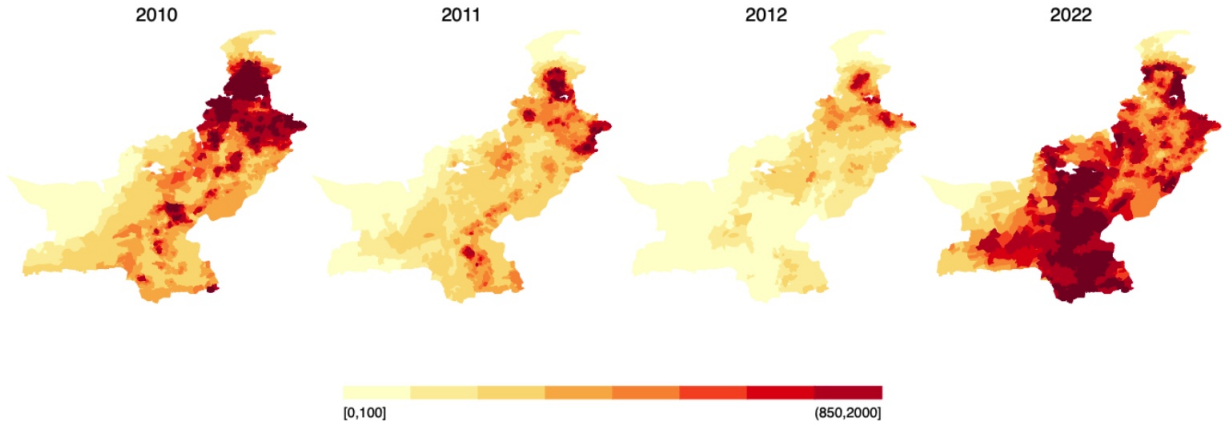
Notes: This figure plots the percentage of land flooded during 2022 for all of Sindh, for the six districts in our study sample, and for the households in our study sample. The y-axis shows the percentage of land area flooded, while the x-axis shows time from July to December 2022. The source of the data is NOAA NESDIS OSPO (2021), River and Surface Flood Map Products (RSVFM).

The areas of Sindh where we work — dictated by where our NGO partner operated — experienced more intense flooding on average, with 49% of land flooded at the peak in early September, dropping to 39%, 24% and 17% at the start of October, November and December respectively. This long duration is mirrored in self-reports in our survey data, where the average household reported flooding of 2.5 months, and for some the inundation lasted up to 7 months. The flooding was also deep — the average peak water depth reported by respondents was 3 feet.

Although some areas of Pakistan regularly experience flooding, particularly those on the banks of the Indus river, this particular flood was unusual — driven by intense rains in places with low flood risk. Cumulatively that summer, Sindh received rain 531% above the 20-year average of rainfall for that time of year, and worse than the previous major flood years of 2010, 2011 and 2012 (Figure 2). Moreover, as Figure 3 shows, the spatial pattern of rainfall varied vastly from historic patterns — heaviest in places which do not usually experience major flooding. Attribution studies have found that this rainfall was 75% more intense than it would have been without human-induced global warming.[2] Yet while the probability of such events is surely rising, only 11% of households in our sample thought unusually heavy rain was likely or very likely in the summer of 2022.

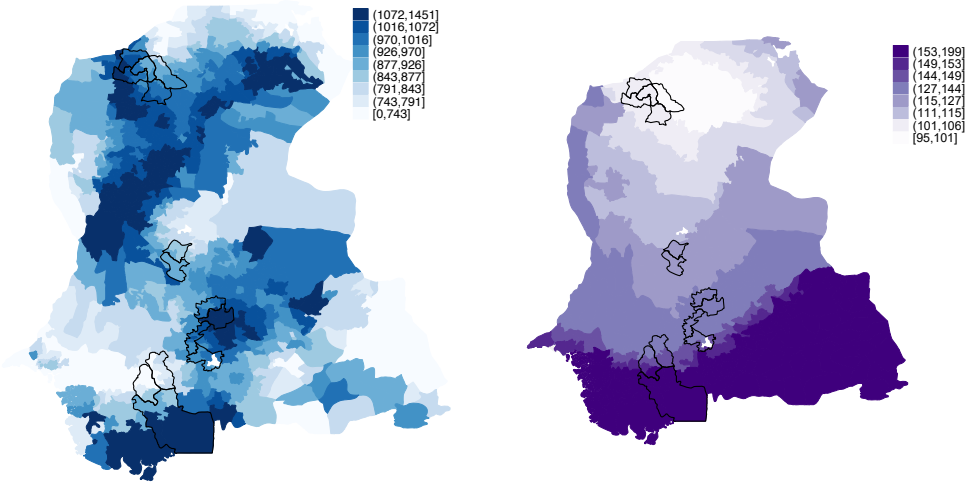
[2]World Weather Attribution. 2022. "Climate Change Likely Increased Extreme Monsoon Rainfall, Flooding Highly Vulnerable Communities in Pakistan." https://www.worldweatherattribution.org/wp-content/uploads/Pakistan-floods-scientific-report.pdf

Figure 2: Cumulative monsoon rainfall during previous severe floods



Notes: NASA Global Precipitation Measurement (GPM)

Figure 3: 2022 monsoon rainfall (left) compared to historical average (right)



(a) Cumulative rainfall July–August 2022

(b) Average cumulative rainfall July–August, 2000–2022

Note: Tehsils included in our data collection are outlined in black polygons. Rainfall is measured in millimetres.
Source: NASA GPM.

3 Research Design

3.1 Measuring Flood Intensity

We would like to estimate the impact of flooding within radius k of each household on its economic outcomes — β_k in Equation 1.

$$Y_{i,t} = \alpha + \beta_k Flood_{i,k,2022} + \varepsilon_{i,t} \quad (1)$$

To do this, we must first define 'flooding'. Satellite data captures two of its three dimensions: extent and duration (but not depth). Using NOAA VIIRS data, we calculate the maximum share of land flooded in a household's vicinity, and the number of days when various thresholds of surrounding land (>5%, >50%, >80%, >90%) were inundated. We combine these measures into a single index using the Anderson (2008) inverse variance-weighted method.

To flexibly construct flooding at different spatial scales, we first compute the index for each cell of a hexagonal grid covering our study areas, where each cell has a radius of approximately 174m. Flooding at wider radii is then constructed by averaging over neighbouring cells at increasing ring distances, yielding treatment measures at radii from approximately 174m to 10km.

Table 3.1: Average flooding by decile of flood index

Index Decile	Max Flooded	Days > 90 flooded	Days > 80 flooded	Days > 50 flooded	Days > 5 flooded
1	0.0	0.0	0.0	0.0	0.0
3	8.0	0.0	0.0	0.0	3.8
4	39.8	0.0	0.0	1.1	13.4
5	57.7	0.0	0.1	7.2	27.4
6	69.9	0.0	2.5	19.2	44.7
7	77.2	0.4	4.4	33.1	67.0
8	82.9	2.0	9.6	45.2	87.9
9	88.6	5.7	15.2	59.8	105.0
10	94.6	42.5	59.6	87.9	112.2

Notes: This table presents average values of flood index components across deciles of the overall flood index. Decile 1 represents areas with the lowest flood intensity, while decile 10 represents the most severely flooded areas. The flood index is a standardized composite measure combining seven indicators. Columns 2-6 report satellite-derived measures: maximum percentage of area flooded, and percentage of area flooded for various duration thresholds (>90 days, >80 days, >50 days, and >5 days). Columns 7-8 report household self-reported measures: flood depth in feet and flood duration in days.

The index shows substantial variation across our sample. Table 3.1 shows how the components of the index at its most granular level ($0.1km^2$ grid cell) differ by decile of the overall index value. Households in the bottom decile experienced 0 days where more than 5% of the land around them was flooded, while those in the top decile faced 112 days when at least 5% of the land around them was flooded.

Table 3.2 contains a Shapley decomposition of the index, showing which components drive most of the variation in our treatment. Number of days when 90 pct surrounded land was flooded is the largest contributor (23.6%), but the remaining variation is distributed fairly evenly across measures, with each measure explaining at least 16.1%.

Table 3.2: Shorrocks-Shapley Decomposition of R-Squared

Variable	Contribution (%)
Max share of land flooded around HH	22.92
N days when > 5 pct surrounded land flooded	19.11
N days when > 50 pct surrounded land flooded	16.18
N days when > 80 pct surrounded land flooded	18.17
N days when > 90 pct surrounded land flooded	23.62

3.2 "Experimental" Design

Estimating the causal effect of flooding on economic outcomes faces identification challenges that could bias results in either direction. Areas with higher historical rainfall may receive more precipitation in 2022 and experience greater flooding, yet also tend to have higher agricultural productivity due to better water availability. Similarly, flatter areas are more flood-prone but also more agriculturally productive. Both patterns would lead us to underestimate flood impacts.

Conversely, other factors may cause overestimation. High flood-risk areas may already be poorer due to past climate shocks or selective out-migration of wealthier households. Additionally, wealthier areas can afford flood protection infrastructure, reducing their exposure while maintaining better economic outcomes — making floods appear more devastating than they are.

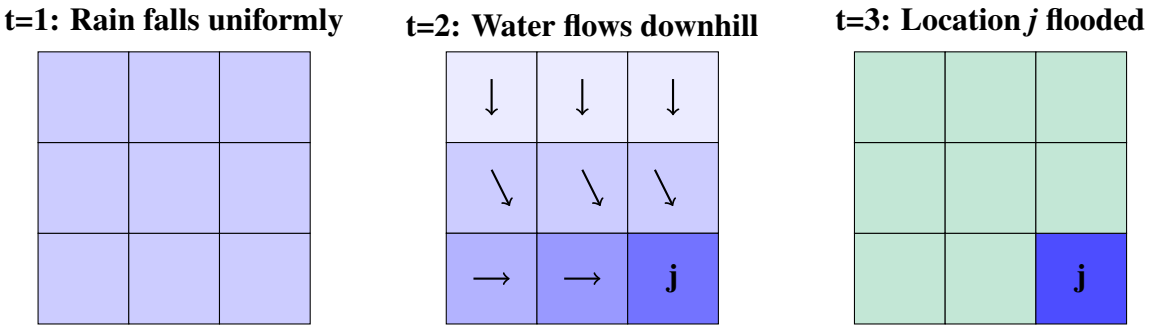
In the face of these challenges, we would like to find some exogenous variation in flooding in order to separate the causal effect of flooding from these potential confounders. We do not have the power to randomise flooding, nor would it be ethical to do so. However, by considering the processes which create flooding, we can think of flooding as the outcome of a randomised experiment.

Most flooding is ultimately the result of rainfall, somewhere.[3] Rain falls from the sky, flows over land and through waterways. Flash flooding occurs as large volumes of water pass through an area, while sustained flooding can happen as water accumulates in low-lying areas and is unable to flow out. This logic is illustrated by the simple example in Figure 4.

With this in mind, we can think of the treatment 'flooding' as a function of a set of shocks r — rainfall in each location on each day — and pre-existing conditions F which determine where water flows and accumulates across space.

[3] Flooding can also result from melting snow or ice, but the logic is the same.

Figure 4: A simple flood model



$$Flooding_t = r_t + Fr_t + F^2 r_{t-1} + ... + \varepsilon_t = \sum_{l=0}^{\infty} F^l r_{t-l} + v_t \tag{2}$$

Here $Flooding_t$ is an N x 1 vector of flooding in all locations and r_{t-l} is rainfall in each location at time $t - l$. F is the N x N hydrological flow matrix — each element F_{ij} captures the proportion of water that flows from location i to location j in each time period. In theory, F may be determined not only by natural topography but also by drainage infrastructure, flood defences, and any other features that affect how water moves across the landscape. The diagonal elements can be less than one, capturing water lost to evaporation, absorption, or pumping. F^l captures multi-period flow accumulation: rain falling upstream affects downstream areas with a lag, and the infinite sum reflects how water accumulates as it moves through the watershed network. This spatial interdependence means that flooding at any location depends on the entire rainfall vector across all upstream areas, weighted by their position in the flow network.

Many papers rely for identification on the assumption that rainfall is, in some sense, 'random'. Suppose this holds in the strictest sense: rainfall in a given location on a given day is fully randomly assigned, independent of topography and of unobservables everywhere:

$$r \perp \varepsilon \qquad \text{and} \qquad r \perp F \tag{3}$$

Is this sufficient for identification of β_k? Borusyak and Hull (2023) show it is not. For any realisation of rainfall, locations that are more central in the flow network F will systematically flood more. If this centrality is correlated with economic fundamentals, our estimates will be biased even under fully random rainfall.

Borusyak and Hull (2023) show that we can overcome this and identify β_k by controlling for expected exposure — the flooding each location would experience under a typical rainfall realisation, given its position in the flow network. Their approach is analogous to controlling for a propensity score, except that rather than estimating it from data, we compute it directly by running the hydrological model under alternative rainfall realisations. We can equivalently control for the ex-

pected exposure or replace our *Flooding* measure with its deviation from expected exposure, and our regression will estimate β_k using only variation driven by the current year's rainfall shock.

Although we have so far assumed that rainfall is random for the purpose of developing the framework, our approach in fact relies on the weaker assumption that rainfall is as good as randomly assigned conditional on expected flooding and district fixed effects. Formally, letting ω denote the set of controls (expected flooding and district fixed effects), our identifying assumption is:

$$\mathbb{E}[\varepsilon_i \mid r, \omega] = \mathbb{E}[\varepsilon_i \mid \omega] \tag{4}$$

This assumption is testable, and we are in the process of subjecting it to a battery of empirical checks — examining whether there is systematic spatial variation in rainfall not absorbed by our controls, whether rainfall is spatially correlated across years after conditioning on expected flooding, and whether the 2022 rainfall anomaly was spatially uniform or concentrated in areas with particular economic characteristics.

3.3 Instrument construction

The previous section established that subtracting expected flooding from observed flooding would identify β_k, provided the expectation averages over alternative realisations of r while holding F fixed. We cannot do this directly with satellite data: if drainage, flood defences, or land use change over time, averaging satellite flooding across years does not hold F constant. We therefore take an instrumental variables approach, using a hydrological model to simulate flooding under 2022 rainfall and under alternative rainfall realisations while holding F fixed, and instrumenting for the satellite flood index with the recentered prediction.

The hydrological model produces daily predictions of flood depth and extent over approximately 150 days, yielding over 300 potential predictors of satellite flooding per grid cell. Rather than selecting a single summary measure ad hoc, we use a random forest to find the combination of hydrological outputs that best predicts our satellite-measured flood index — the optimal instrument in the sense of Chamberlain (1987). We can write the predicted flooding under 2022 rainfall as:

$$\hat{z}_i^{2022} = g(f(r_{2022}))_i \tag{5}$$

where the hydrological model $f(\cdot)$ takes rainfall and topography as inputs and produces predicted flood depth and extent in each location on each day, and the random forest $g(\cdot)$ combines these into the best predictor of satellite-measured flooding. Our instrument is this prediction, recentered by subtracting the prediction under historical average rainfall:

$$\tilde{z}_i = g(f(r_{2022}))_i - g(f(\bar{r}))_i \tag{6}$$

Note that the counterfactuals hold both $f(\cdot)$ and $g(\cdot)$ fixed and vary only r. If the true model $g(f(\cdot))$ is linear, then computing $g(f(\bar{r}))$ is an unbiased estimate of $\mathbb{E}[g(f(r))]$. The true model is likely nonlinear, so we plan to replace this with the average across all 28 individual years in subsequent versions.

Using machine learning to construct the instrument introduces a potential bias. If the random forest is trained on data that includes the households we subsequently use in the IV regression, its predictions will be partly fitted to idiosyncratic noise in each household's satellite flood measure, biasing the instrument (Chernozhukov et al., 2018). We eliminate this using cross-fitting: we partition our grid cells into five spatially contiguous folds and, for each fold, train the random forest on the remaining four folds before predicting flood exposure for the held-out fold. Since we would like the error terms in the hold-out fold to be uncorrelated with the errors in the training folds, we use cluster randomisation to assign units to folds — clustering at the level of a hexagon with an area of approximately $36km^2$.

