CLIMAAX
climate ready regions

Deliverable Phase 3 – Climate risk management

Climate Resilience Enhancement in Dairy Farming (CliResDairy)

Türkiye, Aydin

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Document Information

Deliverable Title	Phase 3 – Climate risk management
Brief Description	This report translates the findings of the Phase 2 Climate Risk Assessment for Aydin's dairy sector into a climate risk management approach under the CliResDairy Project. It presents the priority climate risks, existing resilience capacity, feasible adaptation measures, stakeholder roles, integration into planning processes, and a monitoring and evaluation framework.
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Leading Institution	Cattle Breeders' Association of Aydin (CBAA)
Leading Institution	• Cattle Breeders' Association of Aydin (CBAA)
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Abbreviations and acronyms

Abbreviation / acronym	Description
CBAA	Cattle Breeders' Association of Aydin
AFAD	Disaster and Emergency Management Presidency
CliResDairy	Climate Resilience Enhancement in Dairy Farming
CRM	Climate Risk Management
DSİ	State Hydraulic Works
PV	Photovoltaic
NRR	Non-Return Rate
CRA	Climate Risk Assessment
TSMS	Turkish State Meteorological Service
RCP	Representative Concentration Pathway
THI	Temperature-Humidity Index
ARDSI	Agricultural and Rural Development Support Institution
TARSIM	Agricultural Insurance Pool (TARSIM)

Executive summary

This study was prepared under the Climate Resilience Enhancement in Dairy Farming (CliResDairy) Project, which aims to strengthen the resilience of the dairy sector in Aydin to climate change. The Phase 3 – Climate Risk Management report seeks to translate the findings of the Phase 2 Climate Risk Assessment (CRA) into an actionable and monitorable climate risk management framework. Accordingly, the study takes a holistic approach to priority climate risks affecting Aydin's dairy sector, considering the farm scale, value chain, institutional capacity, policy context, financing opportunities, and local implementation mechanisms.

The Phase 2 assessment identified heatwaves, agricultural drought, extreme precipitation, and river flooding as priority climate hazards for the dairy sector in Aydin. These hazards have multidimensional impacts not only on animal health and milk yield, but also on feed production, access to water, energy costs, feed storage conditions, the cold chain, farm infrastructure, logistics operations, and dairy farmer incomes. Climate risk management is therefore addressed in this report not as an adaptation approach consisting solely of individual technical investments, but as a multi-actor management field that simultaneously safeguards production continuity, rural livelihoods, animal welfare, and value-chain resilience.

Heatwaves constitute one of the most critical risk areas for Aydin's dairy sector. Rising temperature and humidity increase heat stress in dairy cattle, placing direct pressure on milk yield, fertility, feed intake, animal health, and milk quality. Feedback from field staff indicates that the working assumption of an approximately 1% decline in milk yield for every 1 °C increase above 24 °C is applicable under regional conditions. Most farms across Aydin also require fans and cooling systems during the summer; however, these systems have not been adopted sufficiently, particularly by small and medium-sized farms, because of financing constraints. This finding shows that adaptation measures for heatwaves must be considered not only in technical terms but also in terms of affordability and scalability.

Agricultural drought affects the dairy value chain through feed production, irrigation water, drinking water, groundwater use, and energy costs. The sustainability of milk production in Aydin is directly linked to forage crop production and the management of water resources. Drought conditions may reduce forage supply and increase feed prices, thereby weakening the economic resilience of small and medium-sized farms that are particularly sensitive to feed costs. At the same time, greater reliance on groundwater for irrigation places additional pressure on energy expenditure. The report therefore addresses agricultural drought management through modern irrigation systems, drought-resilient forage crops, regional feed planning, water efficiency, renewable energy use, and the development of shared solutions through dairy farmer organizations.

Although extreme precipitation and river flooding are more episodic than heatwaves and drought, they can cause high-impact damage to farm infrastructure when they occur. Flooding and extreme precipitation create significant vulnerabilities for barns and milking units, feed storage facilities, manure management areas, drainage systems, internal farm roads, and rural transport infrastructure. Particularly in the Menderes Plain and other flood-prone areas, farm siting, drainage infrastructure, feed and equipment storage conditions, and emergency preparedness should be treated as core elements of climate risk management. The report recommends aligning new

investments in high-risk areas with risk maps, developing retrofit options for existing dairy farms, and operating early warning mechanisms in a manner that effectively reaches dairy farmers.

The climate risk management framework developed under Phase 3 proposes a set of actionable measures for priority risks. For heatwaves, the principal measures include mechanical ventilation, misting systems, shaded areas, tree planting in open spaces, temperature-humidity monitoring systems, automated milking, and early warning infrastructure. For agricultural drought, priorities include shifting to modern irrigation systems, expanding drought-resilient forage crops, aligning feed production planning with climate risks, meeting farm and irrigation energy demand with solar power systems, and scaling up water-efficiency practices. For extreme precipitation and flood risks, the report recommends strengthening drainage infrastructure, improving feed storage areas against moisture and inundation, reviewing siting decisions in high-risk areas, preparing farm-level disaster preparedness plans, and supporting nature-based solutions

One of the report's key outputs is the linkage of climate risk management objectives to measurable indicators. Proposed core monitoring and evaluation indicators include heat-stress-related milk yield loss, reductions in the Non-Return Rate (NRR), the share of dairy farms equipped with cooling systems, the number of dairy farmers using modern irrigation systems, the cultivated area of drought-resilient forage crops, changes in forage costs, the number of farms with risk-reduction plans in high flood-risk areas, the number of farms or cooperatives with installed solar PV systems, the frequency of veterinary checks, the number of feed batches tested for mycotoxins, and the number of support measures directed to small and medium-sized dairy farms. Compiling these indicators at district level under the coordination of the Cattle Breeders' Association of Aydin (CBAA) will enable regular updates of risk trends and more targeted support programmes.

Successful implementation of climate risk management requires a strong stakeholder structure. Owing to its direct access to dairy farmers, field knowledge, data-collection capacity, and technical guidance role, CBAA is a central intermediary in this process. Farms are the direct implementers of adaptation measures. Provincial and District Directorates of Agriculture and Forestry are key institutional actors in agricultural support, animal health, production planning, and extension services. State Hydraulic Works (DSİ) and irrigation unions play a decisive role in water allocation, irrigation infrastructure, and flood management. Local authorities and the Disaster and Emergency Management Presidency (AFAD) have important responsibilities for disaster risk reduction, spatial planning, infrastructure, and early warning. Universities and research institutions can provide scientific input on climate analysis, forage crops, animal health, data monitoring, and pilot applications. The Agricultural and Rural Development Support Institution (ARDSI), development agencies, and financial institutions are also critical in providing grants, credit, and risk-sharing mechanisms to accelerate adaptation investments.

In terms of the policy context, this report emphasizes that climate risk management in Aydin should be integrated with policies on agriculture, livestock, water management, disaster management, spatial planning, energy, biodiversity, and rural development. Türkiye's climate change adaptation policy framework, agricultural production planning, the Büyük Menderes Basin drought and flood management plans, local disaster risk reduction processes, and the EU approach to climate adaptation provide a multi-level implementation basis for Aydin's dairy sector. The findings of the climate risk assessment should therefore be linked to local agricultural planning, rural infrastructure

investments, water-allocation decisions, disaster preparedness plans, dairy farmers support programmes, and private-sector investments.

The results of Phase 3 are highly usable for moving climate risks in Aydin's dairy sector from technical analysis to implementation. The report specifies priority investment and action areas for dairy farmers, planning and coordination needs for public institutions, and CBAA's roles in training, data collection, dairy farmer guidance, and monitoring. Effective implementation will nevertheless require improved access to finance for small and medium-sized farms, institutionalized local data flows, early warning systems that dairy farmers can readily use, and a regular mechanism for inter-institutional coordination.

In conclusion, the CliResDairy Phase 3 report sets out a holistic, actionable, and monitorable climate risk management framework to strengthen the resilience of the dairy sector in Aydin to climate change. The framework is based on reducing heat stress caused by heatwaves, securing feed and water supplies, strengthening farm infrastructure against floods and extreme precipitation, expanding energy-efficiency and renewable-energy solutions, protecting animal health and milk quality, supporting vulnerable dairy farmer groups, and improving coordination among local institutions. The report's central conclusion is that resilience to climate risks in Aydin's dairy sector can be achieved only by jointly implementing practical farm-level measures, value-chain planning approaches, and institutional delivery mechanisms based on cooperation among the public sector, private sector, and dairy farmers.

1 Introduction

1.1 Main objectives of the project

Located in western Türkiye, Aydin province represents a key agricultural and livestock production area, with a particular prominence in dairy farming. The region features a diverse geography—ranging from lowland coastal areas to mountainous inland districts—and a typical Mediterranean climate marked by hot, dry summers and mild, wet winters. This climatic profile, while traditionally favorable for agriculture, has become increasingly volatile due to the accelerating impacts of climate change.

Dairy production in Aydin is a vital economic activity, involving a large number of small- and medium-scale family-run farms that are highly sensitive to climatic fluctuations. The widespread presence of high-yielding but heat-sensitive Holstein cattle has further increased the sector's vulnerability, particularly to heat stress, drought, and associated feed and water supply issues. Despite the region's productive potential, exposure to extreme temperatures, seasonal water scarcity, and increasing input costs have begun to erode the sustainability of dairy farming systems.

These challenges have underscored the urgent need for locally grounded risk assessment and adaptation planning. In this context, Aydin was selected as a pilot region under the CLIMAAX project to carry out a comprehensive, sector-specific climate risk assessment with a strong local data foundation.

The CliResDairy Project aims to strengthen the resilience of dairy sector in Aydin to climate change and make milk production systems more sustainable by reducing climate-related risks within the CLIMAAX framework. The project combines regional climate risk analysis, stakeholder engagement, field-based validation, and the development of adaptation strategies.

