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Climate Change Impacts on Livelihoods, Work and Health of Women Cotton Pickers in District Tando Allahyar, Sindh, Pakistan

Mir Hassan Bijarani
Department of Agricultural Education, Extension & Short Courses, Faculty of Agricultural Social Sciences, Sindh Agriculture University, Tandojam, Pakistan.
hassanbijarani331@gmail.com
Nasir Ali
Department of Energy and Environment, Faculty of Agricultural Engineering and Technology, Sindh Agriculture University, Tandojam, Pakistan.
nasirlaghari1996@gmail.com
Tooqeer Ahmed
Department Agricultural Education Extension & short Courses, Faculty of Agricultural Social Sciences, Sindh Agriculture University, Tandojam, Pakistan.
tooqeerahmed84@gmail.com
Abdul latif
Department of Agricultural Education Extension and Short courses, Faculty of Agricultural Social Sciences, Sindh Agriculture University, Tandojam, Pakistan.
abdullatifameermuhammad@gmail.com
Ishraque Ahmed
Department of agricultural economics, Faculty of Agricultural Social Sciences, Sindh Agriculture University Tandojam, Pakistan.
ishraqueahmed208@gmail.com
Uswa Noor
Department of agricultural economics, Faculty of Agricultural Social Sciences, Sindh Agriculture University Tandojam, Pakistan.
uswamustafa0@gmail.com

Abstract
Women undertake most manual cotton picking in Pakistan, yet the effects of climate variability and rising temperatures on their livelihoods and working conditions remain underexplored. This study assessed climate-related changes, working conditions, earnings, health challenges, and coping strategies among women cotton pickers in Tando Allahyar district, Sindh. A multi-stage sample of 120 women from 12 villages was interviewed using a structured schedule. Data were analysed in SPSS using frequencies, percentages, means, and standard deviations. Most respondents were young (62.5% aged up to 35 years), unschooled (58.3%), and lived in mud dwellings (50.0%). Nearly four in five (79.2%) reported declining cotton yields, associated with irregular rainfall, pest attacks, and heat waves. Women typically worked 5–6 days per week, earning PKR 800–900 daily, while bonuses were uncommon and wage payments were frequently delayed. Fatigue (41.7%), back pain (20.8%), and respiratory complaints (16.7%) were the leading health problems, while heat negatively affected their working capacity. During income shortfalls, women sought alternative employment (33.3%), reduced food consumption (25.0%), or borrowed money (20.8%); 12.5% reported involving children in labour. The findings reveal that

climate-related agricultural challenges, combined with insecure wages, poor working conditions, and limited social protection, increase the economic and occupational vulnerability of women cotton pickers. The study emphasizes the need for fair wage practices, improved occupational safety, climate-adaptive working schedules, accessible healthcare, and targeted social protection to strengthen women's livelihoods and climate resilience.

Keywords: *Women Cotton Pickers, Climate Change, Livelihood Vulnerability, Occupational Health, Coping Strategies.*

1. Introduction

Cotton remains one of the most valuable cash crops of Pakistan. The Pakistan Economic Survey 2023–24 attributes about 0.6% of national GDP and 2.4% of agricultural value added to the crop, and cotton-based textiles make up roughly 60% of the country's exports (Government of Pakistan, 2024). Pakistan is also among the largest cotton producers in the world, and some 1.5 million smallholder families rely on the crop for their income. Although production has been mechanised in some operations, harvesting is still done by hand, and it is overwhelmingly women who do it, usually for cash wages. Because picking takes place in open fields over several weeks, these women stand directly in the path of heat, dust and agrochemicals. Output is also volatile: the Pakistan Economic Survey 2024–25 recorded a 30.7% fall in national cotton production, which it attributed to above-average monsoon rainfall, late sowing and a smaller sown area (Government of Pakistan, 2025).

Pakistan ranks among the countries most exposed to climate change. Rising temperatures, more frequent heat waves, irregular rainfall, floods and droughts are already disturbing crop production and rural incomes, and economic losses linked to climate damage in agriculture are put at more than US$4 billion every year (Khetran & Salik, 2024; Mahmood & Hassan, 2022). Heat is especially damaging for people who work outdoors. Labour efficiency begins to fall once air temperature passes roughly 24–26 °C, and workers performing moderately heavy tasks may lose about half of their capacity at 33–34 °C (Kjellstrom et al., 2016). The International Labour Organization (ILO, 2024) adds that more than 70% of workers worldwide are at risk of excessive heat, with agricultural workers among the most exposed. Field workers in Sindh, where summers are long and severe, therefore carry a double burden: the climate makes the work harder while also making it scarcer.

