ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Impacts of heat waves on agricultural workers: An analysis of adaptation measures

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WORKLIMATE2.0

1st FutureMed Workshop & Training School
Chania, 29/09 – 01/10 2025

Outline

- Background
- The research project: Worklimate2.0
- Objectives
- The case study: cooperative farms in a N. Italy area
- Results and discussion

Impacts of heat waves on agricultural workers: An analysis of adaptation measures

PDF(Just Accepted)

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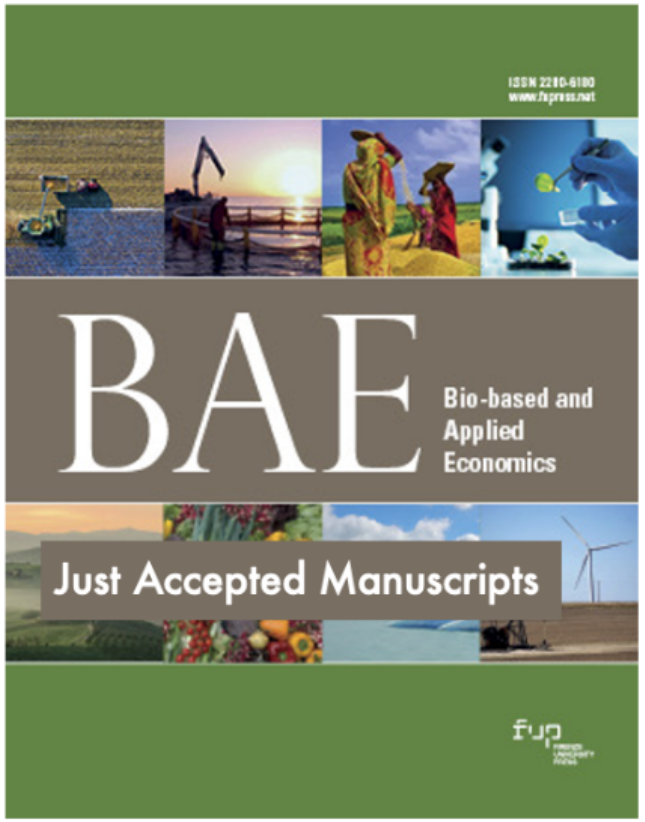

Abstract

This study evaluates the effectiveness of different farm-level adaptation measures aimed at mitigating the adverse impacts of heat waves on labour productivity. Despite the increasing frequency of heat waves, existing literature on occupational heat stress primarily relies on modelled estimates. To address this gap, exploratory interviews and structured questionnaires were employed to identify key challenges posed by heat waves, as well as the perceived benefits and limitations of different adaptation strategies. Data were collected from nine farms located in Emilia-Romagna (Northeast Italy), all of which were characterized by a long-term commitment to improving working conditions. The Analytic Hierarchy Process was used to evaluate the perceived effectiveness of adaptation measures according to three criteria: acceptability, flexibility, and timeliness. Findings indicate that, in the absence of adaptation strategies, productivity losses may reach up to 30%. Among the measures assessed, shifting work hours was identified as the most effective strategy. The study underscores the need for structured thermal risk assessment protocols and provides recommendations to inform sustainable and worker-centered adaptation policies in the agricultural sector.

Background

Evidence of risk

- Extreme heat is becoming more frequent in Mediterranean Europe, especially in Italy
- Multiple studies link extreme heat exposure, workplace injuries, and negative effects on wage loss, reduced productivity, and higher medical/insurance costs.
- In Italy (2014–2019), an estimated **25,632 work injuries** were attributable to high temperatures, with compensation costs of ~€292 million. Marinaccio et al. 2025.
- Sectors most affected: manufacturing, construction, transport/storage, and agriculture (233 injuries, ~€4 million cost despite fewer workers).
- Companies need to adjust and implement protective measures. Lack of information and low perception of heat wave risks hinders worker safety optimization

Background

Policy implications in Italy: *heat is a major emerging risk in occupational health and safety*

- Since 2021, regional regulations in Italy have restricted work during peak heat (12:30–16:00; from mid-June to August 31) when forecasts indicate **“high risk”** conditions for outdoor, intense physical activity.