The main objective of Phase 3 is to translate the findings of the Phase 2 Climate Risk Assessment into an actionable and locally applicable climate risk management framework for Aydin’s dairy sector. Building on the identified priority risks, particularly heatwaves, agricultural drought, extreme precipitation, and river flooding, this phase defines climate risk management objectives, priority measures, responsible institutions, implementation mechanisms, enabling conditions, and monitoring and evaluation requirements. It places particular emphasis on maintaining milk production and farm operations during climate-related disruptions, protecting animal health and welfare, securing feed and water supplies, improving the efficiency and reliability of water and energy use, and strengthening preparedness for extreme events. Phase 3 also incorporates stakeholder consultations to assess the practicality and local relevance of the proposed measures, clarify institutional responsibilities, and identify opportunities for coordination, financing, technical assistance, and capacity building. The resulting framework is supported by updated risk information, practical guidance for dairy farmers, measurable indicators, and recommendations for integrating climate risk management into relevant agricultural, water management, rural development, and disaster risk reduction processes.

1.2 Project team

Project Team:

- Project Coordinator: Dr. Hediye Cerit
- Technical Department of Cattle Breeders' Association of Aydin
- External Consulting Services:
  - Assoc. Prof. Nusret Demir: Technical Advisor (Geomatics & Industrial Engineer)
  - Dr. Çağrı Karaman: Technical Advisor (International Climate Analysis and Model Development Expert)
  - M. Kemal Demirkol: Technical Advisor (Climate Adaptation, Risk Assessment)
  - Engin Koç: Technical Advisor (Climate Adaptation, Risk Assessment)
  - Elif İrem Köse Kiper: Technical Advisor

1.3 Outline of the document's structure

This report consists of seven main sections. The Introduction presents the project objectives and team structure. The Local Profile summarizes the Phase 2 risk assessment results, policy context, stakeholders, and lessons learned from past events. Section 3 details climate risk management objectives, enabling conditions, and potential measures. Sections 4 and 5 provide the project evaluation and Phase 3 conclusions, while Section 6 presents performance indicators and milestones. The final sections list supporting documentation and references.

2 Local profile

2.1 Summary of Key Risk Assessment results

Aydin is an important dairy production area in the Aegean Region. A large proportion of farms are affected by hot and dry summers, variable precipitation patterns, rising energy and feed costs, and increasing pressure on water resources. The Phase 2 risk assessment analyzed heatwaves, agricultural drought, extreme precipitation and river flooding as priority climate hazards. Heatwaves directly affect milk yield, fertility, animal health, cooling-related energy demand, and milk quality. Agricultural drought affects the entire value chain through forage crop production, drinking and irrigation water supply, groundwater use, and feed prices. Extreme precipitation and flood risks create episodic but potentially high-impact damage to barns, feed storage areas, transport routes, and farm infrastructure. Work of Phase 2 and its contributions to the risk output can be summarized as follows and details were given in Section 2 of the Phase 2 Report.

(i) Heat stress is already causing significant losses in milk production and fertility, and these impacts are expected to become increasingly chronic. According to projection results under the RCP8.5 scenario, Didim district emerges as the district most likely to be negatively affected, with projected milk yield losses exceeding approximately 250 liters per animal per year. Söke and Kuşadası districts may experience losses ranging between 180 and 220 liters of milk per animal per year. In central districts such as Efeler, Germencik, İncirliova, Koçarlı, and Yenipazar, potential yield losses are projected to range between 150 and 200 liters per animal per year. Although eastern districts of Aydın show relatively lower projected losses, these areas may still experience milk yield reductions of approximately 120–160 liters per animal per year, representing a twofold or greater increase compared to historical conditions. Under the RCP8.5 scenario, average fertility losses measured through the Non-Return Rate (NRR) exceed 2–3% across much of the region, with the highest impacts observed in coastal and central districts. Didim, Söke, Koçarlı, Germencik, İncirliova, Efeler, and Çine districts emerge as clear risk hotspots where projected NRR losses approach or exceed approximately 3.5–4%. NRR values at this level indicate a systematic deterioration in reproductive performance, suggesting that many herds may shift from moderate fertility conditions toward levels associated with poor reproductive performance and severe heat stress exposure. Related figures are given below as an example from the report of Phase 2 (Figure 2-1).

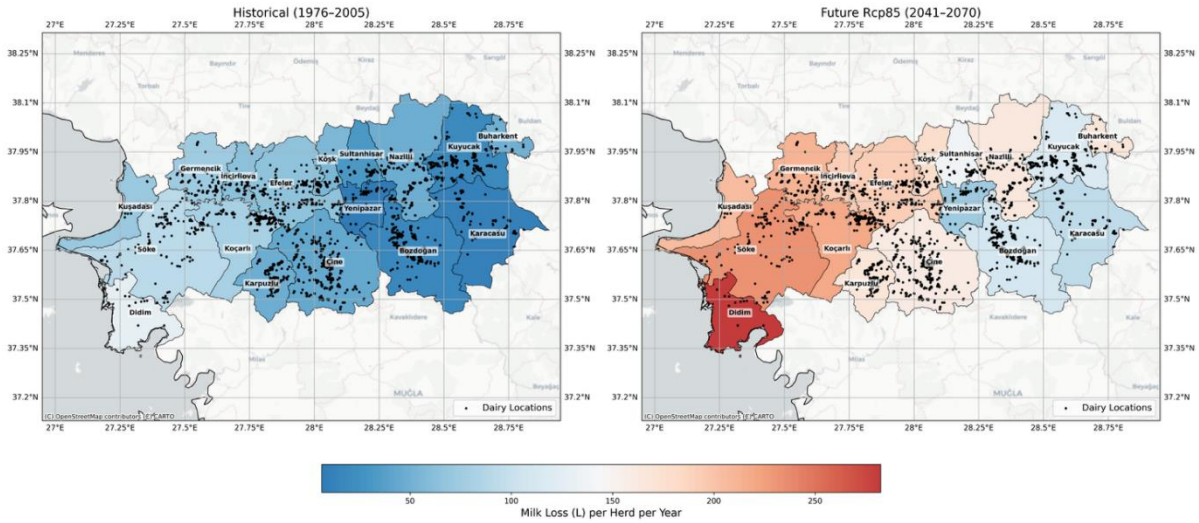


Figure 2-1 Annual cumulative milk loss per herd for each district in Aydin for 30-year time period (left historical, right RCP8.5)[1]

(ii) Another key aspect of the assessment is the use of district-level exposure and vulnerability indicators specific to the dairy sector, including the spatial distribution of farm cooling infrastructure and livestock density. To prevent declines in milk productivity and fertility rates caused by heat stress, substantial increases in farm cooling energy demand are expected. Average annual economic losses are projected to exceed EUR 200,000–300,000 in most districts. The highest losses are expected in Çine and Efeler districts due to intensive dairy farming and high cumulative heat stress exposure, reaching approximately EUR 400,000–500,000 per year.

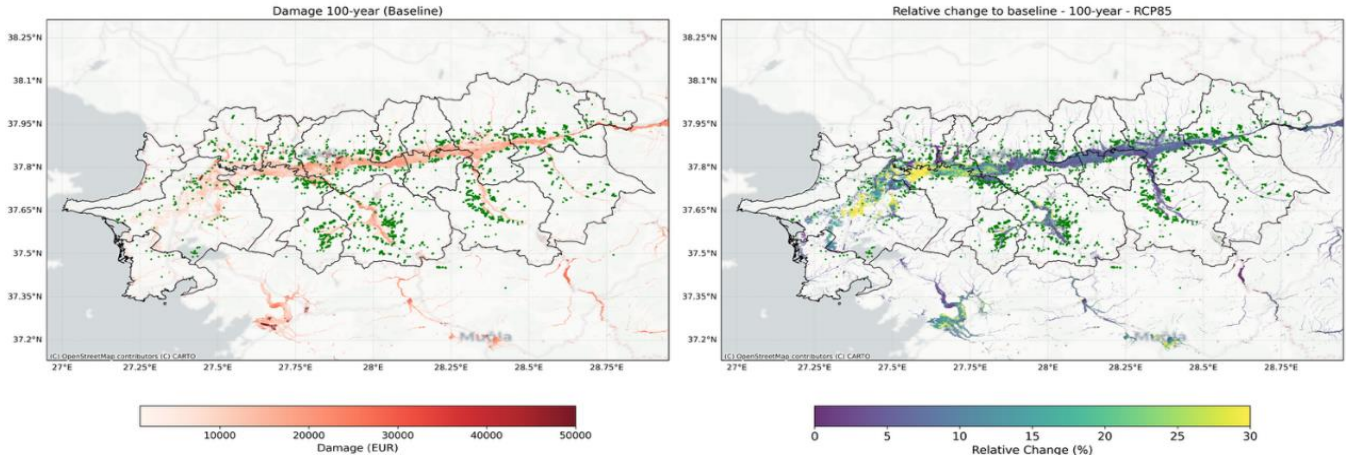


Figure 2-2 The maps of flood and associated damages for extreme river water level scenarios in current climate (left) and RCP8.5 scenario (2071-2100) for 1 in 100-year extreme event for Aydin Region.[2]

[1] All deliverables and outputs have been uploaded to the Zenodo platform during Phase 2; no new figures have been generated for the Phase 3 period.
[2] All deliverables and outputs have been uploaded to the Zenodo platform during Phase 2; no new figures have been generated for the Phase 3 period.

(iii) Precipitation patterns are shifting toward shorter but more intense rainfall events, increasing flood risk for farms located within the Büyük Menderes Basin. Related example of a flood risk map developed during Phase 2 is shared above (**Hata! B aşvuru kaynağı bulunamadı.**). Overall, under the RCP8.5 scenario, approximately 15% of farms in the Aydın region face an economic loss risk ranging between EUR 10,000 and EUR 50,000.

(iv) Within the framework of agricultural drought analyses, yield losses and associated economic risks caused by agricultural drought were assessed for each crop referenced in region-specific agricultural planning documents[3]. Agricultural drought is expected to reduce forage crop yields, directly threaten feed availability, and increase production costs. These projections are particularly critical for small and medium-sized farms with limited adaptive capacity. Under the RCP8.5 scenario, yield losses in alfalfa, vetch, silage maize, and sorghum production in the region may range between 42% and 52%. Districts most likely to experience these losses include Kuyucak, Buharkent, Nazilli, Sultanhisar, and Germencik. Related example of a drought risk map developed during Phase 2 is shared below (Figure 2-3).