Chemical exposure adds to the risk. Cotton is sprayed repeatedly, and spraying is often timed close to, or even during, the picking period. In Punjab, more than 60% of cotton pickers surveyed by Bakhsh et al. (2016) linked skin trouble, headache, cough, flu and eye irritation to pesticide contact. Globally, more than 870 million agricultural workers are likely to be exposed to pesticides (ILO, 2024). Heat, long hours and chemical residues together make cotton picking one of the more hazardous forms of rural women's work.

The social position of women pickers magnifies these hazards. Many are landless or belong to small-holding families, have little schooling, and hold almost no say in decisions about work, pay or crops. Insecure land tenure, limited access to credit and training, and other structural barriers leave rural women with fewer ways to absorb a climate shock than men, and their workloads fall less than men's during heat stress (Food and Agriculture Organization of the United Nations [FAO], 2023; Intergovernmental Panel on Climate Change [IPCC], 2022). If a changing climate shortens the picking season, lowers yields or pushes growers toward other crops or machines, the loss of earnings falls first on women who have few alternative sources of income.

Most Pakistani research on climate and cotton has followed yields, water use and the adaptation choices of farm owners. Evidence on the women who actually harvest the crop is thin, particularly for the cotton belt of lower Sindh. This study addresses that gap for Tando Allahyar, one of the

main cotton-producing districts of the province. This descriptive survey addresses that gap with three objectives:

1. Describe the socio-economic circumstances and work-related problems of women cotton pickers
2. Examine how climate change is affecting cotton production and the livelihoods of these women; and
3. Propose practical measures for improving their socio-economic situation.

2. Background

Studies of climate and cotton in Pakistan have mostly followed production. Rehman et al. (2019) applied an ARDL bounds-testing framework to show how climatic and input variables jointly shape national cotton output. Abbas (2020), covering 1980–2018, reported that rising mean temperature did not raise cotton yield in the long run, whereas expanded area and fertiliser use had clear positive effects, and he urged water conservation, tree planting and climate-friendly production methods. Ahmad et al. (2023) combined crop models with a survey of 165 farms in Punjab to quantify climate impacts and argued that such estimates are needed to design adaptation measures that protect food security and farm livelihoods. In Sindh itself, Joyo et al. (2023) found from district data for 2015–16 to 2019–20 that temperature significantly affected the productivity of wheat, cotton and sugarcane while rainfall did not, whereas Nazir et al. (2024) reported that kharif rainfall and cultivated area were positively related to cotton production in the short run and recommended temperature-tolerant varieties and farm-specific climate information.

A second group of studies concerns vulnerability and adaptation. Batool and Saeed (2018) surveyed cotton farmers in two semi-arid districts of Punjab and found that vulnerability depended on landholding size, financial capital, livelihood diversification and access to weather information; households with more capital coped better with climatic stress. Imran et al. (2018) showed that climate-smart practices, including laser levelling, bed planting, reduced tillage and stress-tolerant varieties, raised yield and resource efficiency among cotton growers of Punjab.

Work on the labourers themselves is far scarcer and concentrates on health. Memon et al. (2019) interviewed 260 women cotton pickers in Shaheed Benazirabad, Sindh, and recorded skin and eye injury, headache, stomach pain and fever; protective practice was weak, with only 22.3% covering the face and 10.8% wearing gloves, and age, marital status and experience influenced protection. Naheed et al. (2025), using 2023 interview data from Vehari and Multan in Punjab, found that 56% of young pickers used no protective measure, and Bakhsh et al. (2016) documented the substantial health costs these hazards impose. At the policy level, FAO (2023) and IPCC (2022) stress that women in agriculture are held back by unequal access to land, finance and services, which weakens their ability to adapt.

Taken together, the literature explains yields and farm-level adaptation reasonably well but says little about how climatic change translates into earnings, working hours, payment security, health and coping behaviour among women pickers. The present study speaks to that gap.

3. Data and Methods

This study is a descriptive field survey of women cotton pickers in two talukas, Jhando Mari and Chamber, of district Tando Allahyar, Sindh. The district is among the leading cotton producers of the province, with fertile alluvial soil and canal irrigation from the Indus Basin system, and many rural households depend on the crop directly or indirectly. It also faces rising temperatures, irregular rainfall, pest pressure and limited access to modern technology and extension services, which makes it a suitable setting for examining climate-related stress on the farm workforce.