3.4 Estimation

Our first stage regresses the satellite flood index on the recentered instrument, controlling for district fixed effects:

$$Flood_{i,k,2022} = \pi_0 + \pi_1 \tilde{z}_{i,k} + \delta_d + u_{i,k} \tag{7}$$

The second stage then estimates:

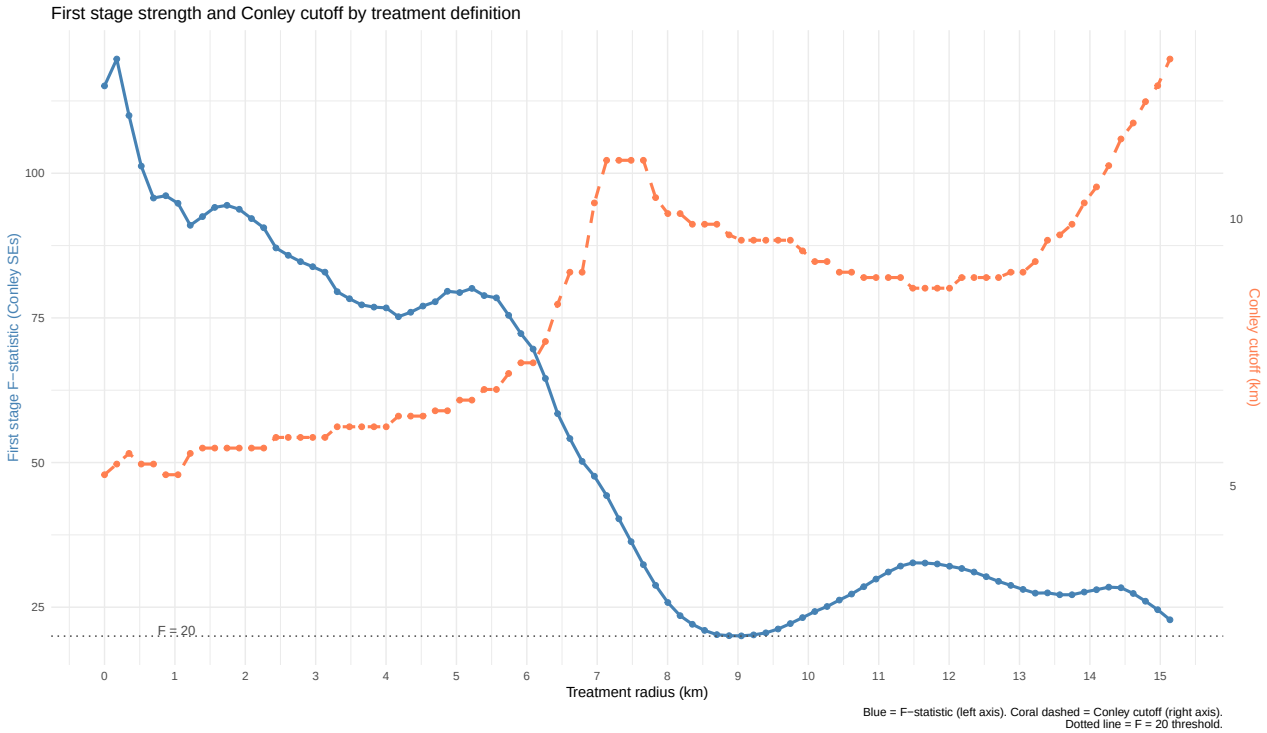
$$Y_{i,t} = \alpha + \beta_k \widehat{Flood}_{i,k,2022} + \delta_d + \varepsilon_{i,t} \tag{8}$$

where $\widehat{Flood}$ is the predicted value from the first stage.

To estimate effects at different spatial scales, we construct the flood index and instrument at increasing radii around each household. Starting from the hexagonal cell in which the household resides (radius approximately 174m), we average over successive rings of neighbouring cells, yielding treatment measures at radii from 174m to approximately 10km. We estimate the equation above separately for each radius.

Because our treatment is generated by a single rainfall shock propagating through a connected hydrological network, the theoretically correct approach to inference is randomisation inference, which we plan to implement using counterfactual rainfall realisations from our hydrological simulations. For now, we report Conley (1999) standard errors. Since the appropriate distance cutoff depends on the spatial scale of treatment, we estimate it separately for each treatment radius by computing the correlation between a household's instrument value and the instrument values of its neighbours at increasing distances, and setting the cutoff at the distance where the correlation first reaches zero.

Figure 5: Conley cut-off and first stage strength by size of treatment area



Notes: Blue (left axis): first-stage F-statistic from a regression of the satellite flood index on the recentered hydrological instrument, controlling for district fixed effects, with Conley standard errors at the specification-specific cutoff. Coral dashed (right axis): Conley cutoff in km, set at the distance where the spatial correlation of the instrument first reaches zero. Each point is a separate specification at a different treatment radius. Dotted line marks $F = 20$.

Figure 5 plots both the Conley cutoff and the first-stage F-statistic for each treatment radius. The Conley cutoff increases with treatment radius, ranging from approximately 4–5km for the narrowest treatments to 10–12km for the widest. The instrument is strong at narrow radii ($F > 100$ at 0–0.5km) and remains well above conventional thresholds through approximately 6km ($F \approx 70$). Beyond this, the F-statistic drops sharply but still remains above 20 at all the distances we consider.

Table 3.3 reports the first stage for our main donut specification, in which we include local (0–2km) and regional (2–6km) flooding simultaneously and instrument for each with its own re-centered hydrological prediction. Each instrument primarily predicts its own endogenous variable: the local hydrological instrument strongly predicts local satellite flooding (1.546) and the regional instrument strongly predicts regional satellite flooding (1.595). The local instrument also predicts regional flooding (0.310), consistent with spatial correlation, but the regional instrument does not significantly predict local flooding. The partial F-statistics — computed by orthogonalising each instrument against the other — are 74.2 and 62.4, confirming that there is sufficient independent variation to separately identify the effects of local and regional flooding.

Table 3.3: Two-donut first stage

	(1) Flooding 0–2km (satellite)	(2) Flooding 2–6km (satellite)
Flooding 0–2km (hydro)	1.546***	0.310***
	(0.179)	(0.083)
Flooding 2–6km (hydro)	0.310	1.595***
	(0.417)	(0.202)
Partial F-statistic	74.2	62.4
R-squared	0.596	0.626
Observations	4517	4517

Notes: Each column reports the first stage for one endogenous variable, with both instruments included simultaneously. The partial *F*-statistic is computed from the orthogonalised first stage, testing whether each instrument has independent predictive power after partialling out the other. Conley standard errors with an empirically motivated cutoff. All specifications include district fixed effects.

4 Results

4.1 Direct Damage

Using the strategy outlined above, we first confirm what we would expect: satellite-measured flooding predicts self-reported flooding, causes physical damage, and displaces households. Households with greater local flooding report longer flood durations, greater damage to livestock, land, and productive assets, and are more likely to have evacuated. Households with greater regional flooding report no additional physical damage or evacuation, consistent with the regional measure capturing flooding in surrounding areas rather than at the household itself. These results validate our identification strategy and confirm that the two measures capture distinct dimensions of flood exposure.

Self-reported flooding: Table 4.1 reports estimates of flood exposure on self-reported flood length and depth. Since both self-reported measures refer to flooding in the household's village, we expect the strongest relationship when the treatment area roughly matches the scale of a village. This is what we find for flood length: the effect is large and highly significant at close distances ($\beta = 17.3$, $p < 0.01$ at ~180m) and weakens as the treatment area grows. In the donut specification, flooding close to the household (0–2km) strongly predicts flood length ($\beta = 20.9$, $p < 0.01$), while flooding further away (2–6km) adds no additional predictive power. For flood depth, the pattern is reversed: nearby flooding is a poor predictor, while flooding over a wider area predicts depth well ($\beta = 0.92$, $p < 0.05$ for the 2–6km ring). This likely reflects the fact that our satellite measure captures where floodwaters spread, not how deep they were. The extent of flooding in a small area

Table 4.1: IV estimates of flood exposure on self-reported flooding

	F-stat	Conley cutoff (km)	Self-reported flood length	Self-reported flood depth
1. Results by size of treatment area				
Flooding within 180m	114.1	5.2	17.344***	0.140
			(5.515)	(0.159)
Flooding within 350m	118.6	5.4	15.674***	0.150
			(4.947)	(0.138)
Flooding within 530m	109.0	5.6	16.464***	0.177
			(4.819)	(0.133)
Flooding within 700m	100.3	5.4	17.033***	0.205
			(4.756)	(0.133)
Flooding within 870m	94.8	5.4	17.067***	0.222*
			(4.764)	(0.134)
Flooding within 1,050m	95.2	5.2	17.034***	0.237*
			(4.814)	(0.138)
Flooding within 2,090m	92.9	5.7	17.974***	0.301*
			(5.621)	(0.163)
Flooding within 3,130m	83.1	5.9	16.456***	0.379**
			(6.112)	(0.192)
Flooding within 4,000m	76.0	6.1	15.171**	0.500**
			(6.676)	(0.242)
Flooding within 5,050m	78.7	6.6	14.053*	0.658**
			(7.520)	(0.294)
Flooding within 5,920m	71.6	7.3	13.715	0.879***
			(8.511)	(0.332)
Flooding within 7,000m	47.2	10.3	12.499	1.166***
			(9.369)	(0.380)
Flooding within 8,000m	25.6	10.1	9.124	1.549***
			(15.216)	(0.546)
Flooding within 9,050m	19.9	9.6	5.547	1.886***
			(23.075)	(0.698)
Flooding within 10,090m	23.0	9.4	2.492	1.959***
			(24.723)	(0.714)
2. Direct vs. indirect effects				
Local exposure (0–2 km)	74.2	7.3	20.923***	-0.032
			(7.404)	(0.179)
Regional exposure (2–6 km)	62.4	7.3	-8.156	0.918**
			(11.199)	(0.402)
3. Direct vs. indirect effects (three-band robustness)				
Local exposure (0–2 km)	69.8	9.4	23.458***	0.087
			(7.450)	(0.197)
Regional exposure (2–6 km)	59.7	9.4	-12.378	0.353
			(10.067)	(0.276)
Wider regional exposure (5–10 km)	66.9	9.4	4.895	1.486***
			(14.590)	(0.541)
Min. obs.			4,468	4,468
Max. obs.			4,520	4,520

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with empirically determined cutoffs based on the spatial correlogram of first-stage residuals (reported in the Conley cutoff column). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables), computed as the chi-squared statistic from a test of the own instrument in the first-stage OLS regression. Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

around a household tells us little about water depth, but being in a broadly flooded area may be a better signal — widespread flooding means more water with fewer places to drain.

Table 4.2: IV estimates of flood exposure on physical damage

	F-stat	Conley cutoff (km)	House fully damaged (self-rep)	Livestock damaged (owners only)	Livestock/land damaged (owners only)	Productive assets damaged (owners only)	HH assets damaged (owners only)
1. Results by size of treatment area							
Flooding within 180m	[82.6, 120.5]	5.2	0.017	0.117***	0.080*	0.089**	0.048
			(0.049)	(0.042)	(0.042)	(0.044)	(0.049)
Flooding within 350m	[84.9, 124.8]	5.4	0.022	0.104***	0.084**	0.096***	0.046
			(0.042)	(0.037)	(0.036)	(0.035)	(0.044)
Flooding within 530m	[81.2, 111.0]	5.6	0.020	0.104***	0.088**	0.102***	0.051
			(0.041)	(0.038)	(0.036)	(0.034)	(0.043)
Flooding within 700m	[78.6, 100.3]	5.4	0.015	0.109***	0.094***	0.106***	0.047
			(0.040)	(0.037)	(0.034)	(0.034)	(0.041)
Flooding within 870m	[76.8, 94.8]	5.4	0.014	0.114***	0.099***	0.109***	0.045
			(0.040)	(0.038)	(0.035)	(0.034)	(0.040)
Flooding within 1,050m	[77.4, 95.2]	5.2	0.013	0.125***	0.110***	0.118***	0.044
			(0.040)	(0.040)	(0.037)	(0.036)	(0.039)
Flooding within 2,090m	[73.0, 92.9]	5.7	0.023	0.179***	0.153***	0.160***	0.049
			(0.049)	(0.047)	(0.043)	(0.042)	(0.043)
Flooding within 3,130m	[63.8, 83.1]	5.9	0.038	0.219***	0.182***	0.189***	0.050
			(0.054)	(0.056)	(0.051)	(0.051)	(0.048)
Flooding within 4,000m	[53.6, 76.0]	6.1	0.052	0.246***	0.200***	0.205***	0.058
			(0.061)	(0.078)	(0.069)	(0.068)	(0.055)
Flooding within 5,050m	[53.9, 78.7]	6.6	0.075	0.232**	0.180**	0.179**	0.071
			(0.075)	(0.100)	(0.087)	(0.085)	(0.064)
Flooding within 5,920m	[51.3, 71.6]	7.3	0.122	0.217*	0.158	0.150	0.094
			(0.096)	(0.129)	(0.113)	(0.110)	(0.073)
Flooding within 7,000m	[42.5, 55.6]	10.3	0.198	0.177	0.106	0.081	0.151
			(0.128)	(0.203)	(0.180)	(0.178)	(0.102)
Flooding within 8,000m	[21.7, 29.4]	10.1	0.289*	0.098	0.001	-0.039	0.206
			(0.159)	(0.312)	(0.284)	(0.279)	(0.140)
Flooding within 9,050m	[16.8, 24.1]	9.6	0.316*	-0.014	-0.112	-0.169	0.219
			(0.180)	(0.382)	(0.349)	(0.344)	(0.151)
Flooding within 10,090m	[20.7, 28.8]	9.4	0.302*	-0.096	-0.173	-0.241	0.188
			(0.178)	(0.378)	(0.341)	(0.333)	(0.155)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	74.2	7.3	-0.034	0.159**	0.150**	0.165***	0.026
			(0.073)	(0.066)	(0.063)	(0.058)	(0.047)
Regional exposure (2–6 km)	62.4	7.3	0.158	0.060	0.009	-0.013	0.069
			(0.139)	(0.185)	(0.164)	(0.155)	(0.086)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)							
Local exposure (0–2 km)	69.8	9.4	-0.008	0.145*	0.133*	0.142**	0.047
			(0.066)	(0.082)	(0.076)	(0.068)	(0.055)
Regional exposure (2–5 km)	59.7	9.4	0.051	0.080	0.043	0.037	0.013
			(0.102)	(0.166)	(0.152)	(0.145)	(0.072)
Wider regional exposure (5–10 km)	66.9	9.4	0.229*	0.028	-0.053	-0.102	0.156
			(0.127)	(0.150)	(0.140)	(0.131)	(0.119)
Min. obs.			4,468	2,167	2,334	2,617	3,209
Max. obs.			4,520	2,180	2,352	2,641	3,237

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Physical damage: Table 4.2 reports effects on physical damage. We find clear effects on damage to livestock, land, and productive assets, conditioning on pre-flood ownership as measured in the 2017 survey. Flooding close to the household (0–2km) increases the probability of reporting livestock damage by 16 percentage points ($p < 0.05$), damage to livestock or land by 15 percentage points ($p < 0.05$), and damage to productive assets by 17 percentage points ($p < 0.01$). Flooding further away (2–6km) has no significant additional effect on any of these outcomes. This is reassur-

ing: physical damage is driven by direct contact with floodwaters, not by flooding in surrounding areas. We do not find significant effects on housing damage, whether measured through household self-reports or matched administrative records. For self-reports, this may reflect awareness of the government's Sindh People's Housing Fund, which compensated for housing damage and could have led households to over-report regardless of actual exposure. For the administrative data, the damage registry only records damaged households, so an unmatched household could reflect either a failed match or genuinely no damage.

