Hybrid AI-Assisted Smart Greenhouse

A digital Decision-Support System for Climate-Smart Agriculture in Palestine

Proposal for D4D Fund 2023 -2026

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Erik Van Mele

OXFAM België | Belgique

Summary of the proposal

Goal: **Optimize water usage**, **improve crop resilience** and **reduce production costs** for smallholders in Palestine by **designing and testing** (= *phases to be funded*) a digital, **AI-supported climate management system** for **greenhouse farming**, integrating **IoT-based real-time monitoring**, **predictive analytics** and **recommended interventions**.

Budget: €18.750 - **Duration: 18 months**

Tayasir – Tubas – Northern West Bank

Linked to 'Improved benefits for and power of small-scale producers (focus on women & youth) in fresh vegetables value chain in Palestine' (22-26 DGD-co-funded progr. Res 2)

Local partner: Agricultural Development Association – PARC

(previously: **Palestinian Agricultural Relief Committee**)

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Relevance in the context

- Climate change ➡ irregular weather patterns
- Plants in greenhouses suffer drought and/or heat
- Timely & adequate irrigation or ventilation = challenge
- Human intervention often too late
  - ➔Diseases, heat stress
  - ➔flowering & pollination are late
- Traditional energy sources scarce & costly

➡ Lower yields, limited access to food and/or less income

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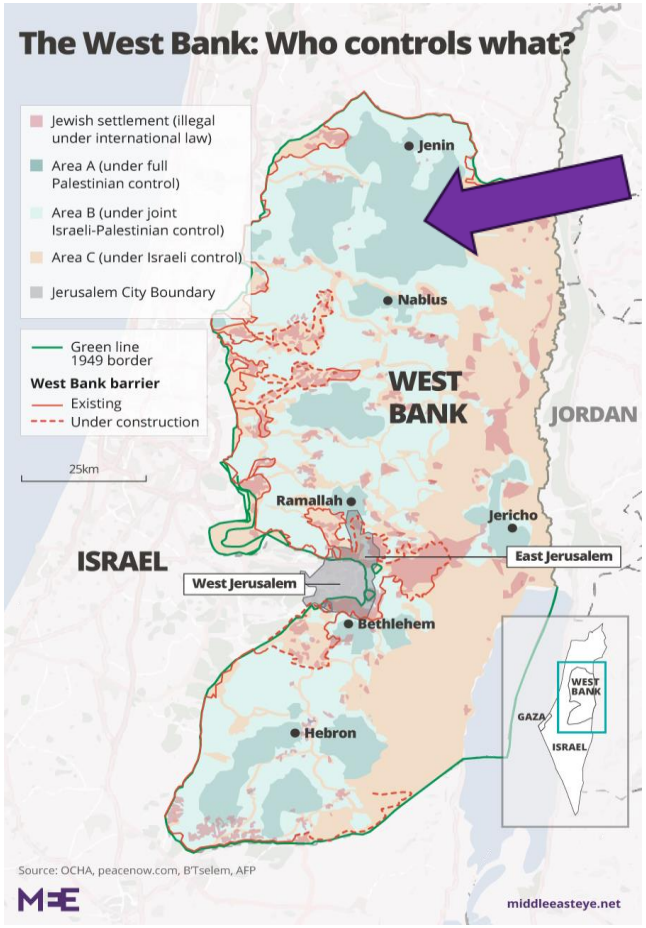
The People We Work With

- **<u>Who?</u> Three young male, educated smallholder farmers (pilot phase) Model to be presented to wider group of farmers + Exchange visits foreseen**

- **<u>Where?</u> Tayasir village, 8 – 9.000 m² (= Area A: under full Palestinian control)**

- **<u>How long?</u> 18 months of deploying, testing and learning**



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Feasibility of proposed solution

- **Existing technologies provide only partial solutions**:
  - Smart irrigation systems: often expensive
  - Climate monitoring Platforms: focus on large-scale operations
  - Humidity & temp. sensors: do not take into account real-time data from multiple sources

  ➔**Lack of integrated platforms**: irrigation, climate control, pest management, resource optimization

  ➔Existing tools **do not address specific socio-econ. challenges**
- This project offers **key advantages** compared to existing tools:
  - Affordable, easy to use for and adaptable to Palestinian farmers
  - Integrated real-time monit. & manag. of greenhouse conditions
  - Effective and efficient, leveraging locally available solutions
  - Optimization of fertilizer and pesticides use, lowering costs
  - **Adressess root causes** of water waste, heat stress and fungal diseases

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Contribution to achieve the goal (1)

1. Smart Irrigation System (AI-Based Water Optimization)

- **IoT soil moisture & salinity sensors** collect real-time data
- Data transmitted to **central AI-powered decision engine**
- **AI analyses trends** and **predicts optimal irrigation schedules** triggering the **computerized precision irrigation system**
- **Farmers receive alerts** (mobile dashboard & SMS) if adjustments are needed

<u>Expected effects</u>:

- 30-40% reduction in water use (precision irrigation)

- Improved soil health & crop resilience

- Reduced dependency on human guesswork for irrigation

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Contribution to achieve the goal (2)