Respondents were drawn through multi-stage cluster sampling, which suits the administrative hierarchy of rural Pakistan and the scattered nature of picking households. Two high-producing talukas were selected at random; two Union Councils were selected at random in each, giving four (Dasori and Umar Sand in Jhando Mari; Began Jarwar and Dad Khan Jarwar in Chamber); and three villages were selected at random in each Union Council, giving 12 villages, subject to practical limits of access and time. In every village, ten women who were actively picking cotton were interviewed, using simple random selection supplemented by snowball referrals because working pickers appear in no official register. The final sample was 120 women.

Data were collected through face-to-face interviews in the fields with a structured schedule prepared under the guidance of the supervisory committee. The schedule covered (a) socio-demographic characteristics (age, schooling, landholding of the husband's family, household members with occupations and incomes, housing and monthly household income); (b) climate and work characteristics (change in the picking season, change in and reasons for yield, years of experience, days and hours worked, daily wage, quantity picked, bonuses and timeliness of payment); and (c) harassment, main work-related health problem, effect of weather and heat on work, and coping strategies in low-income periods. Perception items used five-point scales (1 = not at all to 5 = always, or 1 = very low to 5 = very high). Responses were entered into a spreadsheet, cleaned, coded and analysed in SPSS using frequencies, percentages, means and standard deviations (SD); means were read as low (below 2.5), moderate (2.5–3.5) or high (above 3.5). The fixed format of the schedule allows later verification but leaves little room for further explanation, and all climate-related findings are respondents' perceptions, not instrument readings.

4. Results

4.1 The women are young, unschooled and from low-income households

Key finding: 58.3% of respondents have never attended school, and two-thirds of households (66.7%) live on PKR 30,000 or less a month. Table 1 shows a young workforce: 62.5% of the women were 35 or younger and one-third were 20 or younger. A further 20.8% had reached only primary level, and none had studied beyond intermediate. Half of the women belonged to families holding up to 12½ acres of land, and half lived in mud houses; only 16.7% lived in fully cemented homes. Of the 120 household members recorded, 65 women worked mainly in agricultural labour and cotton picking for PKR 10,000–12,000 a month, while 55 men working in farming, labour and small business earned PKR 15,000–20,000.

Table 1. Socio-economic profile of respondents (N = 120)

Characteristic	Category	n	%
Age (years)	Up to 20	40	33.33
	21–35	35	29.17
	36–50	25	20.83
	Above 51	20	16.67
Education	No formal education	70	58.33
	Primary	25	20.83
	Middle	15	12.50
	Matriculation	7	5.83
	Intermediate	3	2.50
Land owned by husband's family	Up to 12½ acres	60	50.00

	12½–25 acres	40	33.33
	Above 25 acres	20	16.67
House type	Mud	60	50.00
	Mixed (mud and cement)	40	33.33
	Cemented	20	16.67
Monthly household income (PKR)	Below 15,000	30	25.00
	15,000–30,000	50	41.67
	30,001–45,000	25	20.83
	45,001 and above	15	12.50

Source: field survey.

Low schooling and a narrow asset base limit what a woman can do when her work becomes uncertain. This matches the barriers to land, credit, information and services that FAO (2023) and IPCC (2022) identify as the reason rural women adapt less readily than men. The lower earnings of women within the household show that they contribute substantially to income from a weaker economic position.

4.2 Climate change is disturbing the picking season and cutting yields

Key finding: 79.2% of women report falling cotton yields, and 70.8% say the picking season changed almost always or always in 61–80% of occasions. Table 2 shows that, for statements describing alteration of the season in 25–80% of occasions, mean scores rose from 3.50 to 3.96, indicating moderate to high agreement. SDs of 1.12–1.73 show that experiences differed between women.