Table 4.3: IV estimates of flood exposure on displacement and economic disruption

	F-stat	Conley cutoff (km)	Any member evacuated	Any TP flooded	Any TP inaccessible	Length TP inaccessible
1. Results by size of treatment area						
Flooding within 180m	[114.0, 117.4]	5.2	0.078**	0.179	0.085	8.212
			(0.035)	(0.174)	(0.199)	(7.422)
Flooding within 350m	[118.6, 124.4]	5.4	0.080***	0.196	0.087	8.686
			(0.028)	(0.163)	(0.180)	(6.518)
Flooding within 530m	[109.0, 111.4]	5.6	0.080***	0.166	0.072	8.530
			(0.027)	(0.163)	(0.181)	(6.153)
Flooding within 700m	[100.3, 101.3]	5.4	0.078***	0.152	0.061	7.811
			(0.026)	(0.165)	(0.181)	(6.065)
Flooding within 870m	[94.8, 96.0]	5.4	0.077***	0.147	0.056	7.262
			(0.026)	(0.166)	(0.183)	(6.121)
Flooding within 1,050m	[94.6, 96.7]	5.2	0.077***	0.145	0.051	6.686
			(0.025)	(0.166)	(0.182)	(6.062)
Flooding within 2,090m	[92.9, 95.3]	5.7	0.087***	0.179	0.094	6.951
			(0.032)	(0.184)	(0.203)	(7.005)
Flooding within 3,130m	[83.1, 86.7]	5.9	0.090***	0.195	0.141	5.547
			(0.034)	(0.198)	(0.216)	(8.065)
Flooding within 4,000m	[76.0, 77.7]	6.1	0.103***	0.237	0.190	1.933
			(0.039)	(0.223)	(0.234)	(9.731)
Flooding within 5,050m	[77.7, 78.7]	6.6	0.117**	0.246	0.212	-3.049
			(0.048)	(0.263)	(0.273)	(12.593)
Flooding within 5,920m	[67.8, 71.6]	7.3	0.139**	0.133	0.109	-10.031
			(0.067)	(0.328)	(0.339)	(15.230)
Flooding within 7,000m	[44.2, 47.2]	10.3	0.146	-0.101	-0.139	-25.891
			(0.100)	(0.437)	(0.468)	(19.176)
Flooding within 8,000m	[24.1, 25.6]	10.1	0.119	-0.537	-0.628	-52.809*
			(0.108)	(0.660)	(0.737)	(29.115)
Flooding within 9,050m	[19.3, 19.9]	9.6	0.014	-1.069	-1.226	-76.802**
			(0.130)	(0.919)	(1.025)	(38.627)
Flooding within 10,090m	[22.8, 23.0]	9.4	-0.033	-1.451	-1.648	-88.510**
			(0.164)	(1.035)	(1.140)	(42.377)
2. Direct vs. indirect effects						
Local exposure (0–2 km)	74.2	7.3	0.058	0.208	0.087	17.013*
			(0.047)	(0.275)	(0.320)	(8.826)
Regional exposure (2–6 km)	62.4	7.3	0.080	-0.082	0.020	-27.912
			(0.094)	(0.453)	(0.521)	(17.884)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)						
Local exposure (0–2 km)	69.8	9.4	0.065	0.051	-0.097	12.619
			(0.047)	(0.237)	(0.265)	(8.580)
Regional exposure (2–5 km)	59.7	9.4	0.048	0.315	0.462	-7.640
			(0.083)	(0.293)	(0.314)	(12.096)
Wider regional exposure (5–10 km)	66.9	9.4	-0.032	-1.171**	-1.360**	-67.954***
			(0.093)	(0.546)	(0.646)	(22.376)
Min. obs.			4,468	4,230	4,230	4,411
Max. obs.			4,520	4,275	4,275	4,463

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Displacement and trade access: Table 4.3 shows that more flooded households were 8–10 percentage points more likely to evacuate, with effects significant at treatment areas of up to ~6km. In the donut specification, local exposure increases evacuation probability by 5.8 percentage points, while regional exposure has no significant additional effect. We do not find significant effects on flooding of or access to trade partners at close distances, though the point estimates are directionally consistent with disrupted access. At wider treatment radii, the effects on trade partner accessibility become negative and significant in the three-band specification, driven by the 5–10km ring — a pattern we return to below.

4.2 Outcomes one year post-flood

We now turn to the effects of flooding on household outcomes, examining each outcome first across treatment areas of increasing size, then using the donut specification to separate local from regional effects.

4.2.1 Impacts of local flooding

Consumption and unmet needs: Despite the physical damage and displacement documented above, we find no significant effects of local flooding on household consumption or unmet needs one year after the floods (Table 4.4). At narrow treatment radii (180m–1km), point estimates on total monthly expenditure are negative but small and insignificant (ranging from −538 to −186). Effects on food expenditure and health expenditure are similarly noisy and centred around zero. We find no significant effects on a food quantity index, nor on the probability of reducing food or non-food spending, or skipping healthcare. These null results hold when we control for regional flooding in the donut specification. We also find no significant effects of local flooding on physical or mental health (Table 4.5). Point estimates on the combined health index and the health index alone are small and insignificant throughout, as are mental health scores and the probability of severe mental distress.

This raises the question of how households managed to maintain consumption in the face of such a large physical shock. We consider three broad channels: labour markets, financial coping strategies, and aid.

Labour markets: Effects of local flooding on employment are modest and largely insignificant (Table 4.6). At narrow treatment radii, point estimates on paid work are close to zero throughout. There is some evidence of a shift out of casual work, especially among agricultural workers ($\beta = -0.099$, $p < 0.05$ at 180m, Table A.1), with a corresponding increase in self-employment — though these effects shrink and lose significance in the donut specification, suggesting they may partly reflect regional labour market conditions rather than direct flooding alone. We find no significant effects for non-agricultural workers (Table A.2). Those who remain employed do appear to cope by travelling further for work (Table 4.7): local flooding significantly increases the probability of

Table 4.4: IV estimates of flood exposure on consumption and unmet needs

	F-stat	Conley cutoff (km)	Spending index	Monthly total exp (equiv)	Monthly food exp (equiv)	Monthly health exp (equiv)	Food quantity index	Skipped all spending	Reduced food spending	Reduced non-food spending	Skipped healthcare
1. Results by size of treatment area											
Flooding within 180m	[114.1, 114.3]	5.2	-0.100	-537.551	-10.589	-160.085	0.019	-0.029	-0.040	-0.036	-0.018
			(0.080)	(369.041)	(208.553)	(128.237)	(0.086)	(0.044)	(0.032)	(0.042)	(0.041)
Flooding within 350m	[118.6, 118.8]	5.4	-0.047	-219.041	190.303	-146.672	0.027	-0.005	-0.028	-0.025	0.008
			(0.070)	(361.247)	(181.209)	(104.493)	(0.078)	(0.037)	(0.030)	(0.036)	(0.037)
Flooding within 530m	[109.0, 109.1]	5.6	-0.038	-203.941	204.656	-131.437	0.030	-0.002	-0.025	-0.020	0.012
			(0.066)	(350.442)	(185.701)	(96.927)	(0.074)	(0.036)	(0.029)	(0.033)	(0.036)
Flooding within 700m	[100.3, 100.4]	5.4	-0.044	-186.308	161.021	-136.750	0.031	-0.009	-0.025	-0.021	0.006
			(0.061)	(330.754)	(168.647)	(98.725)	(0.075)	(0.035)	(0.029)	(0.034)	(0.037)
Flooding within 870m	[94.8, 94.9]	5.4	-0.052	-205.911	125.166	-142.394	0.032	-0.013	-0.028	-0.023	0.004
			(0.060)	(322.623)	(164.599)	(101.768)	(0.075)	(0.035)	(0.029)	(0.034)	(0.037)
Flooding within 1,050m	[95.2, 95.3]	5.2	-0.052	-204.135	121.266	-141.712	0.034	-0.016	-0.029	-0.025	0.001
			(0.062)	(324.691)	(172.128)	(111.809)	(0.076)	(0.035)	(0.029)	(0.033)	(0.037)
Flooding within 2,090m	[92.9, 92.9]	5.7	-0.083	-326.258	83.865	-187.398	0.022	-0.039	-0.036	-0.039	-0.020
			(0.069)	(361.926)	(207.528)	(130.869)	(0.086)	(0.040)	(0.032)	(0.036)	(0.044)
Flooding within 3,130m	[83.1, 83.1]	5.9	-0.089	-296.737	125.040	-222.615	0.031	-0.070	-0.043	-0.063	-0.040
			(0.075)	(441.596)	(253.680)	(137.951)	(0.096)	(0.049)	(0.036)	(0.039)	(0.053)
Flooding within 4,000m	[76.0, 76.0]	6.1	-0.086	-167.055	38.770	-212.635	0.015	-0.099	-0.053	-0.083*	-0.058
			(0.081)	(533.444)	(271.433)	(148.909)	(0.121)	(0.061)	(0.042)	(0.045)	(0.064)
Flooding within 5,050m	[78.6, 78.7]	6.6	-0.064	-5.904	-78.658	-146.552	-0.009	-0.118	-0.067	-0.100*	-0.067
			(0.108)	(692.488)	(345.186)	(185.961)	(0.157)	(0.076)	(0.051)	(0.056)	(0.076)
Flooding within 5,920m	[71.6, 71.6]	7.3	-0.019	69.598	-169.811	-7.398	-0.040	-0.129	-0.077	-0.124*	-0.057
			(0.143)	(863.692)	(402.001)	(232.580)	(0.191)	(0.089)	(0.060)	(0.067)	(0.090)
Flooding within 7,000m	[47.2, 47.2]	10.3	0.038	-44.926	-346.172	226.685	-0.090	-0.153	-0.109	-0.165**	-0.033
			(0.201)	(1004.589)	(411.789)	(336.630)	(0.245)	(0.119)	(0.072)	(0.073)	(0.121)
Flooding within 8,000m	[25.6, 25.6]	10.1	0.082	-351.565	-549.306	472.366	-0.182	-0.152	-0.179**	-0.243***	0.049
			(0.249)	(995.348)	(515.843)	(444.370)	(0.375)	(0.140)	(0.078)	(0.089)	(0.169)
Flooding within 9,050m	[19.9, 19.9]	9.6	0.144	-555.545	-604.961	697.981	-0.258	-0.187	-0.244***	-0.316***	0.092
			(0.284)	(1065.254)	(656.260)	(536.911)	(0.482)	(0.153)	(0.079)	(0.087)	(0.205)
Flooding within 10,090m	[23.0, 23.0]	9.4	0.190	-848.630	-438.056	823.612	-0.303	-0.194	-0.283***	-0.340***	0.111
			(0.292)	(1125.062)	(757.627)	(561.510)	(0.522)	(0.146)	(0.072)	(0.080)	(0.204)
2. Direct vs. indirect effects											
Local exposure (0–2 km)	74.2	7.3	-0.122	-566.259	235.360	-297.608	0.059	0.013	-0.013	0.009	0.002
			(0.117)	(491.791)	(258.712)	(182.352)	(0.131)	(0.038)	(0.028)	(0.033)	(0.047)
Regional exposure (2–6 km)	62.4	7.3	0.110	663.905	-417.595	304.712	-0.101	-0.143	-0.064	-0.134*	-0.059
			(0.214)	(1122.342)	(478.507)	(279.464)	(0.247)	(0.095)	(0.063)	(0.074)	(0.103)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)											
Local exposure (0–2 km)	69.8	9.4	-0.098	-677.819	208.612	-200.561	0.040	0.025	-0.022	-0.001	0.030
			(0.126)	(581.004)	(335.232)	(179.683)	(0.133)	(0.031)	(0.033)	(0.043)	(0.038)
Regional exposure (2–5 km)	59.7	9.4	0.021	830.128	-251.231	-21.842	-0.022	-0.129*	-0.013	-0.064	-0.115*
			(0.190)	(1013.900)	(428.239)	(251.480)	(0.211)	(0.069)	(0.042)	(0.062)	(0.063)
Wider regional exposure (5–10 km)	66.9	9.4	0.143	-835.465	-294.959	646.436*	-0.234	-0.130	-0.221***	-0.257***	0.108
			(0.196)	(797.839)	(577.060)	(369.114)	(0.373)	(0.110)	(0.062)	(0.067)	(0.138)
Min. obs.			4,468	4,468	4,468	4,468	4,467	4,468	4,468	4,468	4,468
Max. obs.			4,520	4,520	4,520	4,520	4,519	4,520	4,520	4,520	4,520

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. Spending index and food quantity index are standardized inverse-covariance weighted indices following Anderson (2008), constructed using `swindex`. Food quantity variables are winsorised at the 95th percentile prior to index construction. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4.5: IV estimates of flood exposure on physical and mental health

	F-stat	Conley cutoff (km)	Mental / physical health index	Health index	Mental health score	Severe mental distress
1. Results by size of treatment area						
Flooding within 180m	[114.4, 160.5]	5.2	-0.083	-0.075	-0.512	0.015
			(0.082)	(0.085)	(0.362)	(0.033)
Flooding within 350m	[119.0, 156.8]	5.4	-0.057	-0.045	-0.368	0.017
			(0.073)	(0.076)	(0.331)	(0.029)
Flooding within 530m	[109.4, 131.2]	5.6	-0.044	-0.033	-0.275	0.023
			(0.070)	(0.070)	(0.313)	(0.027)
Flooding within 700m	[100.7, 115.4]	5.4	-0.049	-0.036	-0.259	0.024
			(0.069)	(0.070)	(0.330)	(0.028)
Flooding within 870m	[95.2, 105.4]	5.4	-0.049	-0.035	-0.226	0.023
			(0.069)	(0.070)	(0.333)	(0.028)
Flooding within 1,050m	[95.6, 101.2]	5.2	-0.045	-0.029	-0.149	0.024
			(0.071)	(0.071)	(0.365)	(0.028)
Flooding within 2,090m	[93.2, 96.8]	5.7	-0.044	-0.022	-0.002	0.024
			(0.079)	(0.079)	(0.394)	(0.031)
Flooding within 3,130m	[83.1, 86.6]	5.9	-0.042	-0.020	0.082	0.016
			(0.080)	(0.082)	(0.524)	(0.036)
Flooding within 4,000m	[74.7, 75.9]	6.1	-0.036	-0.013	0.173	0.013
			(0.073)	(0.087)	(0.587)	(0.042)
Flooding within 5,050m	[71.8, 78.7]	6.6	0.006	0.038	0.152	0.002
			(0.086)	(0.112)	(0.657)	(0.054)
Flooding within 5,920m	[64.7, 71.8]	7.3	0.098	0.141	0.089	0.009
			(0.119)	(0.143)	(0.874)	(0.067)
Flooding within 7,000m	[43.5, 47.2]	10.3	0.264	0.310*	0.129	0.017
			(0.173)	(0.185)	(1.114)	(0.079)
Flooding within 8,000m	[22.5, 25.6]	10.1	0.471*	0.528*	-0.067	-0.006
			(0.283)	(0.271)	(1.231)	(0.092)
Flooding within 9,050m	[17.4, 19.8]	9.6	0.688**	0.745**	-0.269	-0.022
			(0.344)	(0.324)	(1.370)	(0.111)
Flooding within 10,090m	[20.3, 22.9]	9.4	0.783**	0.865**	-0.841	-0.056
			(0.348)	(0.344)	(1.479)	(0.123)
2. Direct vs. indirect effects						
Local exposure (0–2 km)	74.2	7.3	-0.129	-0.119	-0.055	0.033
			(0.125)	(0.117)	(0.604)	(0.035)
Regional exposure (2–6 km)	62.4	7.3	0.235	0.267	0.147	-0.025
			(0.199)	(0.203)	(1.243)	(0.076)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)						
Local exposure (0–2 km)	69.8	9.4	-0.059	-0.041	-0.198	0.043
			(0.142)	(0.124)	(0.782)	(0.041)
Regional exposure (2–5 km)	59.7	9.4	-0.015	-0.012	0.497	-0.040
			(0.178)	(0.148)	(1.356)	(0.086)
Wider regional exposure (5–10 km)	66.9	9.4	0.620**	0.687**	-0.757	-0.033
			(0.265)	(0.272)	(1.196)	(0.099)
Min. obs.			4,451	4,423	2,210	2,210
Max. obs.			4,503	4,475	2,233	2,233

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The mental/physical health index is a standardized inverse-covariance weighted index following Anderson (2008), constructed using `swindex`. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

temporary migration or commuting at narrow treatment radii ($\beta = 0.080$, $p < 0.05$ at 180m), with effects significant up to around 1km. In the donut specification the point estimate remains positive ($\beta = 0.041$) though imprecise. Locally flooded households seem marginally less likely to be in paid work, but do appear able to travel to find work in less affected areas.