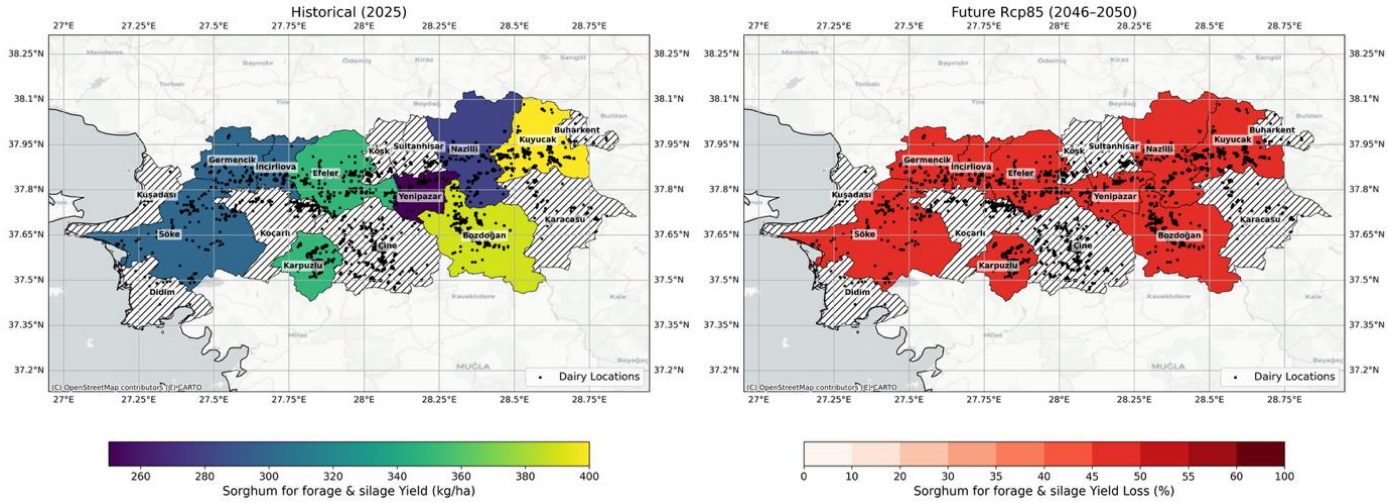


Figure 2-3 Historical sorghum yield in kg/ha (left) and projected yield loss (%) from precipitation deficit for RCP 8.5, 2046–2050 (right). Black dots indicate dairy farm member locations.[4]

The following table has been created to express all risks and existing resilience capacities together with relevant stakeholders.

[3] "Aydın Province Plant Production Planning for 2026-2028" published by the Aydın Provincial Directorate of Agriculture.
[4] All deliverables and outputs have been uploaded to the Zenodo platform during Phase 2; no new figures have been generated for the Phase 3 period.

Priority climate risk	*Resilience capacity (low, medium, substantial, high)*	*Description of the resilience capacity (such as existing knowledge, planned measures, gaps)*	*Stakeholders, experts and priority groups involved in the key risk assessment & modality of engagement*
Heatwaves	Medium-low	Although the need for fans and cooling is widespread, implementation capacity on small and medium-sized farms is constrained by limited access to finance. There is high sensitivity in terms of milk yield, fertility, and animal health.	**Stakeholders:** • Provincial Directorate of Meteorology • Aydin Provincial Directorate of Environment, Urbanisation and Climate Change • Aydin Provincial Directorate of Agriculture and Forestry • Efeler District Directorate of Agriculture and Forestry • Agricultural and Rural Development Support Institution (ARDSI) – Aydin Provincial Coordination Unit • Regional Directorate of State Hydraulic Works (DSİ) • Irrigation unions • Aydin Metropolitan Municipality Department of Agricultural Services • Aydin Adnan Menderes University (faculty members from the Faculties of Agriculture and Veterinary Medicine) • Aydın Milk Producers Association • Small, medium-sized, and large farms **Form of engagement:** In-person workshop and surveys
Agricultural drought	Low-medium	The high demand for irrigation water due to the existing forage crop cover and the use of old and inefficient irrigation techniques such as furrow irrigation in some regions and rising feed costs limit resilience.	**Stakeholders:** • Nazilli and Surrounding Area Agricultural Development Cooperative – ÖR-KOOP • Söke Agricultural Development Cooperative • Aydin Provincial Directorate of Agriculture and Forestry

		Modern irrigation and drought-resilient crop planning is needed	• Efeler District Directorate of Agriculture and Forestry • Agricultural and Rural Development Support Institution (ARDSI) – Aydin Provincial Coordination Unit • Regional Directorate of State Hydraulic Works (DSİ) • Irrigation unions • Aydin Metropolitan Municipality Department of Agricultural Services • Aydin Adnan Menderes University (faculty members from the Faculties of Agriculture and Veterinary Medicine) • Türkiye Association of Agriculturalists, Aydin Branch • Chamber of Commerce – Efeler District • Dalaman Agricultural Development Cooperative • Private-sector organisations operating in agricultural machinery manufacturing and related fields • Small, medium-sized, and large farms **Form of engagement:** In-person workshop and surveys
Extreme precipitation and flash flooding	Medium	Extreme precipitation can affect animal housing, drainage, and feed-storage infrastructure. Although the project has strengthened risk perception and awareness, most small, medium-sized, and large farms—particularly in the Menderes Plain—do not have adequate infrastructure to manage flood risk.	**Stakeholders:** • Aydin Provincial Directorate of Environment, Urbanisation and Climate Change • Regional Directorate of State Hydraulic Works (DSİ) • Provincial Directorate of Meteorology • Disaster and Emergency Management Presidency (AFAD) • Small, medium-sized, and large farms **Form of engagement:** In-person workshop and surveys

River flooding	Low-medium	Flood risk varies spatially and requires longer-term decisions for some farms, including siting, drainage, or relocation. Integrating flood maps into planning and investment decisions is critical.	**Stakeholders:** • Aydin Provincial Directorate of Environment, Urbanisation and Climate Change • Regional Directorate of State Hydraulic Works (DSİ) • Provincial Directorate of Meteorology • Small, medium-sized, and large farms **Form of engagement:** In-person workshop and surveys

2.2 Key implementation mechanisms and policy context for CRM

Climate risk management (CRM) in Aydin's dairy sector requires a coordinated policy framework covering livestock production, feed crops, water allocation, land use, disaster risk reduction, animal health, and rural investment. Heatwaves can reduce feed intake, milk yield and fertility; drought constrains forage and water availability; and extreme rainfall and river flooding can dairy infrastructures. CRM should therefore combine preventive regulation and spatial planning with early warning, extension, insurance, investment support and value-chain coordination.

National policy direction and sectoral mandates

Türkiye's Climate Change Adaptation Strategy and Action Plan 2024–2030 provides the overarching policy direction for resilience in agriculture and food security, water resources, ecosystems and biodiversity, disaster risk management, public health, and rural and urban settlements (MoEUCC, 2024). The Ministry of Agriculture and Forestry's 2024–2028 Strategic Plan and agricultural production-planning framework translate this direction into objectives on food security, efficient soil and water use, animal health, dairy farmer income and climate-informed production (MoAF, 2024). For Aydin, these goals support climate-sensitive decisions on herd capacity, forage demand, pasture use and water availability, and justify stronger extension services on heat stress, emergency water supply, animal disease surveillance, manure management and farm continuity planning.

Water policy is especially important because Aydin lies within the Büyük Menderes River Basin. The National Water Plan 2026–2035 and basin-level drought, river basin and flood management instruments provide mechanisms for water allocation, abstraction control, metering, drought thresholds, flood-hazard mapping, water-quality protection and coordinated response (MoAF , 2026; MoAF-GDWM , 2019; MoAF-GDWM 2023). These instruments can shape irrigation scheduling for maize and other feed crops, farm water audits, efficient watering and cleaning systems, rainwater harvesting and pollution control for manure and silage effluent. Solar-powered pumping should be coupled with permits, metering and groundwater limits so that lower energy costs do not increase abstraction.

Insurance and agricultural risk-transfer mechanisms

State-supported agricultural insurance administered through the Agricultural Insurance Pool (TARSIM) is a central financial risk-transfer mechanism. Under the Agricultural Insurance Law No. 5363, eligible dairy farmers and animals must be registered in the Ministry's relevant registration systems, after which a risk assessment is carried out and a policy is issued through authorised insurers. In 2026, the state pays 50% of the premium for standard cattle life insurance and 60% under the Narrow-Scope-2 tariff; the dairy farmer pays 25% of the remaining share at policy inception and may pay the balance in up to five instalments (TARSIM, 2026a; MoAF, 2025). This subsidy improves affordability and can strengthen post-event liquidity.

For dairy holdings, cattle life insurance can cover losses linked to animal diseases, pregnancy and birth complications, accidents, fire and specified natural hazards, depending on the selected tariff and policy conditions. The 2026 framework also provides specific rules for calf loss or abortion compensation and requires prompt notification, expert loss assessment and documentary verification before indemnity is calculated (TARSIM, 2026b; 2026c). Feed-crop dairy farmers may additionally use crop insurance against specified perils, while other TARSIM products can address drought-related yield or revenue risks where the crop, location and policy conditions are eligible. Insurance does not replace adaptation: policy design, risk inspections, deductibles and premium differentiation can encourage safer housing, backup power, fire prevention, vaccination and record keeping. Climate-risk information from Aydin should also be used to review coverage gaps—for example, production losses from prolonged heat stress that do not result in animal death—and to develop parametric or index-based complements with private insurers, banks, cooperatives and processors.

ARDSI /IPARD III investment policy and implementation

The Agriculture and Rural Development Support Institution (ARDSI) implements the EU–Türkiye co-financed IPARD III Programme and provides a key mechanism for converting CRM priorities into physical investment. Under Measure M1, Investments in Physical Assets of Agricultural Holdings, dairy farms may receive grant support under calls covering milk production; current call conditions provide support rates generally ranging from 60% to 75%, subject to applicant, investment and call-specific eligibility rules (ARDSI , 2026a). Eligible investment categories can support modern livestock buildings, ventilation and cooling, animal-welfare equipment, milk cooling and storage, renewable-energy systems, manure storage and management, resource-efficient machinery and other investments required to meet national and EU standards.