- Initially applied in 3–4 regions (2021–2023; c.a. 300.000 workers concerned).

- In summer 2024, extended to **15 out of 20 regions**, covering agriculture, horticulture, construction, and related sectors (~ 1.7 M workers concerned; ~+460%).

- Aim: reduce heat risks for outdoor workers during extreme temperatures

The project

Worklimate (2020-2022) and **Worklimate 2.0** (2023-2025) granted by INAIL (national work insurance agency) led by CNR Italian Research Council

Project focus:

- social costs related to heatwaves
- knowledge of the effect of heat on workers and their perception
- Identification of adaptation strategies (organizational solutions and operational procedures)
- Heat alert system at the national level to forecast occupational heat risk

WORKLIMATE
CLIMA LAVORO PREVENZIONE

WORKLIMATE2.0

PREVISIONI DELLE AREE IN CUI È POSSIBILE IL SUPERAMENTO DELLA SOGLIA DI TEMPERATURA GIORNALIERA DI 35 ° C

Le previsioni, sperimentali e automatiche (non controllate), basate su modello meteorologico, sono affette da intrinseca incertezza e possono risultare significativamente differenti dalle reali condizioni. Le previsioni vanno pertanto considerate come uno strumento di supporto alle decisioni ad integrazione degli strumenti già esistenti e dell'osservazione meteo-climatica fatta direttamente sul luogo di lavoro. Prima di consultare le previsioni leggere anche l'approfondimento.

Mappe nazionali di previsione del possibile superamento della soglia di temperatura dell'aria di 35 °C basate sul modello meteorologico MOLOCH (risoluzione a 2.5 km).

Accedi alle previsioni

MAPPE SUPERAMENTO DI TEMPERATURA OLTRE I 35°

Le previsioni, sperimentali e automatiche (non controllate), basate su modello meteorologico, sono affette da intrinseca incertezza e possono risultare significativamente differenti dalle reali condizioni. Le previsioni vanno pertanto considerate come uno strumento di supporto alle decisioni ad integrazione degli strumenti già esistenti e dell'osservazione meteo-climatica fatta direttamente sul luogo di lavoro. Prima di consultare le previsioni leggere anche l'approfondimento.

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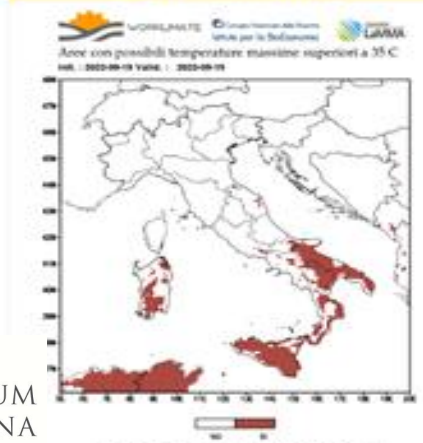	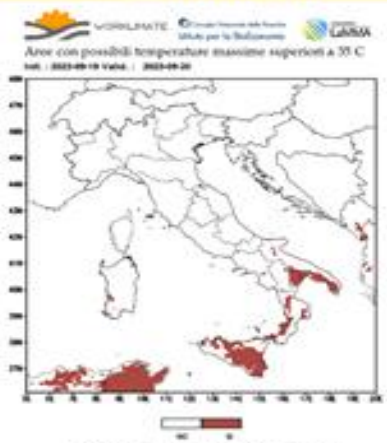	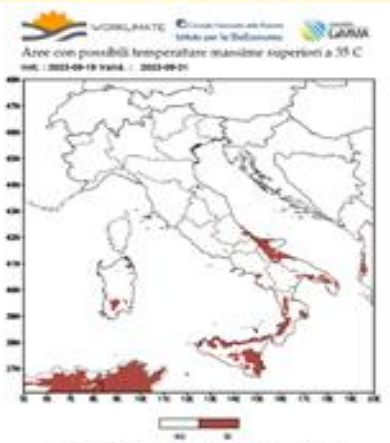

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Objectives

Investigating land managers' perception of adaptation measures for the mitigation of heat waves impacts on outdoor agricultural workers.