Table 4.6: IV estimates of flood exposure on individual labour outcomes

	F-stat	Conley cutoff (km)	Paid work	Casual work	Self employed	Total wage (0 if unemployed)	Total wage (employed only)
1. Results by size of treatment area							
Flooding within 180m	[90.7, 117.1]	5.2	-0.013	-0.045*	0.021	34.180	455.993
			(0.021)	(0.024)	(0.015)	(479.616)	(581.961)
Flooding within 350m	[95.5, 124.1]	5.4	0.000	-0.029	0.022*	55.556	356.295
			(0.018)	(0.021)	(0.013)	(402.270)	(546.010)
Flooding within 530m	[88.3, 112.6]	5.6	0.003	-0.025	0.021*	-49.636	186.525
			(0.017)	(0.021)	(0.012)	(375.226)	(514.849)
Flooding within 700m	[81.3, 99.0]	5.4	0.001	-0.026	0.020*	-9.387	258.265
			(0.017)	(0.021)	(0.012)	(365.627)	(510.784)
Flooding within 870m	[76.9, 90.8]	5.4	-0.001	-0.027	0.020	-7.655	315.284
			(0.017)	(0.021)	(0.012)	(349.666)	(505.737)
Flooding within 1,050m	[76.7, 88.0]	5.2	-0.004	-0.029	0.019	-34.716	333.817
			(0.017)	(0.022)	(0.013)	(343.303)	(501.710)
Flooding within 2,090m	[79.8, 86.6]	5.7	-0.008	-0.033	0.023	-230.491	310.859
			(0.022)	(0.026)	(0.015)	(377.503)	(611.654)
Flooding within 3,130m	[72.4, 77.6]	5.9	-0.012	-0.036	0.026	-356.756	419.918
			(0.029)	(0.032)	(0.020)	(505.404)	(810.233)
Flooding within 4,000m	[64.8, 71.2]	6.1	-0.017	-0.042	0.028	-510.170	529.681
			(0.036)	(0.038)	(0.027)	(643.053)	(1059.233)
Flooding within 5,050m	[67.5, 71.9]	6.6	-0.030	-0.053	0.028	-694.860	796.506
			(0.045)	(0.045)	(0.035)	(778.987)	(1385.475)
Flooding within 5,920m	[59.8, 69.5]	7.3	-0.034	-0.057	0.033	-694.156	1251.842
			(0.055)	(0.055)	(0.047)	(954.151)	(1703.253)
Flooding within 7,000m	[42.1, 50.7]	10.3	-0.036	-0.060	0.045	-735.042	1983.855
			(0.077)	(0.084)	(0.067)	(1250.210)	(2243.721)
Flooding within 8,000m	[20.7, 24.1]	10.1	-0.032	-0.065	0.065	-755.076	3049.116
			(0.101)	(0.113)	(0.079)	(1581.490)	(2786.311)
Flooding within 9,050m	[16.5, 18.1]	9.6	-0.046	-0.080	0.071	-427.925	4198.641
			(0.116)	(0.126)	(0.077)	(1644.693)	(3067.179)
Flooding within 10,090m	[20.0, 20.5]	9.4	-0.062	-0.089	0.060	244.526	4932.178*
			(0.109)	(0.116)	(0.062)	(1393.086)	(2800.725)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	[66.0, 71.7]	7.3	0.007	-0.020	0.018	41.714	-209.076
			(0.024)	(0.030)	(0.018)	(545.154)	(611.559)
Regional exposure (2–6 km)	[53.0, 59.3]	7.3	-0.042	-0.036	0.014	-742.166	1484.543
			(0.067)	(0.067)	(0.059)	(1250.879)	(1949.709)
3. Direct vs. indirect effects (three-band robustness)							
Local exposure (0–2 km)	[67.7, 68.9]	9.4	0.007	-0.025	0.025	207.319	131.397
			(0.023)	(0.024)	(0.017)	(548.865)	(640.422)
Regional exposure (2–6 km)	[54.8, 58.3]	9.4	-0.032	-0.017	-0.004	-942.615	416.229
			(0.054)	(0.042)	(0.042)	(1078.809)	(1595.098)
Wider regional exposure (5–10 km)	[63.4, 71.2]	9.4	-0.042	-0.072	0.052	320.550	3711.374*
			(0.081)	(0.080)	(0.042)	(972.249)	(2165.425)
Min. obs.			14,020	14,020	14,020	8,458	6,968
Max. obs.			14,200	14,200	14,200	8,534	7,042

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure. All regressions control for district fixed effects, age group fixed effects (`i.w1_age5`), and sex. Sample restricted to individuals aged 18–65. Standard errors are Conley (1999) spatial standard errors with empirically determined cutoffs based on the spatial correlogram of instrument residuals (reported in the Conley cutoff column). The last column further restricts to employed individuals (`w1_paid_work==1`). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Financial coping strategies: We find little evidence that locally flooded households resort to financial coping strategies (Table 4.8). At narrow treatment radii, there are no significant effects on spending savings, non-payment of bills, or selling assets. If anything, households are less likely

Table 4.7: IV estimates of flood exposure on individual travel for work

	F-stat	Conley cutoff (km)	Temporary migrant or commuter	Commuter	Temporary migrant	Temporary migrant or commuter (pw only)	Commuter (pw only)	Temporary migrant (pw only)
1. Results by size of treatment area								
Flooding within 180m	[90.7, 117.1]	5.2	0.080**	0.027	0.059	0.078*	0.059*	0.032
			(0.037)	(0.017)	(0.037)	(0.043)	(0.031)	(0.038)
Flooding within 350m	[95.8, 109.6]	5.4	0.069**	0.023	0.050*	0.065*	0.046*	0.026
			(0.030)	(0.014)	(0.029)	(0.035)	(0.027)	(0.030)
Flooding within 530m	[88.5, 98.9]	5.6	0.063**	0.021	0.046*	0.056*	0.040	0.021
			(0.028)	(0.013)	(0.028)	(0.033)	(0.025)	(0.029)
Flooding within 700m	[81.5, 90.4]	5.4	0.057**	0.017	0.042	0.046	0.034	0.017
			(0.028)	(0.013)	(0.027)	(0.033)	(0.025)	(0.028)
Flooding within 870m	[77.0, 85.0]	5.4	0.052*	0.015	0.039	0.042	0.031	0.015
			(0.028)	(0.014)	(0.027)	(0.034)	(0.026)	(0.029)
Flooding within 1,050m	[76.7, 84.9]	5.2	0.047*	0.014	0.035	0.039	0.030	0.012
			(0.028)	(0.014)	(0.027)	(0.035)	(0.027)	(0.029)
Flooding within 2,090m	[79.5, 86.6]	5.7	0.035	0.012	0.023	0.028	0.025	0.004
			(0.036)	(0.019)	(0.031)	(0.046)	(0.036)	(0.032)
Flooding within 3,130m	[73.9, 77.7]	5.9	0.037	0.014	0.020	0.043	0.032	0.006
			(0.040)	(0.022)	(0.033)	(0.052)	(0.042)	(0.035)
Flooding within 4,000m	[68.0, 71.3]	6.1	0.034	0.018	0.012	0.046	0.042	-0.002
			(0.042)	(0.027)	(0.032)	(0.059)	(0.050)	(0.034)
Flooding within 5,050m	[67.5, 71.9]	6.6	0.030	0.020	0.005	0.050	0.047	-0.005
			(0.039)	(0.032)	(0.023)	(0.061)	(0.058)	(0.022)
Flooding within 5,920m	[59.7, 64.9]	7.3	0.026	0.025	-0.001	0.058	0.056	-0.000
			(0.044)	(0.036)	(0.029)	(0.071)	(0.066)	(0.029)
Flooding within 7,000m	[42.1, 45.2]	10.3	0.015	0.025	-0.011	0.063	0.059	0.006
			(0.069)	(0.043)	(0.057)	(0.100)	(0.085)	(0.053)
Flooding within 8,000m	[20.7, 23.2]	10.1	-0.005	0.018	-0.016	0.057	0.047	0.026
			(0.114)	(0.058)	(0.099)	(0.150)	(0.124)	(0.090)
Flooding within 9,050m	[16.5, 17.2]	9.6	-0.024	0.012	-0.020	0.061	0.039	0.055
			(0.156)	(0.076)	(0.138)	(0.183)	(0.161)	(0.122)
Flooding within 10,090m	[20.0, 20.3]	9.4	-0.020	0.020	-0.015	0.085	0.057	0.077
			(0.167)	(0.084)	(0.149)	(0.185)	(0.173)	(0.122)
2. Direct vs. indirect effects								
Local exposure (0–2 km)	[66.0, 71.7]	7.3	0.041	0.004	0.038	0.013	0.009	0.006
			(0.046)	(0.019)	(0.043)	(0.053)	(0.038)	(0.045)
Regional exposure (2–6 km)	[53.0, 59.3]	7.3	-0.017	0.020	-0.041	0.045	0.048	-0.007
			(0.055)	(0.037)	(0.050)	(0.080)	(0.070)	(0.052)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)								
Local exposure (0–2 km)	[67.7, 68.9]	9.4	0.042	0.007	0.041	0.017	0.013	0.015
			(0.041)	(0.015)	(0.039)	(0.050)	(0.031)	(0.044)
Regional exposure (2–5 km)	[54.8, 58.3]	9.4	-0.015	0.011	-0.039	0.027	0.030	-0.025
			(0.034)	(0.030)	(0.024)	(0.063)	(0.055)	(0.037)
Wider regional exposure (5–10 km)	[63.4, 71.2]	9.4	-0.004	0.016	0.002	0.069	0.046	0.063
			(0.109)	(0.060)	(0.103)	(0.131)	(0.119)	(0.095)
Min. obs.			14,020	14,008	14,020	6,976	6,976	6,976
Max. obs.			14,200	14,188	14,200	7,050	7,050	7,050

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure. All regressions control for district fixed effects, age group fixed effects, and sex. Sample restricted to individuals aged 18–65. Columns labelled (pw only) further restrict to paid workers (`w1_paid_work==1`). Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

to take on new loans — the coefficient is negative and significant from around 700m ($\beta = -0.058$, $p < 0.05$), and this holds in the donut specification ($\beta = -0.109$, $p < 0.05$).

Table 4.8: IV estimates of flood exposure on financial coping strategies

	F-stat	Conley cutoff (km)	Depleted assets or borrowed	Spent savings	Took new loans	Non-payment of bills	Sold any assets	Sold productive assets	Sold household assets	Sold productive assets (oo)	Sold household assets (oo)
1. Results by size of treatment area											
Flooding within 180m	[110.3, 114.1]	5.2	-0.048*	0.018	-0.049	-0.016	0.025	0.015	0.027	0.008	0.017
			(0.028)	(0.050)	(0.038)	(0.033)	(0.032)	(0.027)	(0.024)	(0.030)	(0.025)
Flooding within 350m	[112.2, 122.3]	5.4	-0.036	0.021	-0.041	-0.015	0.004	-0.005	0.019	-0.010	0.014
			(0.023)	(0.042)	(0.032)	(0.030)	(0.028)	(0.023)	(0.019)	(0.026)	(0.021)
Flooding within 530m	[103.6, 109.0]	5.6	-0.036*	0.027	-0.052*	-0.015	-0.012	-0.019	0.013	-0.023	0.009
			(0.022)	(0.038)	(0.028)	(0.030)	(0.026)	(0.022)	(0.018)	(0.024)	(0.020)
Flooding within 700m	[95.8, 100.3]	5.4	-0.036	0.027	-0.058**	-0.014	-0.018	-0.023	0.010	-0.027	0.008
			(0.023)	(0.037)	(0.028)	(0.028)	(0.026)	(0.023)	(0.017)	(0.024)	(0.019)
Flooding within 870m	[90.9, 94.8]	5.4	-0.036	0.027	-0.062**	-0.010	-0.020	-0.025	0.009	-0.028	0.007
			(0.023)	(0.036)	(0.027)	(0.028)	(0.026)	(0.023)	(0.017)	(0.025)	(0.018)
Flooding within 1,050m	[90.9, 95.5]	5.2	-0.035	0.029	-0.067**	-0.007	-0.022	-0.028	0.008	-0.029	0.007
			(0.024)	(0.036)	(0.027)	(0.028)	(0.027)	(0.023)	(0.016)	(0.025)	(0.018)
Flooding within 2,090m	[89.3, 92.9]	5.7	-0.045	0.023	-0.086***	-0.002	-0.028	-0.035	0.011	-0.025	0.008
			(0.029)	(0.043)	(0.031)	(0.034)	(0.034)	(0.030)	(0.019)	(0.031)	(0.020)
Flooding within 3,130m	[81.2, 83.1]	5.9	-0.060	0.008	-0.103***	-0.007	-0.016	-0.030	0.020	-0.026	0.013
			(0.037)	(0.047)	(0.037)	(0.038)	(0.042)	(0.038)	(0.020)	(0.039)	(0.019)
Flooding within 4,000m	[73.6, 76.0]	6.1	-0.074	0.006	-0.100**	-0.035	-0.001	-0.026	0.034	-0.029	0.026
			(0.047)	(0.054)	(0.045)	(0.041)	(0.053)	(0.048)	(0.022)	(0.048)	(0.021)
Flooding within 5,050m	[74.1, 78.7]	6.6	-0.069	0.024	-0.087	-0.062	0.036	-0.003	0.063***	-0.011	0.056**
			(0.055)	(0.058)	(0.062)	(0.042)	(0.072)	(0.067)	(0.024)	(0.069)	(0.023)
Flooding within 5,920m	[65.8, 71.6]	7.3	-0.039	0.042	-0.051	-0.081	0.085	0.034	0.100***	0.029	0.096**
			(0.064)	(0.065)	(0.083)	(0.050)	(0.093)	(0.086)	(0.037)	(0.091)	(0.038)
Flooding within 7,000m	[44.4, 47.2]	10.3	0.033	0.069	0.032	-0.073	0.172	0.104	0.147***	0.096	0.144**
			(0.073)	(0.089)	(0.117)	(0.055)	(0.121)	(0.114)	(0.055)	(0.123)	(0.059)
Flooding within 8,000m	[24.0, 25.6]	10.1	0.160	0.154	0.164	-0.029	0.278*	0.197	0.179**	0.200	0.172**
			(0.114)	(0.111)	(0.187)	(0.060)	(0.144)	(0.135)	(0.072)	(0.151)	(0.075)
Flooding within 9,050m	[18.5, 19.9]	9.6	0.284*	0.218*	0.282	0.042	0.370**	0.289*	0.176**	0.323*	0.167**
			(0.159)	(0.130)	(0.246)	(0.115)	(0.156)	(0.149)	(0.077)	(0.170)	(0.080)
Flooding within 10,090m	[21.7, 23.0]	9.4	0.352**	0.232*	0.350	0.089	0.381***	0.316**	0.149*	0.387**	0.136
			(0.168)	(0.127)	(0.259)	(0.146)	(0.143)	(0.138)	(0.080)	(0.158)	(0.083)
2. Direct vs. indirect effects											
Local exposure (0–2 km)	[74.0, 74.7]	7.3	-0.049*	0.013	-0.109**	0.044	-0.095**	-0.076*	-0.041	-0.058	-0.038
			(0.030)	(0.048)	(0.054)	(0.046)	(0.048)	(0.045)	(0.032)	(0.051)	(0.037)
Regional exposure (2–6 km)	[60.5, 62.4]	7.3	0.012	0.028	0.063	-0.127	0.185	0.114	0.144**	0.090	0.134**
			(0.073)	(0.081)	(0.116)	(0.078)	(0.114)	(0.109)	(0.059)	(0.123)	(0.066)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)											
Local exposure (0–2 km)	[68.9, 73.1]	9.4	-0.009	0.037	-0.075	0.053	-0.071*	-0.053	-0.028	-0.020	-0.022
			(0.029)	(0.050)	(0.052)	(0.063)	(0.038)	(0.035)	(0.034)	(0.041)	(0.040)
Regional exposure (2–5 km)	[56.1, 59.7]	9.4	-0.100	-0.046	-0.045	-0.128	0.073	0.021	0.076	-0.033	0.065
			(0.078)	(0.071)	(0.092)	(0.096)	(0.071)	(0.064)	(0.056)	(0.078)	(0.064)
Wider regional exposure (5–10 km)	[62.1, 73.7]	9.4	0.295***	0.192*	0.281**	0.094	0.286***	0.244**	0.104*	0.310***	0.092
			(0.109)	(0.107)	(0.132)	(0.108)	(0.098)	(0.096)	(0.063)	(0.109)	(0.065)
Min. obs.			4,468	4,468	4,468	4,468	4,468	4,468	4,468	3,042	3,595
Max. obs.			4,520	4,520	4,520	4,520	4,520	4,520	4,520	3,072	3,641

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. Columns labelled (oo) are estimated on the subsample of asset owners only (`succ_ownprodassets==1` and `succ_ownhhassets==1` respectively). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Aid: Locally flooded households are much more likely to receive relief (Table 4.9). At narrow treatment radii, flooding increases the probability of receiving any flood relief by 13 percentage points ($p < 0.01$ at 180m), and the probability of receiving food aid by 7–9 percentage points, reaching significance from around 700m. These effects are significant across treatment areas up to around 4–5km, after which they decline and eventually reverse at very wide radii. In the donut specification, local exposure (0–2km) increases flood relief by 19 percentage points ($p < 0.01$) and food aid by 16 percentage points ($p < 0.01$). The pattern — where the donut coefficients are larger than the cumulative estimates — is consistent with these effects being diluted at wider radii by regional flooding, which as we show below is associated with *less* aid.