Implementation is call-based and compliance-driven. Applicants prepare a business plan, technical designs, permits, ownership or lease evidence, procurement documentation and proof of financing, and submit the application within the announced period. ARDSI performs administrative and eligibility checks, technical and financial assessment and pre-contract on-site controls. Selected applicants sign a contract and normally finance and implement the approved investment first; procurement, construction and equipment must remain within the approved scope and schedule. Payment is made after a payment claim, documentary verification and on-site control confirm eligible expenditure. Post-investment monitoring, asset-retention and operation obligations continue

for the period defined in the contract, and non-compliance may lead to reductions or recovery (ARDSI , 2024; ARDSI 2026b).

For CRM, calls and project-selection criteria could explicitly reward quantified reductions in heat exposure, water demand, flood vulnerability and manure-related pollution. Farm applications should use climate projections and hazard maps when siting buildings and sizing drainage, cooling, water storage and backup-energy systems. Technical assistance from ARDSI coordination structure, the Provincial Directorate of Agriculture and Forestry, cooperatives and consultants is important for small farms that may otherwise face barriers related to co-financing, permits, business-plan preparation and procurement. Blending IPARD grants with concessional agricultural credit, dairy farmer equity and suitable insurance can close the adaptation finance gap, while avoiding double financing of the same expenditure.

EU, local and private-sector implementation

At regional and local levels, the Aydin–Mugla–Denizli Planning Region 1:100,000 Environmental Plan protects agricultural land, pastures, irrigation areas, water basins and ecologically sensitive zones (MoEUCC , 2022). Lower-level plans and permitting can prevent new livestock facilities from being placed in flood-prone areas or protection zones and can require climate-resilient access, drainage, manure storage and emergency water supplies. The Aydin Provincial Disaster Risk Reduction Plan supports coordination among AFAD, municipalities, the State Hydraulic Works, the Provincial Directorate, irrigation organisations, veterinary services and dairy farmer organizations (Aydin Metropolitan Municipality, 2021). Nature-based measures—riparian buffers, erosion control, pasture restoration and protection of water-dependent habitats—should be integrated so that dairy adaptation does not transfer risk to ecosystems.

EU policy influences implementation through the Common Agricultural Policy's climate, environment, animal-welfare and rural-resilience objectives and through IPARD III alignment and financing (EC, 2022). Dairy processors, cooperatives and dairy farmer associations can translate these objectives into supplier standards, heat-alert communication, joint veterinary and extension services, collective cooling or renewable-energy investments, emergency milk-collection protocols and long-term purchasing arrangements. Banks can incorporate climate-risk screening into farm credit, while insurers can link favourable terms to verified risk-reduction measures. An effective CRM system for dairy sector of Aydın should ultimately connect with public hazard information, farm records, water and animal-health monitoring, data generated by TARSIM and TKDK investment support details through privacy-respecting indicators. This would enable public institutions and value-chain actors to track whether investments reduce losses, protect animal welfare and maintain milk production under worsening climate conditions.

2.3 Key actors and systems for CRM

Effective climate risk management for dairy farms in Aydin requires a holistic assessment of the mandates, responsibilities, knowledge, and implementation capacities of different institutions and stakeholder groups. Climate risks in the dairy sector affect not only dairy farmers , but also agricultural production, water management, feed supply, animal health, energy use, logistics,

disaster management, and local planning. It is therefore important to define clearly the roles, responsibilities, needs, and potential contributions of the actors involved in climate risk management. The table below summarizes the key actors involved in developing and implementing climate risk management strategies for dairy farms in Aydin. For each actor, roles and responsibilities in climate risk management, motivations and needs for participation, opportunities created by active engagement, principal barriers, and the form of participation are indicated. The stakeholder groups were brought together during the project's field visits and workshops to discuss problems and solution options collaboratively. The content of these field visits and workshops is detailed in the Phase 2 report.

Key actors	*Role and responsibility*	*Motivation and needs*	*Opportunities related to the their active involvement in CRM*	*Barriers related to the their active involvement in CRM*	*Type of engagement*
CBAA	Dairy farmers coordination, field data, training, and technical guidance	Protecting members' production continuity and competitiveness	Rapid access to dairy farmers and capacity for data collection and dissemination	Need for sustained financing and continuity of data collection	Field interviews, surveys, workshops, and technical reporting
Dairy Farms/dairy farmers	Implementation of on-farm adaptation measures	Protecting milk yield, animal health, and income stability	Local knowledge, rapid implementation, and sharing of experience	Limited investment capacity on small farms	Field visits and workshop sessions
Provincial and District Directorates of Agriculture and Forestry	Agricultural support, animal health, and livestock and crop production planning	Sector sustainability and food supply security	Technical support, training programmes, and agricultural extension services	Coordination with other institutions and budget constraints	Workshops, institutional feedback, and training activities
State Hydraulic Works (DSİ) and irrigation unions	Water allocation, irrigation infrastructure, and flood management	Efficient use of water resources and infrastructure safety	Basin-scale planning and technical infrastructure expertise	Scale of investment and long implementation periods	Workshops and technical assessment
AFAD and local authorities	Disaster risk reduction, early warning, and spatial planning	Preventing loss of life and property	Integration of risk maps into planning	Division of mandates and implementation coordination	Workshops and policy integration

Universities and research institutions	Climate analysis, forage crops, animal health, and technology assessment	Scientific knowledge generation and local capacity building	Pilot applications and monitoring systems	Research financing and data access	Workshop moderation and expert input
ARDSI, development agencies, and financial institutions	Grants, credit, investment support, and risk sharing	Accelerating feasible adaptation investments	Directing financing instruments towards climate-risk priorities	Adequate application capacity and co-financing requirements	Workshops and support programmes
Agricultural Organisations • Nazilli and Surrounding Area Agricultural Development Cooperative (ÖRKOOP) • Dalaman Agricultural Development Cooperative • Söke Agricultural Development Cooperative • Aydın Milk	Supporting coordination among members and farmers, facilitating knowledge transfer, providing extension and advisory services, promoting climate adaptation practices, supporting collective investments, and strengthening collaboration between members, farmers and relevant public institutions.	Improving members' and farmers resilience to climate change, sustaining agricultural productivity, strengthening dairy farmer organisations and increasing the adoption of climate-smart agricultural practices.	Wider dissemination of climate adaptation measures, stronger cooperation among dairy farmers, increased awareness, collective investments and improved uptake of climate-resilient practices.	Limited financial and technical capacity, varying institutional capacity among organisations and limited participation of members.	Workshops, technical field visits, stakeholder consultations and conference participation.

Producers' Association - Chamber of Commerce – Efeler District					
Civil Society Organisations (NGOs)	Raising awareness of climate change and climate risks, promoting climate adaptation toolkits and guidance materials, supporting capacity-building activities, providing training for members and farmers, encouraging stakeholder cooperation, and contributing to the dissemination of climate adaptation knowledge and good practices.	Increasing members' awareness and capacity for climate change adaptation, strengthening community resilience, promoting sustainable agricultural practices, and supporting local adaptation initiatives.	Wider dissemination of climate adaptation toolkits and good practices, stronger stakeholder engagement, increased public awareness, enhanced capacity-building activities, and improved cooperation among local actors.	Limited financial and human resources, project-based funding, varying institutional capacity, and challenges in ensuring long-term continuity of awareness and training activities.	Workshops, stakeholder consultations and conference participation.

2.4 Lessons learned from past events

The implementation of Phase 3 demonstrated the value of an iterative Climate Risk Management (CRM) process built upon both scientific evidence and continuous stakeholder engagement. During Phase 2, the climate risk assessment was developed not only through climate projections, hazard analyses and spatial modelling, but also through technical field visits to representative dairy farms and extensive consultations with local stakeholders, including public institutions, agricultural organisations, cooperatives, universities, civil society organisations, private sector representatives and dairy farmers. These activities ensured that scientific evidence was complemented by local knowledge and practical experience, enabling the identification and validation of priority climate risks affecting the dairy sector.

Building on this foundation, Phase 3 focused on disseminating the results of the climate risk assessment, validating the proposed CRM recommendations and strengthening stakeholder ownership of the adaptation process. The findings of Phase 1 and Phase 2 were shared through stakeholder workshops, technical meetings, field visits and scientific conferences, allowing participants to assess the proposed measures against their own operational experience and institutional responsibilities. Stakeholder feedback consistently confirmed that the identified climate risks accurately reflected local conditions and that the proposed CRM measures addressed the priority adaptation needs of the dairy sector.

One of the most important lessons learned was that climate adaptation should be considered as a continuous process rather than the final output of a project. Throughout Phase 3, emphasis was placed on strengthening dialogue among stakeholders and improving the proposed adaptation measures through continuous consultation. Stakeholders generally considered the CRM recommendations technically feasible and relevant for long-term implementation. However, they also highlighted that successful implementation will require adequate financial resources, stronger institutional cooperation and continuous technical support, particularly for small and medium-sized dairy farms.

The discussions also confirmed several key technical findings of the climate risk assessment. Stakeholders agreed that extreme heat has increasingly reduced milk yield and fertility during summer months, while the relatively lower impacts observed in higher-altitude districts such as Karacasu demonstrated the importance of considering local microclimatic differences in climate adaptation planning. Across Aydin, the need for ventilation and cooling systems was recognised by almost all stakeholders, although financial constraints continue to limit implementation, especially on small farms.

Regarding drought, the principal lesson learned was that forage production, irrigation water availability and energy costs should be addressed through an integrated approach rather than separately. Field observations and stakeholder discussions confirmed that agricultural water scarcity has become one of the most critical challenges across the province. Future adaptation strategies should therefore integrate water allocation planning, the promotion of low water-demand forage crops, modern irrigation technologies, renewable energy solutions and cooperative-based implementation models to improve long-term resilience.

Experience from recent extreme precipitation and flood events reinforced the need to strengthen farm infrastructure and preparedness. Stakeholders highlighted the importance of protecting feed storage facilities against moisture and flooding, improving drainage systems, incorporating flood hazard

maps into farm planning and expanding early warning systems capable of rapidly reaching dairy farmers.

These discussions confirmed that infrastructure deficiencies remain one of the principal barriers to climate resilience, particularly for farms located within the Büyük Menderes Plain.

Learning throughout the project was ensured through an iterative process involving field visits, technical consultations, stakeholder workshops and scientific dissemination activities. Rather than serving only as dissemination events, these activities facilitated continuous knowledge exchange among researchers, technical experts, public authorities, agricultural organisations, cooperatives, civil society organisations, private sector representatives and dairy farmers. This continuous interaction allowed the CRM recommendations to be progressively refined while strengthening awareness of climate risks and adaptation opportunities.