Table 2. Perceived change in the cotton-picking season

Statement (share of occasions with practical change)	Almost always / always (%)	Mean	SD
No change in up to 25% of occasions	41.7	2.96	1.73
Change in 25–40% of occasions	58.3	3.50	1.45
Change in 41–60% of occasions	62.5	3.71	1.31
Change in 61–80% of occasions	70.8	3.96	1.12

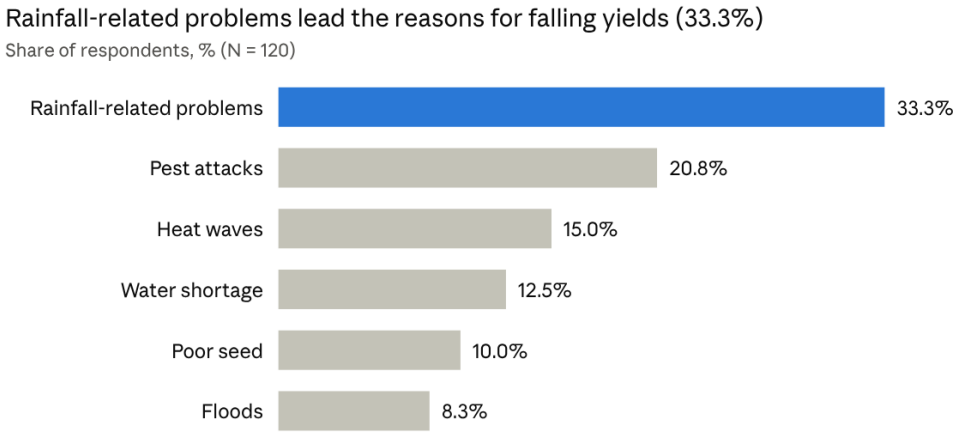
Source: field survey. Scale: 1 = not at all, 5 = always.

Yield perceptions were more one-sided (Table 3). Almost four in five women said yield had decreased, against 12.5% who saw an increase and 8.3% who saw no change. Rainfall-related problems were named most often as the reason (33.3%), followed by pest attacks (20.8%) and heat waves (15.0%); water shortage (12.5%), poor seed (10.0%) and floods (8.3%) made up the rest (Figure 1). Climatic factors (rainfall, heat, floods and water) account for about 69% of the reasons given, and pests and seed quality, which are agronomic, for about 31%.

Table 3. Perceived change in cotton yield (N = 120)

Response	n	%
Decreased	95	79.2
Increased	15	12.5
No change	10	8.3

Source: field survey.



field survey, N = 120

Figure 1. Reasons given for the decline in cotton yield (% of respondents, N = 120). Source: field survey.

Respondents' perceptions were strong and consistent, and they agree with national evidence that temperature and precipitation shifts affect Pakistani cotton output (Rehman et al., 2019; Khetran & Salik, 2024). In Sindh, Joyo et al. (2023) and Nazir et al. (2024) likewise link weather variables to cotton output, and the 2024–25 Economic Survey attributes a 30.7% fall in national cotton production to above-average monsoon rainfall, late sowing and a smaller sown area (Government of Pakistan, 2025). They also fit Batool and Saeed (2018), where cotton households with limited capital and few alternative livelihoods were the most vulnerable. Two cautions apply. Abbas (2020) found that warming alone did not lower yields in the long run once area and fertiliser were accounted for, and the large share of pest and seed answers suggests that agronomic and climatic problems are tangled together in workers' minds. The yield results are therefore perceptions, best read as the experience of people who depend on the harvest.

4.3 Work is near-daily, long and poorly paid

Key finding: 91.7% of women work five or more days a week, and 45.8% earn PKR 800–900 a day. Half of the women had picked cotton for 6–10 years and a further 20.0% for more than ten (Table 4). One in four (25.0%) worked all seven days. Most put in 5–6 hours a day (58.3%) and one-third worked 7–8 hours. Daily output was 10–15 maunds for 40.0% of the women, 16–20 maunds for 35.0% and above 20 maunds for 25.0%.

Table 4. Work experience, schedule, wage and daily output (N = 120)

Variable	Category	n	%
Experience	1–5 years	36	30.00
	6–10 years	60	50.00
	Above 10 years	24	20.00
Days per week	Less than 5	10	8.33
	5–6 days	80	66.67
	7 days	30	25.00
Hours per day	5–6 hours	70	58.33
	7–8 hours	40	33.33
	Above 8 hours	10	8.33
Daily wage (PKR)	Up to 800	35	29.17
	800–900	55	45.83
	Above 1,000	30	25.00

Quantity picked per day (maunds)	10–15	48	40.00
	16–20	42	35.00
	Above 20	30	25.00

Source: field survey.

Nine in ten women worked at least five days a week, mostly for daily wages of PKR 900 or below. Output per day was substantial, yet bonuses were seldom linked to it. Wages that vary little with effort give women no reward for picking more, and they push the cost of long hours onto their own health. Globally, women in agriculture earn about 82 cents for every dollar earned by men (FAO, 2023).