Balance sheet: Taking stock, locally flooded households do show signs of depleted physical assets (Table 4.10). The physical asset index declines significantly at narrow treatment radii ($\beta = -0.164$, $p < 0.05$ at 180m), likely reflecting direct damage. But their financial position is broadly intact: we find no significant effects on debt or savings in the donut specification. The combination

Table 4.9: IV estimates of flood exposure on aid, social protection and community assistance

	F-stat	Conley cutoff (km)	Received any flood relief	Any food aid	Last week food aid	Non-financial community support
1. Results by size of treatment area						
Flooding within 180m	[108.9, 114.1]	5.2	0.134***	0.074	0.060*	0.033
			(0.049)	(0.051)	(0.033)	(0.032)
Flooding within 350m	[110.2, 118.6]	5.4	0.126***	0.073*	0.043	0.035
			(0.043)	(0.044)	(0.030)	(0.028)
Flooding within 530m	[105.0, 109.0]	5.6	0.127***	0.078*	0.036	0.032
			(0.041)	(0.041)	(0.028)	(0.027)
Flooding within 700m	[98.6, 100.3]	5.4	0.130***	0.082**	0.034	0.031
			(0.038)	(0.038)	(0.027)	(0.028)
Flooding within 870m	[93.6, 94.8]	5.4	0.129***	0.084**	0.034	0.028
			(0.037)	(0.037)	(0.027)	(0.028)
Flooding within 1,050m	[95.0, 95.2]	5.2	0.126***	0.085**	0.035	0.026
			(0.037)	(0.037)	(0.026)	(0.028)
Flooding within 2,090m	[89.6, 92.9]	5.7	0.121***	0.090**	0.040	0.028
			(0.041)	(0.043)	(0.031)	(0.033)
Flooding within 3,130m	[82.1, 83.1]	5.9	0.108**	0.085*	0.041	0.026
			(0.043)	(0.047)	(0.032)	(0.040)
Flooding within 4,000m	[76.0, 76.2]	6.1	0.079*	0.065	0.041	0.021
			(0.042)	(0.048)	(0.033)	(0.050)
Flooding within 5,050m	[78.5, 78.7]	6.6	0.040	0.023	0.026	0.027
			(0.050)	(0.056)	(0.040)	(0.065)
Flooding within 5,920m	[70.3, 71.6]	7.3	0.019	-0.023	-0.002	0.037
			(0.061)	(0.072)	(0.055)	(0.081)
Flooding within 7,000m	[46.0, 47.2]	10.3	0.012	-0.081	-0.043	0.057
			(0.081)	(0.106)	(0.085)	(0.102)
Flooding within 8,000m	[25.1, 25.6]	10.1	0.013	-0.146	-0.083	0.081
			(0.133)	(0.166)	(0.134)	(0.125)
Flooding within 9,050m	[19.9, 20.6]	9.6	-0.032	-0.225	-0.113	0.097
			(0.192)	(0.226)	(0.178)	(0.140)
Flooding within 10,090m	[23.0, 24.7]	9.4	-0.100	-0.287	-0.120	0.098
			(0.213)	(0.256)	(0.198)	(0.144)
2. Direct vs. indirect effects						
Local exposure (0–2 km)	74.2	7.3	0.190***	0.159***	0.066	0.024
			(0.056)	(0.050)	(0.043)	(0.044)
Regional exposure (2–6 km)	62.4	7.3	-0.189**	-0.190**	-0.072	0.013
			(0.095)	(0.080)	(0.069)	(0.101)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)						
Local exposure (0–2 km)	69.8	9.4	0.211***	0.147***	0.049	0.039
			(0.050)	(0.048)	(0.038)	(0.040)
Regional exposure (2–5 km)	59.7	9.4	-0.188***	-0.107*	-0.012	-0.029
			(0.066)	(0.058)	(0.039)	(0.077)
Wider regional exposure (5–10 km)	66.9	9.4	-0.057	-0.203	-0.091	0.084
			(0.119)	(0.139)	(0.131)	(0.107)
Min. obs.			4,111	4,468	4,468	4,468
Max. obs.			4,163	4,520	4,520	4,520

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification: for each treatment radius, the cutoff is the first distance at which spatial correlation in the instrument decays to zero in a spatial correlogram. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

of aid, some labour mobility, and limited drawdown of financial buffers appears to have helped these households cope in the short term.

Table 4.10: IV estimates of flood exposure on assets

	F-stat	Conley cutoff (km)	Physical asset index	HH has debt	Value of HH debt	HH has savings	Value of HH savings
1. Results by size of treatment area							
Flooding within 180m	[114.1, 116.2]	5.2	-0.164**	-0.013	-4135.610	0.062*	759.627
			(0.082)	(0.029)	(7780.710)	(0.034)	(567.090)
Flooding within 350m	[118.6, 120.6]	5.4	-0.162**	-0.001	-3727.924	0.041	370.407
			(0.073)	(0.027)	(5742.295)	(0.031)	(483.320)
Flooding within 530m	[109.0, 110.8]	5.6	-0.166**	-0.009	-5613.495	0.038	247.492
			(0.069)	(0.027)	(5304.317)	(0.031)	(461.351)
Flooding within 700m	[100.3, 101.7]	5.4	-0.157**	-0.013	-6533.860	0.038	274.474
			(0.072)	(0.027)	(5211.819)	(0.031)	(467.516)
Flooding within 870m	[94.8, 96.0]	5.4	-0.144**	-0.018	-7435.258	0.039	287.804
			(0.073)	(0.028)	(5252.381)	(0.031)	(474.176)
Flooding within 1,050m	[95.2, 96.2]	5.2	-0.135*	-0.020	-7509.694	0.041	307.270
			(0.073)	(0.029)	(5518.348)	(0.032)	(498.417)
Flooding within 2,090m	[92.9, 93.6]	5.7	-0.143*	-0.013	-9013.401	0.052	563.347
			(0.083)	(0.037)	(6123.344)	(0.046)	(691.473)
Flooding within 3,130m	[83.1, 83.1]	5.9	-0.161	-0.002	-1.05e+04	0.071	921.238
			(0.102)	(0.041)	(6439.300)	(0.061)	(948.740)
Flooding within 4,000m	[75.8, 76.0]	6.1	-0.232**	0.019	-1.06e+04	0.102	1504.628
			(0.114)	(0.044)	(7174.183)	(0.080)	(1265.716)
Flooding within 5,050m	[78.7, 78.7]	6.6	-0.330***	0.040	-1.01e+04	0.151	2456.236
			(0.128)	(0.048)	(9877.464)	(0.103)	(1748.423)
Flooding within 5,920m	[71.6, 71.8]	7.3	-0.411***	0.066	-9802.865	0.208*	3294.380
			(0.134)	(0.056)	(11148.692)	(0.121)	(2183.259)
Flooding within 7,000m	[47.2, 47.2]	10.3	-0.506***	0.107	-8844.851	0.302**	4451.946
			(0.189)	(0.068)	(12264.780)	(0.150)	(2804.628)
Flooding within 8,000m	[25.6, 25.6]	10.1	-0.605**	0.134*	-8815.983	0.426**	5845.662*
			(0.258)	(0.078)	(16949.551)	(0.167)	(3262.175)
Flooding within 9,050m	[19.7, 19.9]	9.6	-0.573**	0.144	-5444.422	0.523***	6954.021*
			(0.239)	(0.089)	(24431.785)	(0.174)	(3580.910)
Flooding within 10,090m	[22.8, 23.0]	9.4	-0.578***	0.117	-1.02e+04	0.541***	6952.191*
			(0.193)	(0.096)	(27334.042)	(0.175)	(3653.187)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	74.2	7.3	0.009	-0.060	-8770.751	-0.039	-1025.809
			(0.101)	(0.042)	(7641.818)	(0.032)	(635.169)
Regional exposure (2–6 km)	62.4	7.3	-0.423**	0.130*	-656.796	0.249*	4388.210*
			(0.185)	(0.072)	(14612.747)	(0.129)	(2547.239)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)							
Local exposure (0–2 km)	69.8	9.4	-0.018	-0.058	-8992.392	-0.011	-814.584
			(0.107)	(0.040)	(7642.247)	(0.037)	(720.996)
Regional exposure (2–5 km)	59.7	9.4	-0.243	0.092*	585.690	0.104	2595.462
			(0.215)	(0.049)	(11331.102)	(0.087)	(1942.359)
Wider regional exposure (5–10 km)	66.9	9.4	-0.413**	0.074	-8442.062	0.408***	5005.817*
			(0.181)	(0.079)	(20699.021)	(0.137)	(2813.372)
Min. obs.			4,423	4,468	4,468	4,468	4,468
Max. obs.			4,475	4,520	4,520	4,520	4,520

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification: for each treatment radius, the cutoff is the first distance at which spatial correlation in the instrument decays to zero in a spatial correlogram. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4.2.2 Regional flood exposure

Conditional on their own flooding, households surrounded by more widespread flooding face a very different set of circumstances.

Consumption and health: We do not find significant effects of regional exposure on total expenditure or food expenditure in the donut specification (Table 4.4). However, regional flooding is associated with worse physical health: in the three-band specification, the 5–10km ring shows large significant effects on the combined health index ($\beta = 0.620$, $p < 0.05$) and the health index alone ($\beta = 0.687$, $p < 0.05$, Table 4.5). Mental health is not significantly affected.

Labour markets: In the pooled results (Table 4.6), the effects of flooding on employment grow steadily as the treatment area widens — with the coefficient on casual work becoming increasingly negative and reaching significance at wider radii — suggesting that flooding in the broader area drives much larger employment losses than localised flooding. This pattern is particularly pronounced among agricultural workers (Table A.1), where regional exposure (2–5km) reduces the probability of being in paid work by 10 percentage points ($p < 0.10$) in the three-band specification, and wider regional exposure (5–10km) reduces the probability of being in paid work by over 30 percentage points. For non-agricultural workers, we find no significant effects at any distance (Table A.2). The commuting channel that helped locally flooded households also appears to be blocked: while local flooding increases temporary migration, regional flooding works in the opposite direction, with a negative (though insignificant) coefficient on regional exposure in the donut specification ($\beta = -0.017$, Table 4.7).

Financial coping: Households with more flooding in surrounding areas are more likely to sell assets (Table 4.8). At wider treatment radii we see significant increases in selling productive assets ($\beta = 0.316$, $p < 0.05$ at 10km) and household assets ($\beta = 0.149$, $p < 0.10$ at 10km). This could reflect households who were not themselves directly flooded but who live in flooded areas liquidating undamaged assets, perhaps at favourable prices when others in the area have lost theirs. Alternatively, it could reflect households who were themselves flooded and in very widely damaged areas having less aid and worse employment outcomes, and resorting to asset sales as a result.

Aid: While local flooding increases the probability of receiving aid, regional exposure (2–6km) does the opposite, reducing the probability of receiving any flood relief by 19 percentage points ($p < 0.05$) and food aid by 19 percentage points ($p < 0.05$, Table 4.9). This is consistent with a zero-sum allocation of limited relief within areas — when everyone around you has been flooded, there is less to go around.

Balance sheet: The asset picture for regionally flooded households reflects these coping strategies (Table 4.10). Regional exposure is associated with a large decline in the physical asset index ($\beta = -0.423$, $p < 0.05$), but also an increase in the probability of having savings ($\beta = 0.249$, $p < 0.10$) and in the value of savings ($\beta = 4388$, $p < 0.10$) — likely reflecting the proceeds from asset sales.

Table 4.11: IV estimates of flood exposure on consumption and unmet needs (wave 2)