Another important lesson learned was that maintaining stakeholder engagement beyond the formal project activities is essential. While the large multi-stakeholder workshop successfully brought together all relevant actors, smaller thematic meetings with specific stakeholder groups would further strengthen cooperation, encourage more detailed technical discussions and facilitate the development of locally tailored adaptation measures. Keeping climate change and climate risk management on the agenda through regular stakeholder dialogue was recognised as an effective way to sustain institutional cooperation and accelerate implementation.

The integration of scientific analyses with local knowledge and stakeholder participation proved to be one of the strongest aspects of the project. The combination of climate modelling results, field observations and stakeholder feedback significantly increased the credibility, practicality and local ownership of the CRM recommendations. Nevertheless, limited financial capacity, particularly among small-scale farms, together with the need for sustained institutional coordination after project completion remain the main barriers to implementing many of the proposed adaptation measures.

Project resources were used efficiently by integrating field assessments, technical consultations, stakeholder engagement activities and dissemination events within a coordinated implementation process. Existing institutional networks, technical expertise and stakeholder participation were effectively utilised throughout the project, allowing available time, staff and financial resources to be used efficiently while avoiding duplication of activities and maximising project outputs.

The project outcomes were communicated through CLIMAAX deliverables, stakeholder workshops, technical meetings, scientific conference presentations and direct engagement with regional institutions and dairy farmer organisations. Beyond dissemination, one of the most significant lessons learned was that the completion of the project represents the beginning rather than the end of the climate adaptation process. The climate risk assessment and CRM recommendations should continue to guide regional planning, support the development of practical adaptation projects, inform future investment decisions and contribute to evidence-based agricultural and climate policies.

Overall, the CRM process substantially improved the common understanding of climate risks affecting dairy farming in Aydin, strengthened cooperation among stakeholders, increased public awareness and institutional capacity, and established a solid foundation for future adaptation investments, collaborative projects and evidence-based policy development.

3 Climate risk management – phase 3

3.1 CRM objectives

Climate risk management objectives for Aydin's dairy sector were defined in view of the priority climate hazards identified in the Phase 2 Climate Risk Assessment and their effects on the value chain. Heatwaves, agricultural drought, extreme precipitation and flood risks were assessed in relation to animal health and welfare, milk yield, fertility, feed production, access to water, dairy farm infrastructure and located area distribution, energy use, and production continuity. The objectives aim not only to reduce current risks but also to strengthen the sector's adaptive capacity in response to climate pressures expected to intensify in the future. The table below presents the main climate risk management objectives proposed for Aydin's dairy sector and illustrative indicators that may be used to monitor them.

While defining the objectives, the assessment considered not only technical risk reduction but also access to finance for small and medium-sized farms, support for vulnerable dairy farmer groups, and regional feed-water-energy security. The Phase 3 framework therefore adopts an adaptation approach that also safeguards dairy farmer welfare and livelihoods.

Primary objectives	*Examples of assessment indicators*
Reduce heatwave-related losses in milk yield and fertility	Heat-stress-related milk yield loss; decline in NRR; share of farms with cooling systems; number of dairy farmers trained
Reduce drought risk associated with feed production and water management	Number of dairy farmers using modern irrigation systems; cultivated area of drought-resilient forage crops; changes in forage costs; water-efficiency indicators
Increase the resilience of farm infrastructure to extreme precipitation and flooding	Number of farms with risk-reduction plans in high flood-risk areas; number of farms with drainage or ground improvements; number of farms with upgraded feed-storage infrastructure
Scale up low-carbon solutions for energy costs and climate-control demand	Number of farms or agricultural organisations with installed solar PV systems; energy consumption for milk cooling; electricity expenditure for fans and climate control; number of energy-efficiency investments
Reduce risks to animal health, feed safety, and milk quality	Frequency of veterinary checks; number of feed batches tested for mycotoxins; records of mastitis and heat-stress-related cases; milk-quality indicators
Support equitable and inclusive adaptation	Number of support measures directed to small and medium-sized farms; participation of women and young dairy farmers in training; number of pilots implemented in vulnerable districts

Additional objectives	*Examples of assessment indicators*
Public health and occupational safety Protect farm workers, milk consumers, and nearby communities from heat-related illness and from food-, water-, and zoonotic-health risks that may increase during heatwaves and floods.	• Number of heat-related illnesses, first-aid, or lost-time incidents among farm owners and workers during heatwave periods • Share of farms with worker heat-health protocols, drinking water, shaded rest areas, and emergency-response arrangements • Number of milk, feed, or farm-water safety non-compliance incidents recorded after heatwaves, extreme rainfall, or flooding • Frequency of coordinated veterinary and public-health surveillance or alerts reaching dairy farms
Social well-being Maintain safe working conditions, dairy farmer well-being, access to support services, and the continuity of dairy-farming households and rural communities exposed to climate shocks.	• Farm workdays lost because of heatwaves, drought, extreme rainfall, or flooding • Share of dairy farmers receiving timely early warnings and able to access veterinary, extension, and emergency-support services • Number and diversity of dairy farmers and farm workers completing climate-risk and preparedness training • Dairy farmer -reported preparedness, stress, and ability to cope with climate-related disruptions, assessed through periodic surveys
Environmental quality and ecosystem resilience Reduce pressure on water, soil, and ecosystems while preventing dairy adaptation investments from transferring risk to groundwater, surface water, biodiversity, or neighbouring land.	• Farm water use per animal or litre of milk, and irrigation water use per hectare of forage crop • Groundwater abstraction volume and share of farms complying with permits, metering, and allocation limits • Share of farms with secure manure, slurry, and silage-effluent storage protected from flood pathways • Renewable-energy share and energy or greenhouse-gas intensity per litre of milk • Area or number of shade trees, riparian buffers, restored pasture, and other nature-based measures maintained
Justice and equity Ensure that small and medium-sized farms, women and young dairy farmers, and farms in the most exposed districts can access information, finance, insurance, technology, and decision-making processes.	• Share of small and medium-sized farms accessing grants, concessional credit, TARSIM insurance, technical assistance, or adaptation training • Share of public and private adaptation support allocated to districts and farms with the highest assessed climate risk • Participation and beneficiary rates of women and young dairy farmers in training, pilots, finance, and dairy farmer organisations
Rural economic resilience and value-chain continuity Limit climate-related income losses and maintain essential milk production, cooling, collection, feed supply, and logistics during and after extreme events.	• Climate-related production and income loss per farm and district • Forage and purchased-feed costs as a share of total production costs, including seasonal price volatility • Share of eligible animals, crops, and farm assets insured and average time between a claim and indemnity payment • Average time required for affected farms and value-chain services to return to normal operation

3.2 Supportive elements for effective CRM

Effective climate risk management for Aydin's dairy sector depends not only on identifying technical risk-reduction measures, but also on strengthening the institutional, technical, financial, and social capacity needed to implement them. The Phase 2 Climate Risk Assessment and stakeholder engagement process show that successful adaptation to heatwaves, agricultural drought, extreme precipitation, and flooding requires better information and data infrastructure; the use of early warning and monitoring systems; improved farm-level technology; stronger dairy farmers awareness and implementation capacity; and enhanced inter-institutional coordination.

The table below summarizes the principal enabling conditions for effective climate risk management in Aydin's dairy sector. It assesses the current situation, needs, and areas for improvement under information and data; technology and infrastructure; social and behavioral factors; citizen and dairy farmers participation; financing and resources; and governance and political ownership. These conditions increase the feasibility of the proposed climate risk management measures and provide an enabling framework for strengthening the long-term climate resilience of dairy farms and other actors of dairy sector value chain.

Supportive elements for effective CRM	*Description*
Information and data monitoring	Regular monitoring of milk yield, fertility, THI, fan use, water consumption, feed costs, and disease records; standardisation of data at district level.
Technology and infrastructure	Cooling and ventilation systems, misting systems, shade structures, automated milking and monitoring systems, modern irrigation technologies, solar photovoltaic (PV) and other renewable energy systems, climate-resilient feed-storage facilities, and drainage infrastructure for flood risk management.
Social and behavioural factors	Raising dairy farmers' risk awareness, sharing examples of good practice, and supporting behavioural change and improved husbandry and feeding practices on dairy farms.
Dairy farmers and relevant institutions participation	Two-way feedback mechanisms through workshops, field visits, surveys, trainings.
Financing and resources	Developing grants, low-interest credit, insurance mechanisms, purchase guarantees, shared solar PV systems between dairy farms, and cooperative-based investment models such as biogas production from manure management.
Governance and political leadership	Establishment of an inter-institutional coordination mechanism for climate risk management, led by the relevant public authorities, with clearly defined roles and responsibilities among public institutions, local authorities, State Hydraulic Works (DSI), AFAD, ARDSI, universities, CBAA, agricultural organisations, relevant NGOs.

3.3 Potential CRM measures

The Phase 2 Climate Risk Assessment identified heatwaves, agricultural drought, extreme precipitation, and flooding as priority climate risks for Aydin's dairy sector. These risks have direct and indirect effects on milk yield, fertility, animal health and welfare, feed production, access to water, farm infrastructure, energy demand, the cold chain, and production continuity. Measures developed for climate risk management should therefore be considered not as isolated technical investments, but together with the farm scale, value chain, local infrastructure, institutional coordination, and financing mechanisms.

The table below summarizes potential climate risk management measures for the priority risks identified. Each measure is assessed in terms of its expected effectiveness and risk-reduction potential, contribution to climate risk management objectives, potential co-benefits, implementation timeframe, responsible institutions or actors, and possible limits to adaptation. This framework enables a comparative assessment of the feasibility of the proposed measures and provides a basis for prioritizing actions to strengthen the climate resilience of Aydin's dairy sector.