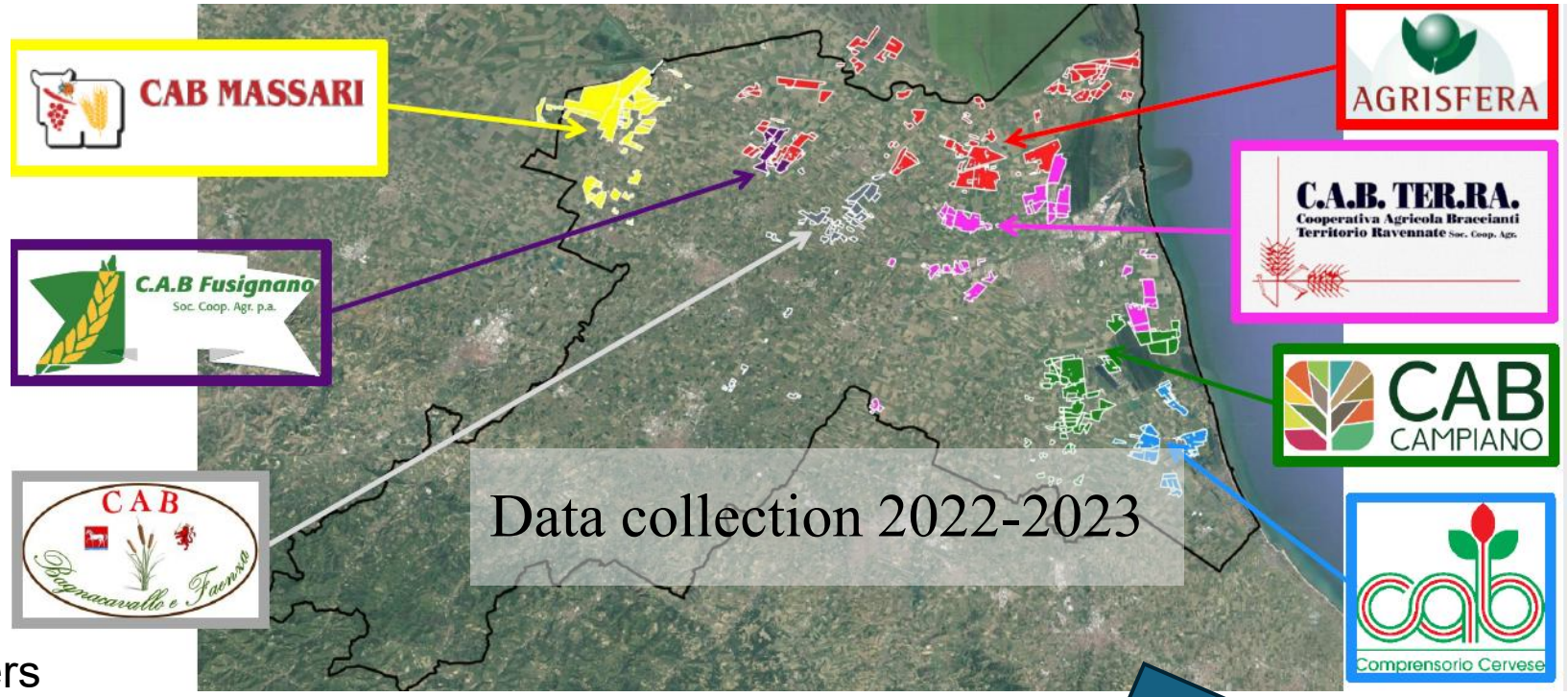
By means of:

1. An analysis of the challenges posed by heat waves within a specific agricultural context;

2. The evaluation of perceived effectiveness of adaptation strategies based on empirical data collected from nine farms in an agricultural region.