	F-stat	Conley cutoff (km)	Spending index	Monthly total exp (equiv)	Monthly food exp (equiv)	Monthly health exp (equiv)	Food quantity index	Skipped all spending	Reduced food spending	Reduced non-food spending	Skipped healthcare
1. Results by size of treatment area											
Flooding within 180m	[114.1, 114.8]	5.2	0.097	292.845	73.184	244.138	0.162**	0.018	-0.004	-0.002	0.015
			(0.073)	(306.002)	(203.200)	(182.361)	(0.075)	(0.033)	(0.024)	(0.026)	(0.029)
Flooding within 350m	[111.9, 118.6]	5.4	0.056	142.726	-19.232	174.875	0.150**	0.009	-0.003	-0.004	0.013
			(0.070)	(308.686)	(177.179)	(173.778)	(0.067)	(0.031)	(0.021)	(0.022)	(0.029)
Flooding within 530m	[103.2, 109.0]	5.6	0.046	72.295	-48.585	175.475	0.141**	0.012	-0.003	-0.002	0.019
			(0.073)	(321.365)	(182.730)	(176.243)	(0.067)	(0.031)	(0.021)	(0.022)	(0.029)
Flooding within 700m	[95.2, 100.3]	5.4	0.041	53.178	-70.745	171.930	0.149**	0.011	-0.004	-0.003	0.018
			(0.072)	(326.072)	(181.791)	(174.689)	(0.069)	(0.030)	(0.021)	(0.022)	(0.029)
Flooding within 870m	[90.2, 94.8]	5.4	0.033	13.535	-102.541	166.267	0.158**	0.012	-0.004	-0.004	0.021
			(0.071)	(330.980)	(179.927)	(172.652)	(0.071)	(0.030)	(0.022)	(0.023)	(0.029)
Flooding within 1,050m	[90.4, 95.2]	5.2	0.029	-3.879	-131.165	169.192	0.164**	0.015	-0.005	-0.006	0.024
			(0.073)	(344.626)	(188.285)	(173.750)	(0.072)	(0.031)	(0.022)	(0.023)	(0.028)
Flooding within 2,090m	[86.9, 92.9]	5.7	0.069	161.541	-117.583	263.653	0.205**	0.047	-0.001	-0.001	0.055*
			(0.081)	(423.365)	(207.621)	(191.026)	(0.083)	(0.034)	(0.028)	(0.030)	(0.031)
Flooding within 3,130m	[76.6, 83.1]	5.9	0.104	233.566	-66.797	352.594*	0.206**	0.077**	0.001	0.004	0.083**
			(0.089)	(480.309)	(225.932)	(207.727)	(0.093)	(0.036)	(0.028)	(0.034)	(0.033)
Flooding within 4,000m	[70.5, 76.0]	6.1	0.135	261.145	-40.417	450.336*	0.190*	0.120***	0.013	0.020	0.115***
			(0.101)	(550.379)	(235.263)	(234.554)	(0.105)	(0.039)	(0.030)	(0.037)	(0.036)
Flooding within 5,050m	[75.9, 78.7]	6.6	0.169	424.802	-31.783	524.168**	0.176	0.166***	0.024	0.036	0.147***
			(0.113)	(637.536)	(277.079)	(263.652)	(0.123)	(0.047)	(0.034)	(0.041)	(0.040)
Flooding within 5,920m	[71.6, 72.0]	7.3	0.202*	617.875	-9.688	579.745**	0.188	0.216***	0.038	0.058	0.180***
			(0.118)	(736.399)	(315.089)	(284.113)	(0.152)	(0.061)	(0.039)	(0.044)	(0.051)
Flooding within 7,000m	[47.2, 51.0]	10.3	0.240*	799.897	-62.183	685.475*	0.221	0.309***	0.079	0.116**	0.235***
			(0.139)	(1044.939)	(355.517)	(374.102)	(0.231)	(0.086)	(0.051)	(0.047)	(0.072)
Flooding within 8,000m	[25.6, 26.8]	10.1	0.221	684.596	-295.384	751.396	0.336	0.441***	0.161**	0.213***	0.317***
			(0.216)	(1565.877)	(368.672)	(570.383)	(0.319)	(0.119)	(0.081)	(0.075)	(0.102)
Flooding within 9,050m	[19.9, 20.7]	9.6	0.168	257.329	-524.204	787.568	0.506	0.505***	0.220**	0.292***	0.351***
			(0.353)	(2023.745)	(491.846)	(845.126)	(0.378)	(0.138)	(0.098)	(0.095)	(0.129)
Flooding within 10,090m	[23.0, 24.0]	9.4	0.159	-112.686	-583.908	900.804	0.605	0.507***	0.222**	0.313***	0.366**
			(0.413)	(2045.726)	(583.597)	(1009.790)	(0.406)	(0.170)	(0.102)	(0.096)	(0.156)
2. Direct vs. indirect effects											
Local exposure (0–2 km)	74.2	7.3	-0.007	-101.954	-183.644	85.230	0.216**	-0.052	-0.024	-0.035	-0.016
			(0.099)	(578.917)	(269.141)	(236.147)	(0.099)	(0.036)	(0.030)	(0.030)	(0.040)
Regional exposure (2–6 km)	62.4	7.3	0.211	728.167	182.876	493.500	-0.033	0.271***	0.063*	0.095**	0.199***
			(0.147)	(946.347)	(399.533)	(384.309)	(0.171)	(0.076)	(0.038)	(0.045)	(0.066)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)											
Local exposure (0–2 km)	69.8	9.4	-0.011	-48.997	-233.635	73.583	0.290**	-0.036	-0.013	-0.020	-0.007
			(0.095)	(507.917)	(265.319)	(283.272)	(0.143)	(0.041)	(0.032)	(0.032)	(0.044)
Regional exposure (2–5 km)	59.7	9.4	0.168	482.759	299.310	358.829	-0.201	0.153***	0.014	0.025	0.117***
			(0.156)	(769.124)	(398.075)	(371.578)	(0.145)	(0.056)	(0.037)	(0.040)	(0.044)
Wider regional exposure (5–10 km)	66.9	9.4	0.096	-173.939	-520.019	650.754	0.526*	0.372**	0.172*	0.242***	0.268**
			(0.294)	(1515.978)	(460.752)	(727.614)	(0.272)	(0.148)	(0.093)	(0.088)	(0.119)
Min. obs.			4,468	4,468	4,468	4,468	4,163	4,468	4,468	4,468	4,467
Max. obs.			4,520	4,520	4,520	4,520	4,215	4,520	4,520	4,520	4,519

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. Spending index and food quantity index are standardized inverse-covariance weighted indices following Anderson (2008), constructed using `swindex`. Food quantity variables are winsorised at the 95th percentile prior to index construction. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4.12: IV estimates of flood exposure on physical and mental health (wave 2)

	F-stat	Conley cutoff (km)	Mental / physical health index	Health index	Ailment index	Mental health score (m)	Severe mental distress (m)	Mental health score (f)	Severe mental distress (f)
1. Results by size of treatment area									
Flooding within 180m	[80.3, 117.7]	5.2	0.122	0.134	0.245**	-0.620	-0.045	-0.548	-0.027
			(0.101)	(0.084)	(0.112)	(0.457)	(0.038)	(0.611)	(0.058)
Flooding within 350m	[77.0, 112.0]	5.4	0.081	0.088	0.197*	-0.593	-0.036	-0.416	-0.019
			(0.093)	(0.074)	(0.104)	(0.452)	(0.036)	(0.548)	(0.049)
Flooding within 530m	[77.2, 102.7]	5.6	0.075	0.086	0.200*	-0.698	-0.049	-0.499	-0.033
			(0.093)	(0.068)	(0.105)	(0.444)	(0.034)	(0.532)	(0.047)
Flooding within 700m	[76.4, 94.1]	5.4	0.089	0.099	0.220**	-0.744*	-0.055*	-0.614	-0.044
			(0.090)	(0.066)	(0.104)	(0.431)	(0.032)	(0.520)	(0.044)
Flooding within 870m	[74.7, 88.8]	5.4	0.099	0.108*	0.235**	-0.788*	-0.058*	-0.708	-0.053
			(0.088)	(0.063)	(0.104)	(0.431)	(0.031)	(0.519)	(0.043)
Flooding within 1,050m	[77.0, 88.7]	5.2	0.103	0.115*	0.242**	-0.861**	-0.063**	-0.824	-0.062
			(0.084)	(0.061)	(0.100)	(0.432)	(0.031)	(0.518)	(0.042)
Flooding within 2,090m	[77.6, 86.5]	5.7	0.137	0.154**	0.322***	-1.113**	-0.072*	-1.281**	-0.090**
			(0.102)	(0.068)	(0.114)	(0.537)	(0.038)	(0.569)	(0.040)
Flooding within 3,130m	[73.9, 76.6]	5.9	0.171	0.178**	0.398***	-1.301**	-0.073*	-1.374**	-0.090**
			(0.120)	(0.084)	(0.127)	(0.583)	(0.043)	(0.629)	(0.042)
Flooding within 4,000m	[70.4, 74.0]	6.1	0.257**	0.244**	0.509***	-1.475**	-0.078*	-1.380*	-0.089*
			(0.131)	(0.100)	(0.142)	(0.636)	(0.047)	(0.705)	(0.046)
Flooding within 5,050m	[74.6, 77.3]	6.6	0.368***	0.334***	0.579***	-1.309*	-0.057	-1.028	-0.078
			(0.139)	(0.119)	(0.169)	(0.682)	(0.051)	(0.726)	(0.052)
Flooding within 5,920m	[66.4, 71.3]	7.3	0.517***	0.408***	0.615***	-0.562	-0.001	0.032	-0.029
			(0.147)	(0.116)	(0.205)	(0.687)	(0.056)	(0.799)	(0.061)
Flooding within 7,000m	[43.4, 50.0]	10.3	0.817***	0.498***	0.671**	1.522	0.142*	2.666	0.108
			(0.251)	(0.135)	(0.298)	(1.205)	(0.077)	(1.728)	(0.109)
Flooding within 8,000m	[22.2, 26.3]	10.1	1.103**	0.495**	0.647	4.636*	0.354**	6.337*	0.313
			(0.450)	(0.247)	(0.491)	(2.654)	(0.168)	(3.438)	(0.203)
Flooding within 9,050m	[19.6, 20.6]	9.6	1.259*	0.408	0.606	7.059**	0.493**	8.948**	0.474**
			(0.646)	(0.466)	(0.740)	(3.540)	(0.229)	(4.142)	(0.241)
Flooding within 10,090m	[23.2, 28.2]	9.4	1.141	0.277	0.467	7.506**	0.517**	9.126**	0.496**
			(0.773)	(0.601)	(0.882)	(3.382)	(0.226)	(3.751)	(0.222)
2. Direct vs. indirect effects									
Local exposure (0–2 km)	74.2	7.3	-0.070	0.018	0.167	-1.453*	-0.114**	-1.991**	-0.124**
			(0.162)	(0.098)	(0.166)	(0.773)	(0.050)	(0.875)	(0.061)
Regional exposure (2–6 km)	62.4	7.3	0.590***	0.391***	0.445*	0.969	0.119	2.115*	0.100
			(0.226)	(0.147)	(0.256)	(1.018)	(0.077)	(1.173)	(0.092)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)									
Local exposure (0–2 km)	69.8	9.4	0.012	0.034	0.141	-0.620	-0.063	-0.977	-0.077
			(0.116)	(0.094)	(0.151)	(0.737)	(0.044)	(0.650)	(0.059)
Regional exposure (2–5 km)	59.7	9.4	0.250	0.264	0.387**	-1.179	-0.025	-0.530	-0.021
			(0.240)	(0.216)	(0.174)	(1.270)	(0.066)	(1.354)	(0.088)
Wider regional exposure (5–10 km)	66.9	9.4	0.854	0.192	0.344	5.474**	0.372***	6.761**	0.364**
			(0.611)	(0.388)	(0.480)	(2.281)	(0.131)	(2.900)	(0.174)
Min. obs.			4,231	4,189	4,189	3,385	3,385	3,005	3,005
Max. obs.			4,283	4,241	4,241	3,432	3,432	3,050	3,050

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The mental/physical health index is a standardized inverse-covariance weighted index following Anderson (2008), constructed using `swindex`. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4.3 Medium-term impacts (Year 2)

4.3.1 Impacts of local flooding

Consumption and health: Two years after the floods, locally flooded households continue to show no significant differences in consumption (Table **??**). Point estimates on total expenditure and food expenditure are small and insignificant at narrow treatment radii and in the donut specification. There is, however, some evidence that locally flooded households consume more food by quantity: the food quantity index is positive and significant across most treatment radii ($\beta = 0.162$, $p < 0.05$ at 180m), and this holds in the donut specification ($\beta = 0.216$, $p < 0.05$). We find no significant effects on skipping food or non-food spending, or on skipping healthcare. Although we find positive and significant effects on the health and ailment indices (a higher value means worse health), the effect sizes grow steadily with the treatment area, and local effects are not significant in the donut specifications, suggesting that these health effects are driven by regional flood exposure, not local. We also find no significant effects on mental health (though the point estimates are negative, indicating better mental health).

Table 4.13: IV estimates of flood exposure on individual labour outcomes (Wave 2)

	F-stat	Conley cutoff (km)	Paid work	Casual work	Self employed	Total wage (0 if unemployed)	Total wage (employed only)	Hours worked (0 if unemployed)	Hours worked (employed only)	Hourly wage (0 if unemployed)	Hourly wage (employed only)	Works outside village (0 if unemployed)	Works outside village (employed only)
1. Results by size of treatment area													
Flooding within 180m	[82.6, 113.1]	5.2	-0.005	-0.021	0.001	388.563	1030.378***	5.770	14.276**	1.086	3.488	0.015	0.025
			(0.021)	(0.019)	(0.014)	(237.187)	(388.679)	(4.219)	(5.737)	(1.784)	(3.333)	(0.033)	(0.042)
Flooding within 350m	[77.4, 108.5]	5.4	-0.007	-0.024	-0.003	249.240	771.199**	5.067	12.943**	-0.010	1.812	0.014	0.021
			(0.018)	(0.018)	(0.012)	(234.928)	(385.747)	(3.928)	(5.211)	(1.588)	(2.856)	(0.031)	(0.038)
Flooding within 530m	[76.0, 98.9]	5.6	-0.012	-0.026	-0.005	174.655	677.475*	4.092	11.924**	-0.519	1.415	0.010	0.017
			(0.018)	(0.017)	(0.011)	(236.328)	(392.411)	(3.986)	(5.410)	(1.505)	(2.702)	(0.030)	(0.038)
Flooding within 700m	[72.8, 90.6]	5.4	-0.015	-0.029	-0.005	164.734	701.212*	3.725	11.761**	-0.652	1.641	0.007	0.014
			(0.018)	(0.018)	(0.011)	(236.083)	(398.531)	(4.168)	(5.793)	(1.487)	(2.721)	(0.032)	(0.040)
Flooding within 870m	[70.6, 85.2]	5.4	-0.018	-0.034*	-0.004	154.279	716.546*	3.142	11.394*	-0.766	1.836	0.007	0.014
			(0.018)	(0.018)	(0.010)	(233.422)	(401.662)	(4.180)	(5.902)	(1.410)	(2.633)	(0.032)	(0.041)
Flooding within 1,050m	[71.6, 85.1]	5.2	-0.021	-0.036*	-0.003	148.926	715.610*	2.781	11.057*	-0.853	1.877	0.006	0.014
			(0.018)	(0.018)	(0.010)	(224.211)	(398.931)	(4.080)	(5.889)	(1.347)	(2.624)	(0.033)	(0.042)
Flooding within 2,090m	[71.8, 86.1]	5.7	-0.013	-0.041*	0.003	351.468	901.244*	5.251	13.185*	-0.256	1.635	-0.016	-0.011
			(0.020)	(0.021)	(0.010)	(263.032)	(485.668)	(5.050)	(7.336)	(1.451)	(3.254)	(0.035)	(0.046)
Flooding within 3,130m	[63.4, 77.0]	5.9	-0.005	-0.044*	0.008	468.254	1009.727*	7.539	15.823**	-0.730	-0.577	-0.035	-0.031
			(0.026)	(0.026)	(0.011)	(300.170)	(519.625)	(5.886)	(7.888)	(1.761)	(3.852)	(0.043)	(0.057)
Flooding within 4,000m	[60.1, 71.3]	6.1	-0.002	-0.044	0.009	515.820	997.551*	7.646	14.834*	-1.332	-2.387	-0.068	-0.072
			(0.034)	(0.030)	(0.013)	(355.785)	(540.469)	(7.078)	(8.188)	(2.302)	(4.560)	(0.052)	(0.066)
Flooding within 5,050m	[66.6, 73.5]	6.6	0.001	-0.035	0.004	447.434	783.271	6.264	11.052	-1.729	-3.600	-0.092	-0.104
			(0.044)	(0.034)	(0.017)	(476.719)	(572.684)	(9.138)	(8.787)	(2.761)	(4.798)	(0.065)	(0.077)
Flooding within 5,920m	[64.5, 67.8]	7.3	0.011	-0.013	-0.005	404.319	505.187	4.628	5.018	-0.407	-2.171	-0.095	-0.109
			(0.052)	(0.042)	(0.022)	(578.964)	(692.814)	(10.993)	(11.097)	(3.275)	(5.319)	(0.072)	(0.082)
Flooding within 7,000m	[45.2, 49.0]	10.3	0.015	0.008	-0.016	208.823	-52.279	-1.007	-7.017	3.170	4.300	-0.068	-0.075
			(0.060)	(0.057)	(0.034)	(801.118)	(1011.707)	(14.042)	(17.283)	(3.637)	(6.356)	(0.081)	(0.088)
Flooding within 8,000m	[23.0, 25.1]	10.1	0.036	0.046	-0.030	16.797	-1045.624	-6.780	-24.539	7.688	10.196	0.063	0.059
			(0.073)	(0.078)	(0.044)	(1083.661)	(1675.087)	(18.109)	(26.631)	(6.013)	(10.485)	(0.077)	(0.086)
Flooding within 9,050m	[17.0, 18.4]	9.6	0.074	0.114	-0.046	-186.638	-2090.264	-7.986	-36.454	12.737	14.372	0.226*	0.215
			(0.082)	(0.109)	(0.050)	(1247.638)	(2273.326)	(19.957)	(33.006)	(8.506)	(13.997)	(0.129)	(0.150)
Flooding within 10,090m	[19.9, 21.1]	9.4	0.094	0.144	-0.049	-196.343	-2393.508	-5.660	-36.982	14.329*	14.696	0.311*	0.280
			(0.082)	(0.114)	(0.053)	(1257.879)	(2335.744)	(19.948)	(32.647)	(8.636)	(13.238)	(0.172)	(0.195)
2. Direct vs. indirect effects													
Local exposure (0–2 km)	[60.2, 65.0]	6.4	-0.025	-0.047**	0.001	285.695	1025.955	4.519	15.368	1.125	6.345	0.050	0.074
			(0.022)	(0.023)	(0.015)	(434.775)	(668.913)	(7.397)	(10.671)	(2.043)	(4.003)	(0.042)	(0.050)
Regional exposure (2–5 km)	[59.6, 60.9]	6.4	0.028	0.014	0.004	148.104	-281.001	1.606	-4.771	-3.108	-10.607	-0.147*	-0.184*
			(0.054)	(0.041)	(0.025)	(764.268)	(829.046)	(12.855)	(12.795)	(4.282)	(6.619)	(0.088)	(0.095)
3. Direct vs. indirect effects (three-band robustness)													
Local exposure (0–2 km)	[66.1, 69.6]	9.4	-0.022	-0.043*	-0.000	245.946	895.635	3.981	13.740	1.730	7.182*	0.063*	0.086**
			(0.022)	(0.024)	(0.012)	(437.209)	(705.555)	(7.863)	(12.078)	(2.268)	(4.351)	(0.035)	(0.043)
Regional exposure (2–5 km)	[58.7, 60.6]	9.4	0.018	-0.001	0.009	203.325	-18.499	2.572	-0.258	-4.724	-12.539**	-0.187**	-0.224**
			(0.050)	(0.044)	(0.026)	(746.508)	(879.147)	(12.675)	(12.936)	(3.311)	(5.631)	(0.087)	(0.090)
Wider regional exposure (5–10 km)	[64.1, 65.8]	9.4	0.064	0.099	-0.038	-73.459	-1406.862	-3.546	-24.849	11.435**	13.484*	0.269***	0.255**
			(0.061)	(0.077)	(0.038)	(746.865)	(1411.161)	(12.796)	(19.999)	(5.175)	(8.177)	(0.086)	(0.100)
Min. obs.			13,614	13,614	13,614	13,176	6,377	13,611	6,812	13,173	6,374	13,614	6,815
Max. obs.			13,788	13,788	13,788	13,350	6,453	13,785	6,888	13,347	6,450	13,788	6,891