Key climate risk	*CRM measure*	*Effectiveness / Risk reduction (high, medium, low)*	*Contribution to CRM objectives*	*Possible co-benefits*	*Timeline (short, medium, long term)*	*Responsible organisation*	*Possible adaptation limits*
Heatwaves	Installing and using Automated Milking Systems (AMS) integrated with animal-monitoring sensors and barn-level temperature and humidity	High	AMS supports early detection of heat-stress-related productivity losses and mastitis or other health risks by monitoring milking times, animal movement, and changes in	Continuous animal-health data improve herd management, labour efficiency, milk-quality control, and evidence-based veterinary decisions.	Medium term	Dairy Farms; Cattle Breeders' Association of Aydin; Provincial and District Directorates of Agriculture and Forestry; technology suppliers;	High investment and maintenance costs; reliable electricity and connectivity, staff training, and technical support are required, limiting uptake by small farms.

	monitoring. The system would track indicators such as milking frequency and duration, animal movement, milk yield, milk flow, and milk-quality parameters in real time, allowing farmers to identify changes associated with high Temperature-Humidity Index values and respond before heat stress causes severe health or productivity impacts.		milk yield in real time (Ji et al., 2020).			development and grant programmes.	
Heatwaves	Using Automated Milking Systems (AMS) to strengthen resilience to health risks associated with	High	AMS and associated sensors enable real-time monitoring of milking patterns, animal movement, and changes in	Continuous animal-health data improve herd management, labour efficiency, milk-quality control, and evidence-based veterinary decisions.	Medium term	Dairy farms; Cattle Breeders' Association of Aydin; Provincial and District Directorates of Agriculture and Forestry;	High investment and maintenance costs; reliable electricity and connectivity, staff training, and technical support are required, limiting

	the Temperature-Humidity Index		milk yield and quality. When combined with temperature and humidity data, this information supports the early detection of heat-stress-related productivity losses and health risks, including mastitis, enabling timely adjustments to cooling, watering, feeding, and herd management practices (Ji et al., 2020).			technology suppliers; development and grant programmes.	uptake by small farms.
Heatwaves	Breeding more heat-resilient animals through genetic selection	Medium	Selecting heat-resilient breeds and lines reduces long-term declines in feed intake, fertility, and milk production during heatwaves *(Cartwright et al., 2023)*.	Improved animal welfare, fertility, lower cooling demand and less need for veterinary	Long term	Cattle breeders' associations of Aydin; dairy farms; Provincial Directorate of Agriculture and Forestry; universities and research institutions; veterinarians.	Genetic gains are slow; trade-offs with milk yield and genetic diversity are possible, and local performance data and breeding expertise are required.
Heatwaves	Providing shaded areas on farms and planting	High	Shade and tree planting reduce animals' exposure	Improved animal welfare and worker comfort; trees also	Short term	Dairy farms; municipalities; Cattle Breeders'	Space, land-tenure, irrigation, and maintenance

	trees in open areas		to direct solar radiation, thereby limiting increases in body temperature and reducing heat stress (ARDSI – Agriculture and Rural Development Support Institution: IPARD III Programme, Ninth Call for Applications—Measure M1, https://www.tkdk.gov.tr/Haber/9th-call-for-applications-under-the-ipard-iii-programme-is-announced-12895?lang=en, 2026a. ARDSI – Agriculture and Rural Development Support	support biodiversity, carbon sequestration, wind protection, and cooler farm microclimates.		Association of Aydin; Provincial and District Directorates of Agriculture and Forestry; State Hydraulic Works and forestry authorities.	constraints apply; trees take time to mature, and shade alone may be insufficient under extreme heat and humidity.

			Institution: IPARD III Programme, Application Call Guideline—Investments in Physical Assets of Agricultural Holdings (M1), https://www.tkdk.gov.tr/Content/File/BasvuruFiles/BasvuruPaketiHazirlamaDokumanlari/BasvuruCagriRehberi/IPARDII				

			I/11.0/103.pdf, 2026b. ARDSI – Agriculture and Rural Development Support Institution: Strategic Plan 2024–2028, https://tkdk.gov.tr/Content/File/Stratejik%20Plan%202024-2028.pdf, 2024. Armstrong, *1994; IPCC, 2022*).				
Heatwaves	Using misting (mist cooling) systems	High	Misting systems lower animals' body temperature through evaporative cooling and reduce	Rapid cooling supports animal welfare, feed intake, fertility, and milk yield while reducing	Short term	Dairy farms; irrigation and equipment companies; veterinarians; Provincial and	Adequate water and ventilation are essential; misting may raise humidity, disease risk, and operating costs and

			heat-stress-related losses in milk yield *(Fournel et al., 2017)*.	severe heat-stress incidents.		District Directorates of Agriculture and Forestry.	is less effective during very humid conditions.
Heatwaves	Increasing the use of mechanical ventilation	High	Mechanical ventilation increases air circulation in animal housing and reduces the accumulation of heat and humidity. Under Aydin's high summer temperature and humidity conditions, it helps reduce respiratory stress and *productivity losses (WOAH, 2024)*.	Better air quality and worker comfort, fewer respiratory problems, improved animal welfare, and more stable milk yield.	Short term	Dairy farms; electricity and equipment suppliers; veterinarians; Cattle Breeders' Association of Aydin.	Electricity and maintenance costs, grid outages, and poor system design can limit performance; ventilation alone may not control extreme heat.
Drought	Using renewable electricity for agricultural irrigation and farm energy demand (solar PV systems)	High	Solar PV systems can meet the increased demand for groundwater pumping and farm energy during drought with lower-carbon and more predictable-cost electricity *(Hartung and Pluschke, 2018)*.	Lower energy costs and emissions, greater energy security for cooling, milking, and water pumping, and opportunities for cooperative systems.	Medium term	Dairy farms; agricultural organisations and dairy farmer associations; energy companies; municipalities; Provincial Directorate of Agriculture and Forestry;	Upfront finance, roof or land availability, grid connection, maintenance, and storage constraints apply; cheaper pumping may increase groundwater abstraction without safeguards.

						development agencies and financial institutions.	
Drought	Modernising irrigation systems, including shifting from furrow irrigation to drip irrigation and other efficient alternatives	High	Modern systems such as drip and pressurised irrigation reduce water losses in forage crop production and enable more efficient use of limited water resources during drought *(Perry et al., 2017)*.	Water and energy savings, more reliable forage yields, lower pumping costs, and reduced nutrient losses.	Medium term	Dairy farmers and forage-crop producers; irrigation unions; State Hydraulic Works (DSİ); Provincial and District Directorates of Agriculture and Forestry; municipalities; agricultural organisations.	Upfront cost, filtration, maintenance, farmer training, and water-allocation constraints apply; efficiency gains may be offset by expanded irrigation or severe drought.
Drought	Producing drought-resilient forage crops (Phase 2 study results indicate that currently cultivated forage crops will be significantly affected by drought in the future).	High	Drought-resilient forage crops maintain forage supply during hot and dry periods, reducing external dependency and exposure to feed-cost risks. Using varieties suited to Aydin's conditions supports continuity of milk *production (Indu et al., 2023)*.	Stronger local feed security, more stable feed costs and farm income, improved soil health, and lower dependence on imported feed.	Medium term	Forage-crop producers; dairy farms; Provincial Directorate of Agriculture and Forestry; universities and research institutes; seed suppliers; agricultural organisations.	Seed availability, agronomic knowledge, market acceptance, and variable nutritional value may constrain uptake; prolonged drought can still cause crop failure.

River flooding	Relocating farms situated in flood-prone areas	High	Relocating farms from high flood-risk areas to safer locations permanently reduces the risks of livestock losses, damage to feed and other stocks, infrastructure damage, and production disruptions.	Lower disaster losses, emergency-response needs, contamination risks, and insurance exposure, together with safer and more efficient farm layouts.	Long term	Dairy farms; municipalities; AFAD; State Hydraulic Works (DSİ); Provincial Directorate of Agriculture and Forestry; Provincial Directorate of Environment, Urbanisation and Climate Change; financial institutions.	High land, construction, and compensation costs; planning and permitting constraints, limited suitable land, livelihood disruption, and dairy farmers reluctance.
River flooding	Developing flood-prevention infrastructure	High	Drainage channels, stormwater conveyance systems, permeable surfaces, and flood barriers prevent water from accumulating on farm premises during intense rainfall and protect infrastructure and animal housing from damage *(World Bank, 2021)*.	Protection of roads, feed stores, and neighbouring assets; improved sanitation, water quality, and business continuity; biodiversity gains from nature-based drainage.	Medium term	Dairy farms; municipalities; State Hydraulic Works (DSİ); AFAD; Provincial and District Directorates of Agriculture and Forestry; infrastructure engineering firms.	High capital and maintenance costs, land and coordination needs; infrastructure may be overtopped or shift flood risk downstream as rainfall extremes intensify.

3.4 Integration into planning and decision making

Integrating climate risk assessment results into local policy and planning is one of the most critical output areas of Phase 3. Heatwave risks should be reflected in farm-investment guidelines and animal-welfare training; agricultural drought findings in cropping patterns, irrigation planning, and feed-production support; and flood and extreme precipitation findings in spatial planning, disaster risk reduction, and infrastructure investment decisions.

P During Phase 3, CBAA prepared climate-risk information notes and initiated the development of practical guidance documents for both dairy farmers and relevant public institutions. These guidance materials are being finalized together with the final project report and will continue to be disseminated to their target audiences after project completion to support the long-term implementation of climate risk management measures. Public institutions should link risk maps with irrigation investments, agricultural support programmes, flood-prevention infrastructure, and rural development support. For local authorities and AFAD, early warning, evacuation, infrastructure, and spatial risk-reduction mechanisms are priority areas for integration.

Although cooperation among public institutions and stakeholders was generally positive throughout the project, obtaining data from different institutions required longer than anticipated. Differences in institutional procedures and data-sharing processes slowed the collection of some datasets, which affected the overall assessment timeline. These experiences highlighted the importance of strengthening inter-institutional coordination mechanisms, establishing more efficient data-sharing procedures and improving communication among stakeholders for future climate risk management activities.

Phase 2 generated district-level climate risk maps, farm-level observations and sector-specific risk information, while Phase 3 further strengthened this evidence base through stakeholder consultations, dissemination activities and the preparation of practical guidance documents. These outputs provide a strong foundation for integrating climate risk considerations into future planning and decision-making. However, further improvements in climate risk assessments and climate risk management will require long-term monitoring data on animal health, groundwater resources, forage production, socio-economic vulnerability and the effectiveness of adaptation measures, together with strengthened institutional capacity for data sharing and analysis. In addition, stakeholder consultations highlighted the need to translate these findings into practice through the implementation of farm-level and site-specific pilot adaptation actions. Developing, implementing and monitoring such pilot adaptation actions will be essential for validating adaptation measures, supporting evidence-based decision-making and strengthening the long-term climate resilience of the dairy sector.