Methods

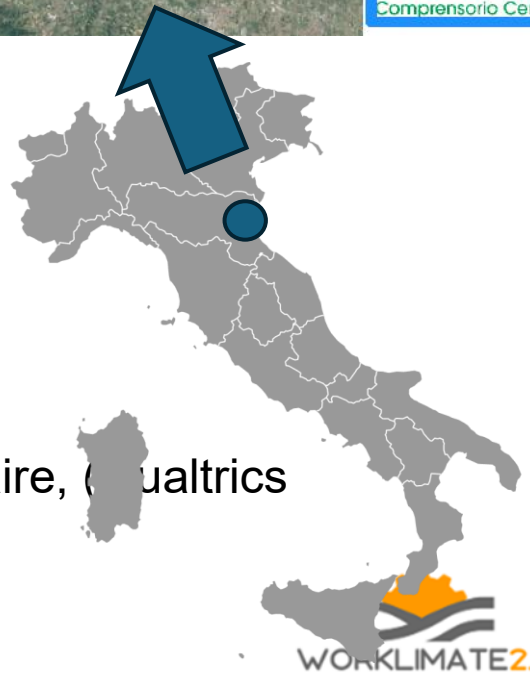
- Feasibility/ effectiveness of adaptation strategies in 9 agricultural cooperatives (11.000 UAA).



- Exploratory interviews: 5 farm managers

- Adaptation Measures Considered:
  - Shifting/anticipating work hours
  - Creating shaded areas
  - More frequent breaks + access to water
  - Special equipment (ventilated/breathable clothing

- Methodology: multicriteria assessment (AHP – Analytic Hierarchy Process); Questionnaire, (ualtrics platform): 15 responses (9 complete).



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Results

•Symptoms reported: **tiredness,** sweating, blood pressure drops, cramps.

•Activities most affected: **fruit & vegetable harvesting (67%)**, field operations (44%), manual weeding (33%).

•Productivity loss:
- •**Common workers**: 20–30% reduction (average 25%, some >30%).
- •**Specialized workers (e.g., tractor drivers)**: smaller losses (mostly 0–10%).