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure. All regressions control for district fixed effects, age group fixed effects (`i.w2_age5`), and sex. Sample restricted to individuals aged 18–65. Standard errors are Conley (1999) spatial standard errors with empirically determined cutoffs based on the spatial correlogram of instrument residuals (reported in the Conley cutoff column). Columns labelled (employed only) further restrict to employed individuals (`w2_paid_work==1`). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts are defined as: local exposure (0–2km, rings 0–11) and regional exposure (2–5km, rings 12–28). Section 3 adds wider regional exposure (5–10km, rings 29–57) as a robustness check. Min./max. observations are reported across all rows within each outcome column. Significance levels: < 0.10*, < 0.05**, < 0.01***.

Labour markets: Employment rates no longer differ significantly by local flood exposure (Table **??**). Point estimates on paid work are close to zero at all distances. There is, however, a significant reduction in casual work in the donut specification ($\beta = -0.047$, $p < 0.05$), suggesting a shift away

from casual labour. Locally flooded households appear to be working harder: hours worked among employed workers are significantly higher at narrow radii ($\beta = 14.3$, $p < 0.05$ at 180m), and this is driven by more hours rather than higher hourly wages.

Table 4.14: IV estimates of flood exposure on financial coping strategies (wave 2)

	F-stat	Conley cutoff (km)	Depleted assets or borrowed	Spent savings	Took new loans	Non-payment of bills	Sold any assets	Sold productive assets	Sold household assets	Sold productive assets (oo)	Sold household assets (oo)
1. Results by size of treatment area											
Flooding within 180m	[110.3, 114.1]	5.2	-0.001	0.033	0.015	0.037	-0.007	-0.014	0.018	-0.014	0.012
			(0.023)	(0.041)	(0.046)	(0.033)	(0.028)	(0.024)	(0.022)	(0.028)	(0.022)
Flooding within 350m	[112.2, 122.3]	5.4	-0.002	0.019	0.005	0.025	-0.018	-0.017	0.004	-0.013	0.005
			(0.020)	(0.037)	(0.039)	(0.027)	(0.023)	(0.019)	(0.018)	(0.023)	(0.018)
Flooding within 530m	[103.6, 109.0]	5.6	-0.007	0.012	-0.004	0.018	-0.027	-0.022	-0.004	-0.018	-0.003
			(0.021)	(0.038)	(0.039)	(0.025)	(0.024)	(0.019)	(0.018)	(0.023)	(0.018)
Flooding within 700m	[95.8, 100.3]	5.4	-0.008	0.012	-0.004	0.011	-0.028	-0.023	-0.005	-0.019	-0.003
			(0.020)	(0.036)	(0.039)	(0.026)	(0.023)	(0.018)	(0.018)	(0.021)	(0.018)
Flooding within 870m	[90.9, 94.8]	5.4	-0.010	0.013	-0.002	0.007	-0.029	-0.022	-0.005	-0.017	-0.003
			(0.020)	(0.035)	(0.039)	(0.026)	(0.023)	(0.018)	(0.018)	(0.021)	(0.018)
Flooding within 1,050m	[90.9, 95.5]	5.2	-0.012	0.013	-0.002	0.006	-0.030	-0.022	-0.006	-0.015	-0.002
			(0.020)	(0.034)	(0.038)	(0.025)	(0.023)	(0.018)	(0.018)	(0.021)	(0.018)
Flooding within 2,090m	[89.3, 92.9]	5.7	-0.012	0.028	0.010	-0.009	-0.037	-0.016	-0.013	-0.010	-0.008
			(0.027)	(0.040)	(0.045)	(0.031)	(0.029)	(0.021)	(0.021)	(0.024)	(0.022)
Flooding within 3,130m	[81.2, 83.1]	5.9	-0.008	0.049	0.033	-0.037	-0.034	-0.002	-0.013	0.004	-0.007
			(0.032)	(0.040)	(0.050)	(0.037)	(0.034)	(0.026)	(0.025)	(0.031)	(0.027)
Flooding within 4,000m	[73.6, 76.0]	6.1	0.001	0.068*	0.053	-0.076**	-0.025	0.002	-0.002	0.004	0.007
			(0.037)	(0.041)	(0.055)	(0.038)	(0.038)	(0.034)	(0.027)	(0.039)	(0.028)
Flooding within 5,050m	[74.1, 78.7]	6.6	0.017	0.094**	0.066	-0.103***	-0.012	0.005	0.013	0.001	0.022
			(0.041)	(0.045)	(0.058)	(0.038)	(0.044)	(0.045)	(0.033)	(0.051)	(0.036)
Flooding within 5,920m	[65.8, 71.6]	7.3	0.036	0.110**	0.097	-0.118***	-0.003	0.005	0.032	-0.002	0.041
			(0.050)	(0.053)	(0.067)	(0.044)	(0.047)	(0.050)	(0.040)	(0.057)	(0.044)
Flooding within 7,000m	[44.4, 47.2]	10.3	0.072	0.155**	0.184*	-0.076*	-0.004	-0.007	0.057	-0.017	0.063
			(0.073)	(0.075)	(0.098)	(0.043)	(0.057)	(0.054)	(0.051)	(0.062)	(0.056)
Flooding within 8,000m	[24.0, 25.6]	10.1	0.113	0.195*	0.315**	0.056	0.015	-0.008	0.102	-0.013	0.120*
			(0.109)	(0.114)	(0.149)	(0.082)	(0.072)	(0.067)	(0.066)	(0.081)	(0.069)
Flooding within 9,050m	[18.5, 19.9]	9.6	0.150	0.217	0.405**	0.236	0.017	-0.033	0.130	-0.027	0.159*
			(0.130)	(0.141)	(0.189)	(0.165)	(0.089)	(0.081)	(0.085)	(0.102)	(0.089)
Flooding within 10,090m	[21.7, 23.0]	9.4	0.157	0.234	0.380*	0.311*	0.016	-0.058	0.147*	-0.036	0.176*
			(0.127)	(0.145)	(0.204)	(0.187)	(0.087)	(0.081)	(0.086)	(0.098)	(0.091)
2. Direct vs. indirect effects											
Local exposure (0–2 km)	[74.0, 74.7]	7.3	-0.040	-0.019	-0.040	0.055	-0.058*	-0.029	-0.039	-0.015	-0.034
			(0.036)	(0.058)	(0.055)	(0.045)	(0.035)	(0.022)	(0.035)	(0.026)	(0.035)
Regional exposure (2–6 km)	[60.5, 62.4]	7.3	0.078	0.130*	0.139*	-0.176**	0.059	0.035	0.073	0.014	0.076
			(0.056)	(0.078)	(0.076)	(0.075)	(0.057)	(0.059)	(0.063)	(0.066)	(0.070)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)											
Local exposure (0–2 km)	[68.9, 73.1]	9.4	-0.031	-0.015	-0.026	0.093**	-0.062*	-0.042	-0.030	-0.024	-0.025
			(0.030)	(0.047)	(0.061)	(0.044)	(0.034)	(0.027)	(0.035)	(0.031)	(0.036)
Regional exposure (2–5 km)	[56.1, 59.7]	9.4	0.034	0.085***	0.057	-0.241***	0.055	0.060	0.030	0.034	0.034
			(0.035)	(0.031)	(0.058)	(0.063)	(0.040)	(0.047)	(0.050)	(0.053)	(0.058)
Wider regional exposure (5–10 km)	[62.1, 73.7]	9.4	0.117	0.169	0.289	0.290***	0.001	-0.058	0.110	-0.036	0.127
			(0.110)	(0.113)	(0.177)	(0.097)	(0.066)	(0.060)	(0.068)	(0.071)	(0.079)
Min. obs.			4,468	4,467	4,467	4,467	4,468	4,468	4,468	3,042	3,595
Max. obs.			4,520	4,519	4,519	4,519	4,520	4,520	4,520	3,072	3,641

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. Columns labelled (oo) are estimated on the subsample of asset owners only (`succ_ownprodassets==1` and `succ_ownhhassets==1` respectively). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Financial coping: We find little evidence that locally flooded households are drawing down financial buffers in Year 2 (Table 4.14). There are no significant effects on spending savings, taking new loans, or non-payment of bills at narrow treatment radii or in the donut specification. There is a marginally significant increase in non-payment of bills in the three-band specification ($\beta = 0.093$, $p < 0.05$ for local exposure), but this is not robust across specifications.

Balance sheet: The asset position of locally flooded households has partially recovered (Table 4.15). The physical asset index is no longer significantly lower — point estimates are small and positive. However, locally flooded households are now less likely to have savings ($\beta = -0.054$, $p < 0.05$ at 350m, significant across most treatment radii) and have lower value of savings ($\beta = -317$, $p < 0.05$ at 350m). In the donut specification, local exposure reduces the probability of having savings by 7.9 percentage points ($p < 0.10$). Debt is not significantly affected.

Table 4.15: IV estimates of flood exposure on assets (wave 2)

	F-stat	Conley cutoff (km)	Physical asset index	HH has debt	Value of HH debt	HH has savings	Value of HH savings
1. Results by size of treatment area							
Flooding within 180m	[108.4, 116.2]	5.2	0.088	0.021	-1929.381	-0.041	-286.605*
			(0.070)	(0.036)	(12489.412)	(0.028)	(164.968)
Flooding within 350m	[108.5, 120.6]	5.4	0.086	-0.003	-1793.348	-0.054**	-316.740**
			(0.062)	(0.031)	(10374.190)	(0.027)	(149.155)
Flooding within 530m	[99.7, 110.8]	5.6	0.063	-0.015	-4430.317	-0.056**	-319.424**
			(0.066)	(0.031)	(9968.807)	(0.026)	(143.675)
Flooding within 700m	[91.8, 101.7]	5.4	0.054	-0.017	-4900.833	-0.055**	-316.902**
			(0.064)	(0.032)	(10106.155)	(0.025)	(143.159)
Flooding within 870m	[86.9, 96.0]	5.4	0.052	-0.017	-4629.424	-0.054**	-308.369**
			(0.064)	(0.033)	(10075.570)	(0.025)	(144.689)
Flooding within 1,050m	[87.2, 96.2]	5.2	0.051	-0.018	-4417.586	-0.053**	-301.961**
			(0.065)	(0.032)	(10184.474)	(0.025)	(144.664)
Flooding within 2,090m	[85.8, 93.6]	5.7	0.060	-0.006	-2753.507	-0.056*	-289.673*
			(0.069)	(0.037)	(11907.493)	(0.033)	(170.294)
Flooding within 3,130m	[76.2, 83.1]	5.9	0.076	0.004	-5551.095	-0.052	-302.606*
			(0.079)	(0.041)	(13994.060)	(0.038)	(183.663)
Flooding within 4,000m	[70.0, 76.0]	6.1	0.090	0.022	-9120.725	-0.040	-341.727*
			(0.100)	(0.045)	(15269.703)	(0.039)	(199.832)
Flooding within 5,050m	[74.6, 78.7]	6.6	0.099	0.036	-8108.291	-0.026	-387.014*
			(0.121)	(0.048)	(17081.251)	(0.039)	(228.085)
Flooding within 5,920m	[69.7, 71.8]	7.3	0.076	0.059	2156.575	-0.021	-488.755*
			(0.142)	(0.055)	(18782.801)	(0.045)	(296.887)
Flooding within 7,000m	[47.2, 49.6]	10.3	0.067	0.102	24774.096	-0.039	-737.312
			(0.198)	(0.081)	(23529.555)	(0.064)	(467.403)
Flooding within 8,000m	[25.3, 26.0]	10.1	0.084	0.152	59089.987*	-0.069	-1172.711*
			(0.258)	(0.116)	(33798.821)	(0.092)	(680.135)
Flooding within 9,050m	[19.7, 20.4]	9.6	0.037	0.193	98875.281**	-0.095	-1539.011*
			(0.318)	(0.139)	(41145.282)	(0.115)	(796.593)
Flooding within 10,090m	[22.8, 23.9]	9.4	-0.012	0.202	1.13e+05***	-0.093	-1595.634**
			(0.325)	(0.142)	(38951.416)	(0.115)	(798.940)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	74.2	7.3	0.052	-0.045	-5496.625	-0.079*	-185.529
			(0.113)	(0.044)	(13599.626)	(0.047)	(205.561)
Regional exposure (2–6 km)	62.4	7.3	0.022	0.106*	7803.331	0.062	-298.403
			(0.224)	(0.064)	(20217.771)	(0.072)	(356.733)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)							
Local exposure (0–2 km)	69.8	9.4	0.023	-0.038	8498.823	-0.095**	-319.248
			(0.133)	(0.050)	(15608.532)	(0.048)	(221.072)
Regional exposure (2–5 km)	59.7	9.4	0.081	0.058	-2.79e+04*	0.090	101.901
			(0.226)	(0.051)	(16460.084)	(0.055)	(346.084)
Wider regional exposure (5–10 km)	66.9	9.4	-0.024	0.148	89995.081***	-0.092	-1277.111**
			(0.231)	(0.121)	(32858.461)	(0.084)	(626.549)
Min. obs.			4,423	4,468	4,220	4,468	4,198
Max. obs.			4,475	4,520	4,272	4,520	4,250

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure from a regression controlling for district fixed effects. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification: for each treatment radius, the cutoff is the first distance at which spatial correlation in the instrument decays to zero in a spatial correlogram. The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–6km, rings 12–34), using a Conley cutoff motivated by the 6km treatment radius. Section 3 repeats with local exposure (0–2km, rings 0–11), regional exposure (2–5km, rings 12–28), and wider regional exposure (5–10km, rings 29–57) as a robustness check, using a 10km Conley cutoff. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

In summary, locally flooded households appear to be managing two years after the floods — consumption is maintained, employment has recovered, and they have not resorted to financial coping strategies. But there are signs of strain: depleted savings and more hours worked. They received aid, they travelled for work, and they are working harder — but the buffers that protected them in Year 1 are thinner.