2. Automated Climate Control System (Smart Ventilation & Humidity Regulation)

- **Humidity & temperature sensors** monitor real-time climate conditions
- **AI detects patterns** of **fungal risk** or **heat stress** and automatically **activates ventilation fans & air vents**
- **Farmers receive alerts** on mobile devices and can judge if manual intervention is required

<u>Expected effects</u>:

- Reduced plant diseases by lowering excess humidity

- Increased yields by improved flowering and pollination

- Lower pesticide use, reducing environmental impact, costs and time spent

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Contribution to achieve the goal (3)

3. Solar-Powered Smart Greenhouse (Sust. Energy Integration)

- Entire **AI-driven system (sensors, irrigation and ventilation controls)** will run on **solar power with battery storage**, ensuring uninterrupted operations
- **Energy consumption data** will be tracked and visualized for **sustainability analysis**

<u>Expected effects</u>:

- **Cost savings on electricity**
- **Scalable and eco-friendly** model for expansion to remote farming areas

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Sustainability, Values & Principles

- D4D-project as part of 22-26 program dynamics and entire OBE-cooperation with partners in Palestine
- Contribution to solidarity movement with Palestinian population through OBE-engagement & messaging
- Centrality of rights & dignity of Palestinian population
- A grassroots initiative from social basis of PARC
- Showcasing the importance of partnership
    - Contributing to justice in sustainable food systems: ownership of data with farmers/PARC
    - Underlining importance of techn. quality and professionalism in 21st century cooperation

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Coherence with digit. dev. principles

- The evolving West Bank ecosystem is known and monitored by PARC & Oxfam
- Share, reuse and improve: A learning experience with and a demonstration site for farmers
- Inclusive: Pilot lead by PARC, allowing improvement and sharing, Design with farmers, Monitoring & feed-back loops
- Supports technical, organisational and ecological sustainability
- People-first data practices: Producer centred, open and transparant application: farmers are in control
  - Includes risk management regarding data access

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Data Protection

On the basis of existing legislation: eg. GDPR criteria on privacy

1. Lawfulness, fairness and transparency are assured in agreement with farmers
2. Purpose limitation: focus on technical data
3. Data minimization: very limited personal data
4. Accuracy: data checked by PARC and Oxfam DP Focal Point
5. Storage limitation: in line with usefulness for the objective
6. Integrity and confidentiality: following strictly the robust

OI-procedures:

- = Responsibility of 'Executing Affiliate' (in charge of all systems, facilitating operating in a country: ONL in the case of PAL)
- Data Protection Officer (ONL) and
  Data Protection Focal Point (PAL)

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Protection against Hacking/Misuse

- Data encryption & end-to-end encryption (AWS)
- Secure communication protocols (HTTPS)
- Strong authentication mechanisms (MFA, PKI)
- Automatic software updates & patching
- Firewall and network segmentation (VPN)
- Intrusion Detection System
- Data access control (RBAC, applying PoLP)
- Device security (TPM or HSM, Secure boot)
- Continuous Monitoring & Logging (SIEM)
- Backup and disaster recovery plan

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General risk Analysis & Mitigation

Identified risks	Mitigation measures
Limited ability among some farmers to interpret or use digital data effectively	Prioritize selection of educated farmers with basic digital literacy and capacity to read and interpret data. Ongoing training for effective use
Required material is not available in the market on the West Bank	The market has been studied, and the material is available
Difficulties to transport the equipment to the farmers in Tayasir	Monitor situation day by day (Oxfam security officer)
Theft of (part of) the equipment	Greenhouses nearby farmers houses Social control in the village
Geo-political risks: Demolition, eviction, land confiscation,...	Less likely in Area A. Far from cities & settlements. Pre-installation assessment
Inappropriate use of the equipment	Capacity building and accompaniment of the farmers

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Learning potential for the sector

- **Useful foreseen learnings:**
  - Theoretical understanding of and practical handling by farmers
  - AI-learning process: From ‘AI-supported decision-making’ towards ‘AI-decision making’
  - Permanent update of risk analysis and management
  - Comparison with traditional greenhouse farming
  - Calculation of saved costs, better yields versus investment
- **Sharing of the results:**
  - Report (EN) will be available and shared (JSF, OI,…)
  - Oxfam will integrate this project in info sessions on Palestine
    - Oxfam-staff available for bilateral or group exchanges in Palestine, Belgium and wider (as OI-initiative)

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Budget

Item	D4D fund (€)	OBE (€)
Consultancy:	**0**	**0**
Digital tools:		
- Solar energy system with battery storage (7)	**5.950**	
- IoT soil moisture, salinity & temp. sensors (2)	**1.900**	
- AI-powered irrigation system & control unit (1)	**7.000**	
- AI-controlled ventilation fans (2)	**150**	**1.350**
- Automatic opening air vents (2)		**400**
- AI-enabled fan control system (1)		**200**
- Weather station (1)		**400**
Other costs:		
Training and learning materials (5 farmer exchange visits to demonstration farms)		**1.400**
Totals	**15.000**	**3.750**

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THANK YOU!