Regular monitoring is recommended for indicators such as milk yield, fertility, the Temperature-Humidity Index (THI), water use, feed prices, forage crop yields, energy consumption for fans and cooling, disease incidence, mycotoxin testing, and disaster-damage records. Compiling these data through cooperation among the relevant public institutions, CBAA and other stakeholders at district level will support annual updates of risk trends, facilitate monitoring of CRM objectives and contribute to more targeted support programmes.

4 Project Evaluation

4.1 Usability of the results

The Phase 3 outputs provide practical and evidence-based guidance to strengthen resilience against climate risks in Aydin's dairy sector from technical, implementation and governance perspectives. Building on the Phase 2 climate risk assessment, Phase 3 translated the results into practical guidance for decision-makers and dairy farmers through stakeholder engagement, adaptation planning and dissemination activities. The project developed an integrated climate risk assessment by combining regional climate projections, farm-level observations, stakeholder consultations and sector-specific risk analyses, generating new knowledge on climate risks affecting the regional dairy sector. The study identifies priority investment areas for dairy farmers, planning, support and coordination needs for public institutions, and the role of the Cattle Breeders' Association of Aydin (CBAA) in training, data collection and dairy farmer guidance. The report can therefore inform both short-term farm-level adaptation actions and medium- to long-term regional policy decisions, climate adaptation planning, and future investment decisions.
The most important contribution of the results is that climate risks are defined not as abstract climate hazards, but through indicators directly connected to dairy farmers' decision-making, such as milk yield, fertility, feed costs, water use, energy consumption, feed security and farm infrastructure. This approach makes the findings more understandable and actionable for local stakeholders, enabling them to prioritize adaptation measures and make evidence-based management decisions. In addition, the district-level climate risk maps and spatial analyses produced by the project can support future updates of sectoral support programmes, local climate adaptation strategies and municipal spatial planning processes by identifying priority areas requiring targeted adaptation measures and investments.

4.2 Lessons learned

A key lesson from the Phase 3 implementation is that climate risk management cannot be reduced to individual technical investments. Mechanical ventilation or misting can provide a short-term response to heatwaves, for example, but their adoption remains limited if energy costs, water scarcity and access to finance for small farms are not considered. Similarly, modern irrigation and drought-resilient forage crops depend not only on farmers' preferences, but also on water allocation, agricultural support, purchase guarantees and technical advisory capacity.

Another important lesson was the value of combining technical analyses with continuous stakeholder engagement. Conducting technical field visits and discussions with leading dairy farmers representing small, medium and large-scale farms made it possible to assess climate risks, adaptation priorities and implementation barriers according to different production scales. This approach enabled a more comprehensive understanding of the different challenges faced by farms of varying sizes and provided a stronger basis for developing practical adaptation measures and policy recommendations. One of the main challenges encountered during Phase 3 was the time required to collect and harmonise data from different institutions and to coordinate multiple

stakeholders. Although these processes required additional communication and coordination, they also highlighted the importance of strengthening institutional collaboration for future climate risk assessments.

Stakeholder engagement was instrumental in validating risks and identifying feasible adaptation measures. The stakeholder workshop held on 24 December 2025 brought together dairy farmers, public institutions, academia and private-sector representatives, allowing model outputs to be validated against local experience regarding heat stress, drought and flooding. Stakeholders highlighted the importance of increasing financial support for adaptation investments, strengthening institutional cooperation, expanding farmer training and implementing practical pilot adaptation projects at farm level.

An additional lesson learned was that raising awareness is not a one-time activity. Repeatedly presenting project findings to public institutions and dairy farmers throughout the project significantly increased awareness, encouraged ownership of the results and strengthened stakeholder commitment to climate adaptation. The experience also showed that larger stakeholder meetings should be complemented by more frequent meetings with smaller discussion groups to facilitate more detailed exchanges, improve stakeholder participation and generate more targeted feedback.

Available project resources, including time, staff and budget, were managed efficiently through careful planning and coordination of project activities. The timing of stakeholder workshops, technical field visits and dissemination events was planned according to the availability of the invited institutions and dairy farmers, ensuring effective use of both time and financial resources while maximizing participation. The selection of participants and preparation processes ensured balanced representation of relevant institutions and dairy farms of different sizes. Throughout the project, every effort was made to reach the largest possible number of stakeholders and dairy farmers within the available resources. Project outcomes were communicated through stakeholder workshops, technical field visits, practical guidance documents prepared for dairy farmers and public institutions, scientific dissemination activities, and the CLIMAAX project deliverables. The main findings were presented at the CliResDairy Final Conference held on 6 May 2026, and a second scientific contribution entitled "From Climate Projections to Farm-Level Risk: A Multi-Hazard Assessment for Dairy Farming in Aydin, Türkiye" was accepted for presentation at the EMS Annual Meeting 2026. In addition, a scientific journal article based on the project results is currently under preparation. Furthermore, training agricultural advisors and promoting peer learning among dairy farmers will support the continued dissemination of project results beyond the project lifetime, contributing to the efficient and sustainable use of project outcomes.

Finally, one of the most important lessons learned is that the most critical phase begins after the project is completed. The long-term value and impact of the Climate Risk Assessment will depend on the continued dissemination of its findings, their integration into future projects, policies and institutional planning processes, and the development of practical pilot adaptation projects demonstrating how the proposed measures can be implemented at farm level. These follow-up activities will help maintain stakeholder engagement, strengthen institutional capacity, improve public awareness, support evidence-based investment decisions, and encourage the wider adoption of climate adaptation practices across the regional dairy sector.

5 Conclusions Phase 3

Main conclusions and challenges

Phase 3 successfully translated the Phase 2 Climate Risk Assessment into an actionable and monitorable climate risk management (CRM) framework for Aydin's dairy sector. It addressed the combined effects of heatwaves, agricultural drought, extreme precipitation and river flooding on animal health and welfare, milk yield and fertility, feed and water security, farm infrastructure, energy demand, milk quality and production continuity. The main conclusion is that these risks cannot be managed through isolated farm investments alone: effective CRM requires farm-level measures to be combined with value-chain planning, basin-scale water management, spatial and disaster-risk planning, accessible finance, dairy farmer guidance and sustained coordination among public institutions, dairy farmer organizations, academia and the private sector.

Key findings

The assessment confirms that heat stress is becoming a chronic rather than occasional threat. Under RCP8.5, annual milk-yield losses may exceed approximately 250 litres per animal in Didim District, reach 180–220 litres in Söke and Kuşadası Districts, and range from 150–200 litres in several central districts. Projected Non-Return Rate losses approach or exceed 3.5–4% in coastal and central hotspots, while annual economic losses associated with intensive dairy production and heat exposure may reach EUR 400,000–500,000 in Çine and Efeler Districts. Agricultural drought is expected to reduce yields of key forage crops by approximately 42–52% in the most affected districts, increasing feed-price and water-security pressures. Flooding remains more episodic but can generate severe local damage; around 15% of farms may face losses of EUR 10,000–50,000 under the assessed future scenario. Existing resilience was consequently assessed as medium-low for heatwaves, low-medium for drought and river flooding, and medium for extreme precipitation and flash flooding.

Priority CRM response

Phase 3 studies identified high-priority measures that directly respond to findings mentioned above. For heatwave, mechanical ventilation, misting, shaded areas and tree planting, automated milking and monitoring systems, and longer-term genetic selection could be the solutions to achieve resilience. For agricultural drought, priorities include efficient irrigation, drought-resilient forage crops and solar PV for irrigation and farm energy, subject to safeguards against increased groundwater abstraction. For extreme precipitation and flooding, the framework prioritizes drainage and flood-protection infrastructure and, where unavoidable, relocation from high-risk areas. These measures were linked to responsible actors, timeframes, co-benefits and adaptation limits, as well as to indicators covering milk yield, fertility, THI, cooling-system uptake, water and energy use, forage costs, animal health, feed safety and disaster damage.

Implementation findings

CBAA is positioned as the principal intermediary for dairy farmers outreach, training, district-level data collection and monitoring. Provincial and district authorities, DSİ and irrigation unions, AFAD and municipalities, universities, veterinary services and financial institutions have complementary roles. TARSIM can support risk transfer and post-event liquidity, while ARDSI/IPARD III grants, concessional credit and cooperative investment models can accelerate cooling, irrigation,

renewable-energy, animal-welfare and flood-resilience investments. The stakeholder process confirmed that technical feasibility alone is insufficient: affordability, co-financing, water allocation, extension services, reliable early warning and usable local data determine whether measures can be adopted, especially by small and medium-sized dairy farms.

The implementation process also demonstrated the importance of continued stakeholder engagement and knowledge dissemination. Scientific dissemination through the CliResDairy Final Conference, the acceptance of a second scientific contribution for the EMS Annual Meeting 2026, and the preparation of a scientific journal article have strengthened the visibility of the project and supported the transfer of knowledge to both scientific and stakeholder communities.

Challenges not fully addressed and remaining priorities

Phase 3 established the strategic framework but did not eliminate key implementation gaps. Limited investment capacity and co-financing remain major barriers for the small and medium-sized farms. Long-term district data and continuous inter-institutional coordination need to be improved. Insurance coverage may not capture prolonged heatwave-related production. Farm relocation against flood risk remains constrained by land availability, cost, permitting and livelihood disruption. The cost-effectiveness and performance of measures under farm-specific conditions still require pilots, follow-up monitoring and periodic review. Phase 3 therefore provides a robust basis for action, but its long-term value will depend on converting the proposed measures into funded programmes, demonstration projects, binding implementation responsibilities and an annually updated CRM monitoring system for the Aydin's dairy sector. Continued stakeholder engagement, dissemination of project results and the implementation of pilot adaptation projects will be essential to translate the proposed CRM framework into practice and ensure its long-term effectiveness for the dairy sector in Aydin.

6 Progress evaluation

6.1 Project outputs

A summary of the achieved milestones and performance indicators is presented in Table 6-1 and Table 6-2.