4.3.2 Regional flood exposure

Consumption and health: By Year 2, the effects of regional flooding on consumption and well-being have sharpened. Regional exposure (2–6km) is associated with significant increases in reducing non-food spending ($\beta = 0.095$, $p < 0.05$) and skipping healthcare ($\beta = 0.199$, $p < 0.01$, Table 4.11). The food quantity index turns negative for regional exposure ($\beta = -0.033$), though this is not significant. Health outcomes deteriorate markedly: regional exposure (2–6km) increases the combined health index by 0.590 ($p < 0.01$), the health index by 0.391 ($p < 0.01$), and the ailment index by 0.445 ($p < 0.10$, Table 4.12). Regional flooding, particularly at the larger radii, is also strongly associated with worse mental health for men and women.

Labour markets: The effects of regional flooding on employment in Year 2 are largely insignificant (Table **??**). In the donut specification, regional exposure (2–5km) has no significant effect on paid work, casual work, self-employment, wages, or hours worked. There is some evidence that regionally flooded workers are less likely to work outside the village ($\beta = -0.184$, $p < 0.10$ for the 2–5km ring, employed workers only), which may reflect reduced opportunities for commuting in areas where the broader economy was damaged.

Financial coping: The financial coping picture has changed dramatically from Year 1 (Table 4.14). Regional exposure (2–6km) is now associated with significant increases in spending savings ($\beta = 0.130$, $p < 0.10$), taking new loans ($\beta = 0.139$, $p < 0.10$), and non-payment of bills ($\beta = -0.176$, $p < 0.05$). At wider treatment radii, the effects on spending savings and taking new loans grow steadily and become highly significant. In Year 1, regionally flooded households sold assets; in Year 2, they are drawing down savings and taking on debt.

Balance sheet: The asset position of regionally flooded households has deteriorated sharply (Table 4.15). Regional exposure (2–6km) is associated with an increase in the probability of having debt ($\beta = 0.106$, $p < 0.10$) and a large increase in the value of debt. The probability of having savings is no longer significantly different. In Year 1, regionally flooded households had more savings, likely from asset sales. By Year 2, those savings appear to have been spent.

4.4 Summary

To make these patterns concrete, consider a household that was directly flooded, but whose neighbours were not. They experience physical damage, are more likely to evacuate, and have moderately

worse labour market outcomes. However, they also travel further to find work and are considerably more likely to receive aid. Together, this allows them to maintain consumption relative to less flooded households. Moving into year two, they still manage to maintain consumption, though they seem to be working more hours and have somewhat depleted savings (but have rebuilt their asset stocks).

Next, consider a household that is directly flooded and located in a widely flooded area. They experience the same physical damage as a directly flooded household in an otherwise dry area — regional flooding does not cause additional destruction. But they receive less aid, because relief is spread across more affected households. They also face worse labour market outcomes, because agricultural work has dried up across the wider area and they cannot commute to less affected places. Moving into year two, they are in a worse position: skipping meals, in worse health, drawing down savings, and taking on debt.

Finally, consider a household that was not itself directly flooded, but is surrounded by widespread flooding. They do not experience direct physical damage, and likely do not qualify for flood relief. Yet they still face the same deteriorating agricultural labour market, driven entirely by their regional exposure. In year two, they too are skipping meals, have worse health, and are taking on debt. These indirect effects are largely invisible to a policy response organised around direct flood exposure.

5 Conclusion

In this paper, we study how the costs of Pakistan's 2022 floods depend on the spatial scale of the shock. We combine panel data on 5,100 households with a recentered instrumental variables design that separately identifies local and regional flood exposure, and find that the worst medium-term outcomes may be driven not by direct physical damage but by indirect effects operating through labour markets and aid allocation. Locally flooded households appear to cope in the short term: they are significantly more likely to receive aid, and appear able to travel to less affected areas for work. We find no significant effects of local flooding on consumption, health, or mental health in either year, though by year two there are signs of strain — more hours worked and depleted savings.

When flooding is more widespread, however, these coping mechanisms appear to break down. Regional flood exposure is associated with significantly less aid — consistent with zero-sum allocation of limited relief — and with large reductions in agricultural employment, particularly in year one. There is suggestive evidence that the ability to commute to less affected areas is curtailed when surrounding areas are also flooded, though this effect is imprecisely estimated. In year one, regionally exposed households appear to cope by selling assets. By year two, this strategy seems to have run its course: we observe significant increases in borrowing and spending down savings, alongside worse physical health and increased unmet needs. These patterns are consistent with a medium-run assistance gap in which the indirect costs of widespread flooding deepen over time.

These results suggest that disaster relief organised primarily around direct flood exposure may miss an important dimension of the welfare costs of flooding. A directly flooded household surrounded by widespread flooding appears to fare significantly worse than an equally flooded household in an otherwise unaffected area — receiving less aid and facing worse labour market conditions despite experiencing the same physical damage. Households who were not themselves directly flooded but who live in widely flooded areas receive little assistance, yet appear to face worsening economic conditions driven entirely by what happened around them. These patterns are consistent with the classic insight that informal coping strategies work best against localised shocks, and break down when the shock is large enough to affect the people and markets that households would otherwise turn to. As climate change drives floods of increasing scale, understanding and addressing these indirect, regional costs seems likely to become increasingly important for disaster response policy.

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A Supplementary Tables

Table A.1: IV estimates of flood exposure on individual labour outcomes (agricultural workers)

	F-stat	Conley cutoff (km)	Paid work	Casual work	Self employed	Total wage (0 if unemployed)	Total wage (employed only)
1. Results by size of treatment area							
Flooding within 180m	[102.9, 132.5]	5.2	-0.041	-0.099**	0.042*	297.057	1113.586
			(0.029)	(0.040)	(0.024)	(579.612)	(863.950)
Flooding within 350m	[98.2, 139.1]	5.4	-0.026	-0.078**	0.043**	390.877	994.604
			(0.027)	(0.038)	(0.021)	(471.026)	(823.777)
Flooding within 530m	[84.9, 118.2]	5.6	-0.022	-0.073**	0.041**	221.393	724.928
			(0.025)	(0.037)	(0.020)	(432.257)	(796.470)
Flooding within 700m	[77.6, 103.4]	5.4	-0.023	-0.075*	0.042**	234.936	782.579
			(0.026)	(0.038)	(0.020)	(437.352)	(794.819)
Flooding within 870m	[72.2, 92.9]	5.4	-0.029	-0.080**	0.041**	219.728	871.372
			(0.026)	(0.039)	(0.019)	(416.665)	(791.834)
Flooding within 1,050m	[71.1, 88.8]	5.2	-0.036	-0.086**	0.041**	199.071	962.723
			(0.028)	(0.041)	(0.020)	(436.194)	(793.278)
Flooding within 2,090m	[68.0, 75.0]	5.7	-0.051	-0.101**	0.045**	117.131	1162.755
			(0.035)	(0.051)	(0.022)	(391.732)	(901.618)
Flooding within 3,130m	[61.2, 64.2]	5.9	-0.070	-0.118*	0.049*	77.848	1505.693
			(0.045)	(0.065)	(0.026)	(513.046)	(1134.236)
Flooding within 4,000m	[55.4, 60.5]	6.1	-0.094	-0.147*	0.055*	-10.416	1930.252
			(0.059)	(0.084)	(0.031)	(713.128)	(1481.643)
Flooding within 5,050m	[53.7, 68.5]	6.6	-0.139*	-0.192*	0.058*	-304.862	2446.439
			(0.075)	(0.104)	(0.034)	(864.314)	(1952.296)
Flooding within 5,920m	[47.2, 69.3]	7.3	-0.186**	-0.242**	0.070*	-370.678	3313.666
			(0.088)	(0.124)	(0.041)	(1060.445)	(2456.797)
Flooding within 7,000m	[33.7, 50.7]	10.3	-0.272**	-0.341**	0.097*	-689.103	4624.351
			(0.112)	(0.164)	(0.059)	(1415.634)	(3452.794)
Flooding within 8,000m	[17.0, 25.1]	10.1	-0.390***	-0.484**	0.126*	-1344.088	6083.431
			(0.131)	(0.188)	(0.076)	(1904.305)	(4333.982)
Flooding within 9,050m	[15.7, 19.4]	9.6	-0.450***	-0.573***	0.142*	-1756.282	6567.516
			(0.142)	(0.201)	(0.079)	(1901.864)	(4498.294)
Flooding within 10,090m	[22.5, 23.0]	9.4	-0.424***	-0.556***	0.134*	-1273.329	6496.761
			(0.141)	(0.202)	(0.076)	(1455.914)	(4101.194)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	[51.7, 58.9]	6.4	0.032	-0.020	0.037	548.607	117.957
			(0.035)	(0.049)	(0.027)	(858.626)	(942.188)
Regional exposure (2–5 km)	[37.5, 48.6]	6.4	-0.169*	-0.164	0.017	-875.375	2261.478
			(0.090)	(0.120)	(0.039)	(1532.185)	(2306.777)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)							
Local exposure (0–2 km)	[53.7, 58.5]	9.4	0.015	-0.043	0.043**	480.602	426.329
			(0.037)	(0.044)	(0.019)	(898.508)	(914.781)
Regional exposure (2–5 km)	[37.8, 52.3]	9.4	-0.102*	-0.074	-0.005	-668.417	1743.350
			(0.055)	(0.060)	(0.032)	(1626.451)	(2187.764)
Wider regional exposure (5–10 km)	[86.7, 87.7]	9.4	-0.315***	-0.425***	0.108**	-865.297	5017.499*
			(0.110)	(0.152)	(0.054)	(969.570)	(2959.473)
Min. obs.			4,641	4,641	4,641	4,590	3,785
Max. obs.			4,680	4,680	4,680	4,627	3,822

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure. All regressions control for district fixed effects, age group fixed effects (`i.w1_age5`), and sex. Sample restricted to agricultural workers (`pf_sector_allon_agri==1`) aged 18–65. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The last column further restricts to employed individuals (`w1_paid_work==1`). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–5km, rings 12–28). Section 3 repeats with a wider regional exposure ring (5–10km, rings 29–57) as a robustness check. Min./max. observations are reported across all rows within each outcome column. Significance levels: $*$ < 0.10, $**$ < 0.05, $***$ < 0.01.

Table A.2: IV estimates of flood exposure on individual labour outcomes (non-agricultural workers)

	F-stat	Conley cutoff (km)	Paid work	Casual work	Self employed	Total wage (0 if unemployed)	Total wage (employed only)
1. Results by size of treatment area							
Flooding within 180m	[77.4, 88.4]	5.2	-0.007	-0.018	0.000	-404.223	-257.131
			(0.034)	(0.037)	(0.029)	(545.706)	(625.316)
Flooding within 350m	[98.6, 115.2]	5.4	0.002	-0.007	0.008	-436.134	-377.587
			(0.029)	(0.028)	(0.024)	(473.525)	(531.301)
Flooding within 530m	[97.9, 111.1]	5.6	0.000	-0.009	0.007	-484.793	-456.710
			(0.028)	(0.028)	(0.024)	(437.381)	(477.091)
Flooding within 700m	[88.1, 95.9]	5.4	-0.003	-0.012	0.004	-421.067	-374.000
			(0.028)	(0.028)	(0.024)	(429.554)	(461.352)
Flooding within 870m	[82.9, 88.2]	5.4	-0.007	-0.013	0.001	-404.640	-346.710
			(0.028)	(0.027)	(0.024)	(423.495)	(446.468)
Flooding within 1,050m	[81.9, 84.3]	5.2	-0.009	-0.016	0.001	-435.719	-385.135
			(0.029)	(0.028)	(0.024)	(421.578)	(439.141)
Flooding within 2,090m	[94.8, 96.3]	5.7	-0.021	-0.020	0.002	-774.503	-741.147
			(0.037)	(0.034)	(0.031)	(507.649)	(522.588)
Flooding within 3,130m	[91.2, 97.0]	5.9	-0.038	-0.028	-0.002	-1006.460*	-911.032
			(0.046)	(0.037)	(0.039)	(597.746)	(651.353)
Flooding within 4,000m	[75.7, 91.5]	6.1	-0.063	-0.042	-0.017	-1235.859*	-1043.568
			(0.054)	(0.038)	(0.052)	(630.763)	(765.137)
Flooding within 5,050m	[74.1, 97.6]	6.6	-0.091	-0.054**	-0.041	-1222.093*	-854.605
			(0.063)	(0.027)	(0.070)	(715.370)	(997.330)
Flooding within 5,920m	[70.0, 84.0]	7.3	-0.105	-0.053	-0.055	-987.162	-536.947
			(0.079)	(0.035)	(0.092)	(851.400)	(1214.385)
Flooding within 7,000m	[47.4, 50.9]	10.3	-0.092	-0.024	-0.069	-469.981	14.039
			(0.116)	(0.051)	(0.133)	(1030.457)	(1422.234)
Flooding within 8,000m	[21.9, 23.9]	10.1	-0.046	0.033	-0.063	520.969	966.516
			(0.138)	(0.054)	(0.163)	(1278.248)	(1780.394)
Flooding within 9,050m	[16.4, 16.5]	9.6	0.019	0.099	-0.049	1914.961	2402.102
			(0.150)	(0.095)	(0.158)	(1979.523)	(2409.278)
Flooding within 10,090m	[17.3, 18.1]	9.4	0.054	0.129	-0.033	2837.421	3433.675
			(0.151)	(0.124)	(0.123)	(2170.212)	(2468.328)
2. Direct vs. indirect effects							
Local exposure (0–2 km)	[69.8, 76.0]	6.4	0.031	0.004	0.035	-443.509	-658.934
			(0.039)	(0.044)	(0.040)	(738.297)	(740.798)
Regional exposure (2–5 km)	[71.6, 90.2]	6.4	-0.121	-0.058	-0.076	-770.956	-187.472
			(0.077)	(0.046)	(0.090)	(1007.630)	(1326.332)
3. Direct vs. indirect effects (robustness: 0–2, 2–5, 5–10 km)							
Local exposure (0–2 km)	[88.1, 91.4]	9.4	0.034	0.006	0.037	-286.793	-526.978
			(0.037)	(0.034)	(0.042)	(779.727)	(765.883)
Regional exposure (2–5 km)	[74.0, 92.6]	9.4	-0.129	-0.066***	-0.078	-1068.719	-534.279
			(0.082)	(0.019)	(0.094)	(978.104)	(1274.464)
Wider regional exposure (5–10 km)	[55.3, 57.1]	9.4	0.071	0.110	-0.001	2210.340	2667.946
			(0.109)	(0.092)	(0.088)	(1679.443)	(1923.938)
Min. obs.			3,895	3,895	3,895	3,822	3,180
Max. obs.			3,935	3,935	3,935	3,857	3,213

Notes: Each cell reports the IV coefficient on the indicated flood exposure measure. All regressions control for district fixed effects, age group fixed effects (`i.w1_age5`), and sex. Sample restricted to non-agricultural workers (`pf_sector_allon_serv==1` or `pf_sector_allon_manuf==1`) aged 18–65. Standard errors are Conley (1999) spatial standard errors with a distance cutoff selected empirically for each specification. The last column further restricts to employed individuals (`w1_paid_work==1`). The F-stat column reports the range [min, max] of the first-stage F-statistic across all outcome columns in that row: the Kleibergen-Paap Wald F statistic for Section 1 (single endogenous variable), and the Conley-robust partial F-statistic for the relevant donut ring in Sections 2 and 3 (multiple endogenous variables). Section 2 donuts: local exposure (0–2km, rings 0–11) and regional exposure (2–5km, rings 12–28). Section 3 repeats with a wider regional exposure ring (5–10km, rings 29–57) as a robustness check. Min./max. observations are reported across all rows within each outcome column. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.