4.4 Bonuses are rare, payment is unreliable and weather disrupts work

Key finding: women rated bonuses and on-time full payment as low to moderate (means 2.28–3.00 and 2.63–3.21), while weather and heat disrupted work moderately to strongly (3.21–3.54). Table 5 summarises the five-point scales. High SDs show that treatment differed from one employer to another. One-third of respondents (33.3%) rated the chance of receiving full wages on time as very low. Harassment or exploitation was reported at low levels (means 1.85–2.33), with 33.3–41.7% choosing the lowest rating across all frequency bands, although a minority reported moderate to high exposure. Weather had the clearest influence: 62.5% of women in the 81–100% band rated its effect high or very high.

Table 5. Summary of five-point perception scales

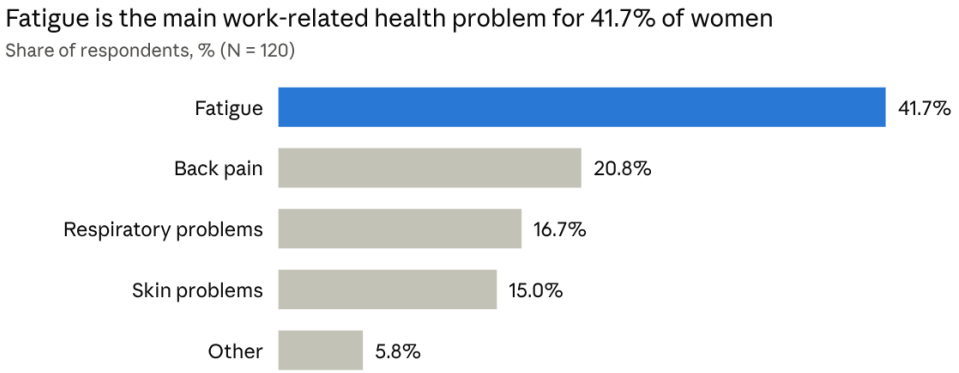
Theme	Statements	Mean range	SD range	Reading
Bonus for higher output	5	2.28–3.00	1.27–1.49	Low to moderate
Full payment on time	5	2.63–3.21	1.27–1.36	Low to moderate
Harassment or exploitation	5	1.85–2.33	1.03–1.20	Low
Work affected by weather and heat	5	3.21–3.54	1.22–1.30	Moderate to high

Source: field survey. Scale: 1 = very low, 5 = very high.

Payment delay is not a minor inconvenience for households that live from one wage to the next: it forces borrowing and meal-skipping, which is exactly what the coping results show. The moderate-to-high weather effect is plausible given evidence that physical work capacity falls sharply as temperatures climb (Kjellstrom et al., 2016) and that heat waves in Pakistan are becoming more frequent (Mahmood & Hassan, 2022). Reported harassment was low, which is reassuring, but any moderate or high response deserves attention, because under-reporting is likely when such questions are asked in the field.

4.5 Fatigue and musculoskeletal strain dominate health complaints

Key finding: fatigue (41.7%) and back pain (20.8%) together account for 62.5% of main work-related complaints. Respiratory problems (16.7%) and skin problems (15.0%) followed, and 5.8% named other ailments (Figure 2). The respiratory and skin complaints, at 31.7% combined, are consistent with continual exposure to dust, plant material and agrochemicals.



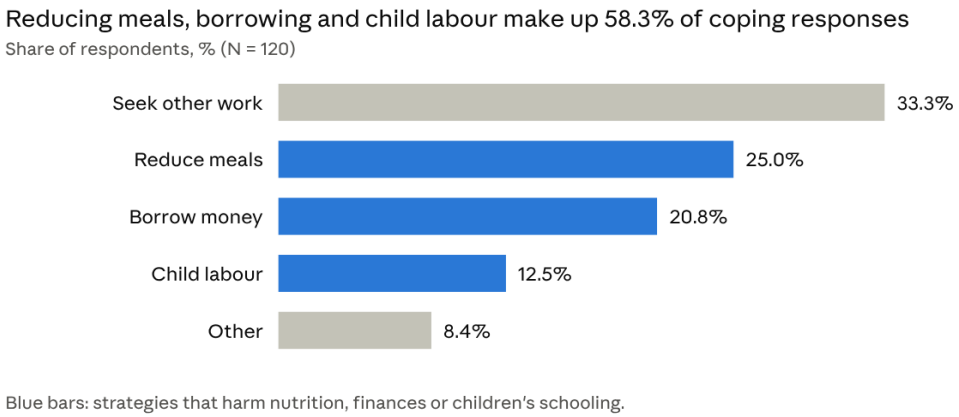
field survey, N = 120

Figure 2. Main work-related health problem (% of respondents, N = 120). Source: field survey.