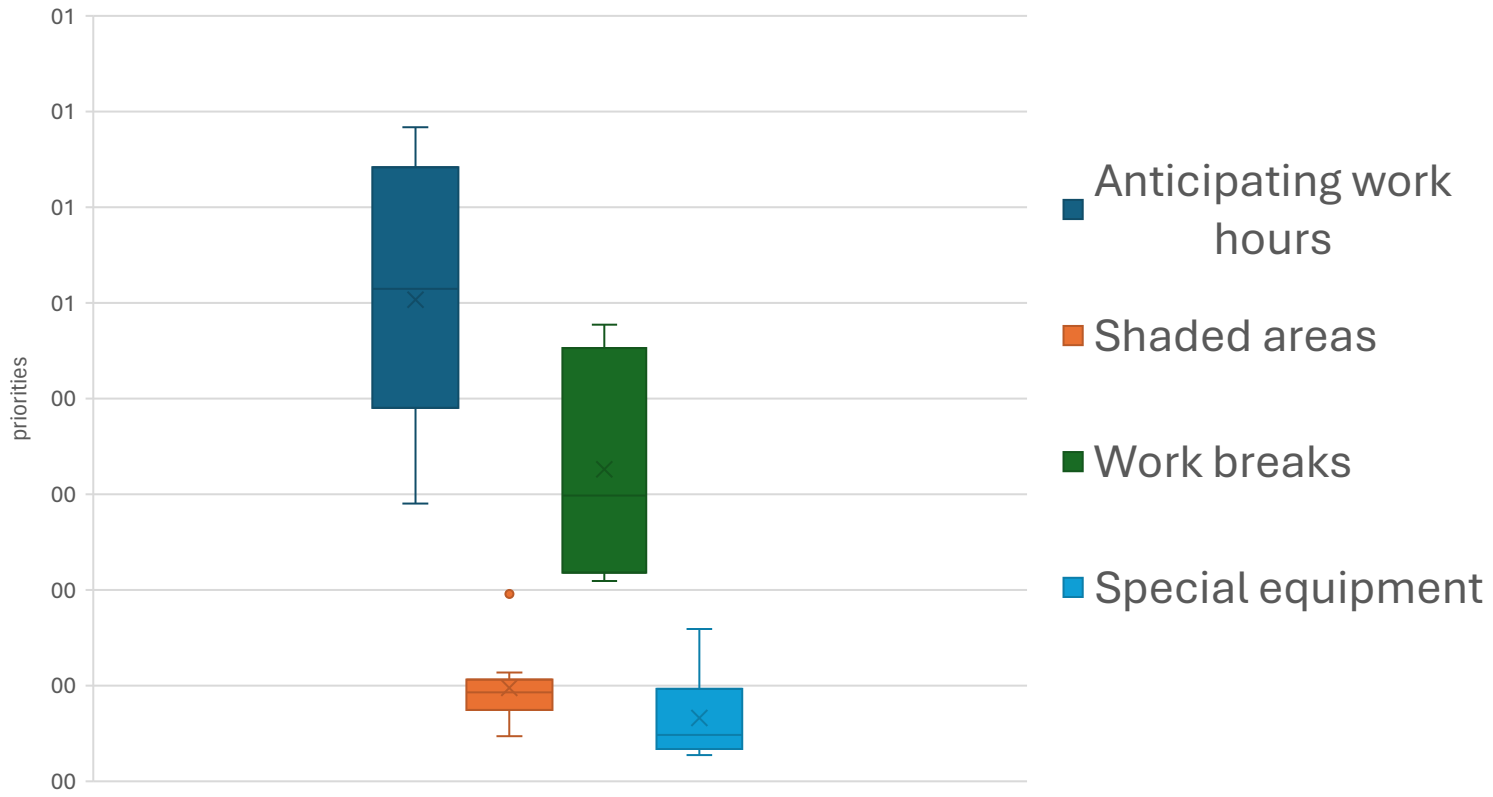
Adopted Adaptation Measures

•Breaks + water: **100%**
•Shifting work hours: **89%**
•Shaded areas: **67%**
•Special equipment: **22%**
•Other (e.g., umbrellas): **11%**

Results

Adaptation measures & effectiveness ->
3 criteria: acceptability; timeliness; flexibility

Most effective (according to farm managers): shifting/advancing working hours.



Discussion & conclusions

•First study exploring farm managers' perceptions of heatwave adaptation measures to limit productivity losses.

- Adaptation strategies—rescheduling work hours—are key to reducing both health risks and economic costs

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  - ✓ Advantages: easy, low-cost, quick to implement.
  - ✓ Additional benefits: may improve fruit quality by reducing exposure before delivery.
  - ✓ Downsides: reduced total working hours, potential income loss, disruption of routines, commuting issues, extra labor/logistics needs, possible need for **lighting infrastructure** if starting before dawn.

Discussion and conclusions

Other measures:

- effective but potentially more expensive and lower acceptability (lost working time, investment costs) .

Least effective: technical clothing (ventilated jackets, breathable fabrics).

- Seen as costly and often rejected by workers as uncomfortable for intense physical activity.

•**Policy implications**: targeted incentives to support farms in adopting costlier measures (e.g., shading infrastructure, night schedules).

Discussion and conclusions

•**Limitations**:

- Small sample size, limited to Emilia-Romagna large cooperatives.
- Possible bias since these farms already focus on worker safety and adaptation capacity.
- Findings not be representative of national or international contexts.

…Next steps

•Enlarge sample

•Cost-benefit analysis of early warning: estimating the value of the heat alert systems

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Thanks for the attention

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