Table 6-1 Overview key performance indicators

Key performance indicators	*Progress*
Multi-risk climate assessment successfully conducted by the end of Phase 1.	**Achieved**
Local data integration completed to refine the multi risk climate assessment by Phase 2.	**Achieved**
Climate adaptation strategy developed and implemented by the end of Phase 3.	**Achieved**
Workshop; conducted for stakeholders, including lead farmers, policymakers, relevant agricultural organizations, sector stakeholders, and local government representatives, to increase climate risk awareness and participation.	**Achieved**
Policy Note; developed and shared with local governments to incorporate climate resilience into regional planning.	**Achieved**
Scientific Article; published based on project findings to contribute to academic research.	**Achieved**
Policy Brief; developed and shared with local governments to guide climate adaptation measures.	**Achieved**
Press Release; issued to increase public awareness and highlight project progress and results.	**Achieved**
Training Session; for agricultural consultants to enhance their capacity to support farmers in climate adaptation strategies.	**Achieved**
Stakeholder Congress; organized to disseminate the project results and foster collaboration among key participants.	**Achieved**

Table 6-2 Overview milestones

Milestones	*Progress*
M1: Completion of the multi-risk climate assessment by the end of Month 6.	**Achieved**
M2: Successful integration of local data into the climate assessment by the end of Month 16	**Achieved**
M3: Workshop for stakeholders (including lead farmers, policymakers, agricultural organizations) completed by Month 16.	**Achieved (24 December 2025)**
M4: Training session for agricultural consultants completed by Month 16.	**Achieved**
M5: Policy Note developed and shared with local governments by Month 16.	**Achieved (First Policy Note was published: 09 January 2026; continued)**
M6: CLIMAAX workshop in Barcelona attended in June 2025	**Achieved**
M7: Climate adaptation strategy developed and implemented by Month 22.	**Achieved**
M8: Scientific article based on project findings submitted for publication by Month 21.	***Achieved (First article was published: 8-10 October 2025)*** *At the Symposium on GeoSpatial Technologies: Visions and Horizons, held from 8–10 October 2025 at Çanakkale Onsekiz Mart University, the Cattle Breeders' Association of Aydin presented the first results of the Climate Resilience Enhancement in Dairy Farming (CliResDairy) project.* *Title: Climate Hazard Assessment for Dairy Farming in Aydin, Türkiye: Preliminary Results from the CliResDairy Project* ***Status updated (Second conference paper was accepted: EMS Annual Meeting 2026*** *The project results were accepted for presentation at the EMS (European Meteorological Society) Annual Meeting 2026. (6-11 September,2026) The accepted contribution, EMS2026-419, entitled "From Climate Projections to Farm-Level Risk: A Multi-Hazard Assessment for Dairy Farming in Aydin, Türkiye," presents the integrated climate risk assessment developed under the CliResDairy project, linking regional climate projections with farm-level multi-hazard risk analysis for the dairy sector.*
M9: Stakeholder Congress conducted by Month 21, bringing together 100 participants to discuss project results and foster collaboration.	**Achieved**
M10: CLIMAAX workshop in Brussels attended in Dec 2026 to present final project results to policy and decision-makers.	**Ongoing**

7 Supporting documentation

The additional documents (communication outputs) and datasets have been uploaded to the Zenodo platform. The content of the files is as follows:

- Main Report (PDF)
- All deliverables and outputs have been uploaded to the Zenodo platform during Phase 2; no new figures have been generated for the Phase 3 period. Therefore, no additional uploads were made to Zenodo for this period.
- Communication Outputs (Press release, media) (Uploaded to Zenodo)

8 References

ARDSI – Agriculture and Rural Development Support Institution: IPARD III Programme, Ninth Call for Applications—Measure M1, https://www.tkdk.gov.tr/Haber/9th-call-for-applications-under-the-ipard-iii-programme-is-announced-12895?lang=en, 2026a.

ARDSI – Agriculture and Rural Development Support Institution: IPARD III Programme, Application Call Guideline—Investments in Physical Assets of Agricultural Holdings (M1), https://www.tkdk.gov.tr/Content/File/BasvuruFiles/BasvuruPaketiHazirlamaDokumanlari/BasvuruCagriRehberi/IPARDIII/11.0/103.pdf, 2026b.

ARDSI – Agriculture and Rural Development Support Institution: Strategic Plan 2024–2028, https://tkdk.gov.tr/Content/File/Stratejik%20Plan%202024-2028.pdf, 2024.

Armstrong, D. V.: Heat Stress Interaction with Shade and Cooling, Journal of Dairy Science, 77(7), 2044–2050, https://doi.org/10.3168/jds.S0022-0302(94)77149-6, 1994.

Aydin Metropolitan Municipality: Actions Assigned under the Aydin Provincial Disaster Risk Reduction Plan, https://aydin.bel.tr/Content/files/duyurular/Aydin-Buyuksehir%20Belediyesi-IRAP-2021.pdf, 2021.

Cartwright, S. L., Schmied, J., Karrow, N., and Mallard, B. A.: Impact of Heat Stress on Dairy Cattle and Selection Strategies for Thermotolerance: A Review, Frontiers in Veterinary Science, 10, 1198697, https://doi.org/10.3389/fvets.2023.1198697, 2023.

EC – European Commission: Forging a climate-resilient Europe – The new EU Strategy on Adaptation to Climate Change. European Commission, COM (2021) 82 final.

EC – European Commission: Common Agricultural Policy at a Glance, https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en, 2022.

Fournel, S., Ouellet, V., and Charbonneau, É.: Practices for Alleviating Heat Stress of Dairy Cows in Humid Continental Climates: A Literature Review, Animals, 7(5), 37, https://doi.org/10.3390/ani7050037, 2017.

Hartung, H., and Pluschke, L.: The Benefits and Risks of Solar-Powered Irrigation: A Global Overview, Food and Agriculture Organization of the United Nations (FAO), Rome, https://openknowledge.fao.org/handle/20.500.14283/i9047en, 2018.

Indu, I., Mehta, B. K., Shashikumara, P., Gupta, G., Dikshit, N., Chand, S., Yadav, P. K., Ahmed, S., and Singhal, R. K.: Forage Crops: A Repository of Functional Trait Diversity for Current and Future Climate Adaptation, Crop and Pasture Science, 74(11), 961–984, https://doi.org/10.1071/CP22200, 2023.

IPCC: Climate Change 2022: Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, https://doi.org/10.1017/9781009325844, 2022.

Ji, B., Banhazi, T., Ghahramani, A., Bowtell, L., Wang, C., and Li, B.: Modelling of Heat Stress in a Robotic Dairy Farm. Part 3: Rumination and Milking Performance, Biosystems Engineering, 199, 58–72, https://doi.org/10.1016/j.biosystemseng.2020.02.006, 2020.

MoAF. (2024): Ministry of Agriculture and Forestry 2024–2028 Strategic Plan. Ministry of Agriculture and Forestry of the Republic of Türkiye.

MoAF. (2026a): Agricultural Production Planning. Ministry of Agriculture and Forestry of the Republic of Türkiye.

MoAF-GDWM. (2019): Büyük Menderes Basin Flood Management Plan. Ministry of Agriculture and Forestry of the Republic of Türkiye, General Directorate of Water Management.

MoAF-GDWM. (2023): Büyük Menderes Basin Drought Management Plan. Ministry of Agriculture and Forestry of the Republic of Türkiye, General Directorate of Water Management.

MoAF: Republic of Türkiye Ministry of Agriculture and Forestry: Strategic Plan 2024–2028, https://www.tarimorman.gov.tr/SGB/Belgeler/stratejikplan.pdf, 2024.

MoAF: Republic of Türkiye Ministry of Agriculture and Forestry: TARSIM Products and Risks to Be Covered in 2026, https://www.tarimorman.gov.tr/Haber/6912/Tarsim-Tarafindan-2026da-Teminat-Altina-Alinacak-Urun-Ve-Riskler-Belirlendi, 2025.

MoAF – Republic of Türkiye Ministry of Agriculture and Forestry: National Water Plan 2026–2035, https://www.tarimorman.gov.tr/SYGM/Belgeler/Ulusal%20Su%20Plan%C4%B1%20%20Resmi%20Gazete/Ulusal%20Su%20Plan%C4%B1%20%282026-2035%29.pdf, 2026.

MoAF-GDWM – Ministry of Agriculture and Forestry, General Directorate of Water Management: Büyük Menderes Basin Drought Management Plan, 2019.

MoAF-GDWM – Ministry of Agriculture and Forestry, General Directorate of Water Management: Büyük Menderes Basin Flood Management Plan, 2023.

MoEUCC. (2024): Climate Change Adaptation Strategy and Action Plan 2024–2030. Ministry of Environment, Urbanisation and Climate Change of the Republic of Türkiye, Directorate of Climate Change.

MoEUCC – Republic of Türkiye Ministry of Environment, Urbanisation and Climate Change: Aydin–Mugla–Denizli Planning Region 1:100,000 Environmental Plan—Planning Provisions, https://webdosya.csb.gov.tr/db/mpgm/icerikler/planhukumleri-20221221142222.pdf, 2022.

Perry, C., Steduto, P., and Karajeh, F.: Does Improved Irrigation Technology Save Water? A Review of the Evidence, Food and Agriculture Organization of the United Nations (FAO), Cairo, https://doi.org/10.13140/RG.2.2.35540.81280, 2017.

TARSIM: Agricultural Insurance Pool: Cattle Life Insurance, https://www.tarsim.gov.tr/subPage/buyukbas-hayvan-hayat-sigortasi, 2026a.

TARSIM: Agricultural Insurance Pool: State-Supported Cattle Life Insurance—General Conditions 2026, https://www.tarsim.gov.tr/staticweb/krm-web/mevzuatlar/genel-sartlar/2026/buyukbas-genel-sartlar.pdf, 2026b.

TARSIM: Agricultural Insurance Pool: State-Supported Cattle Life Insurance—Tariff and Instructions 2026, https://www.tarsim.gov.tr/staticweb/krm-web/mevzuatlar/tarife-ve-talimatlar/2026/buyukbas-tarife-ve-talimatlar.pdf, 2026c.

World Bank: A Catalogue of Nature-Based Solutions for Urban Resilience, World Bank, Washington, DC, https://openknowledge.worldbank.org/handle/10986/36507, 2021.

WOAH: Terrestrial Animal Health Code, Chapter 7.11: Animal Welfare and Dairy Cattle Production Systems, World Organisation for Animal Health, Paris, https://www.woah.org/fileadmin/Home/eng/Health_standards/tahc/2024/en_chapitre_aw_dairy_cattle.htm, 2024.