This pattern mirrors earlier work on women cotton pickers in Sindh and Punjab (Bakhsh et al., 2016; Memon et al., 2019). Memon et al. (2019) found weak protective practice among women pickers, and Naheed et al. (2025) report similar non-use of protection among young pickers in Punjab. The present survey did not measure protective behaviour, but long hours, hot weather and chemical exposure plausibly act together.

4.6 Households cope by looking for other work, but also by cutting meals, borrowing and using child labour

Key finding: 58.3% of coping responses (reducing meals, borrowing and child labour) damage future well-being. One-third of women (33.3%) looked for other work, a quarter (25.0%) reduced meals, one-fifth (20.8%) borrowed money, 12.5% used child labour and 8.4% relied on other measures such as help from relatives or temporary migration (Figure 3).



field survey, N = 120

Figure 3. Coping strategies in low-income periods (% of respondents, N = 120).
Source: field survey.

Looking for other work is a positive adaptation, but only one-third chose it, and with so little schooling the alternatives are likely to be equally insecure. Reduced food intake weakens women who already report fatigue, debt deepens dependence on employers, and child labour interrupts schooling and perpetuates the cycle. Climate stress here is not only an agricultural problem but a nutrition, health and education problem for cotton pickers' households.

5. A Resilience Agenda for Women Cotton Pickers

The findings point to a compound pathway: erratic weather and falling yields disturb the picking season, low and unreliable pay combines with heat and chemical exposure to produce fatigue,

pain and respiratory and skin problems, and shortfalls in income push households toward harmful coping. The pathway is conceptual, assembled from the links documented above rather than estimated as a model. Its implication is that single-link measures, such as protective gear alone, will have limited effect because the drivers re-enter at several points (Table 6).

Table 6. Resilience agenda for women cotton pickers

Pillar	Priority action	Evidence / rationale
Income and payment security	Organise pickers into groups linked to labour-rights organisations; advocate legislation on wage floors, timely payment and output-linked bonuses	45.8% earn PKR 800–900 a day; on-time full payment scores 2.63–3.21 and bonuses 2.28–3.00 (Tables 4, 5)
Occupational protection	Train pickers to use masks, gloves and protective clothing and to wash hands and clothes daily; persuade growers to supply gloves and masks and to leave at least 15 days between spraying and picking	Respiratory and skin complaints for 31.7% (Figure 2); weak protective practice in earlier studies (Memon et al., 2019)
Health and heat adaptation	Strengthen rural medical services for the picking season; run awareness campaigns on climate change and pesticide use	Fatigue and back pain for 62.5%; heat disrupts work (3.21–3.54) (Figure 2, Table 5)
Livelihood and social protection	Offer training and alternative income opportunities; connect pickers' groups with media and human-rights organisations	58.3% of coping responses are harmful; 12.5% use child labour (Figure 3)

Source: compiled by the authors from the survey results and the sources shown.

Three priorities follow. First, wage and payment rules matter most, because delayed or low pay is the entry point to borrowing, meal-skipping and child labour. Second, protection must come before exposure, which makes the spraying interval and protective equipment the cheapest measures available. Third, women's groups, health services and training should be developed together, so that adaptation does not depend on the individual woman's own resources.

6. Conclusion

Women who pick cotton in Tando Allahyar work long, physically demanding seasons for low and uncertain pay, and a changing climate is adding to their burden. The typical respondent was young, unschooled and from a low-income household living in a mud house; almost four in five reported falling yields, wages clustered at PKR 800–900 a day, bonuses were rare and full payment on time was unreliable. Fatigue, back pain and respiratory and skin problems dominated health complaints, heat interfered with work, and shortfalls in income led women to cut meals, borrow and, in 12.5% of cases, use child labour. The main limits are the restriction to two talukas of one district, reliance on self-reported perceptions gathered with a fixed-format schedule, the absence of meteorological or production records, and the descriptive analysis, which cannot test associations between age, education or income and health or coping. Future work could link worker interviews with local climate data, use inferential methods, compare male and female labourers and follow households through successive seasons.

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