

Field testing of an innovative solar powered milk cooling solution for the higher efficiency of the dairy subsector

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DEUTSCHE ZUSAMMENARBEIT

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Background

- The Tunisian Government supported a strategy for the development of the dairy sub sector, because of its strategic importance for agricultural productivity and food security.
 - Genetic improvement of livestock by importation of Holstein heifers
 - Support measures to extend forage production
 - Establishment of a national network of milk collection centers and dairy plants
 - Adoption of a policy for price support accompanied by a control on importation of milk and milk derivatives to strengthen the national milk industry.

The dairy sub sector performances

- High milk production
 - 1 billion liters approx.
 - 484,000 cows
 - 112,000 producers
 - contributing around 22% to annual production of livestock
- Average productivity is under 2200 l of milk per cow and per lactation
- Producers who owns 5 cows and less are the majority forming 82% of the sector
- Producers who owns 6-20 cows forms 11%
- Milk collection is a strategic milestone of the milk production
 - there are 235 active centers collecting 59% of the milk, 188 center have the sanitary accreditation

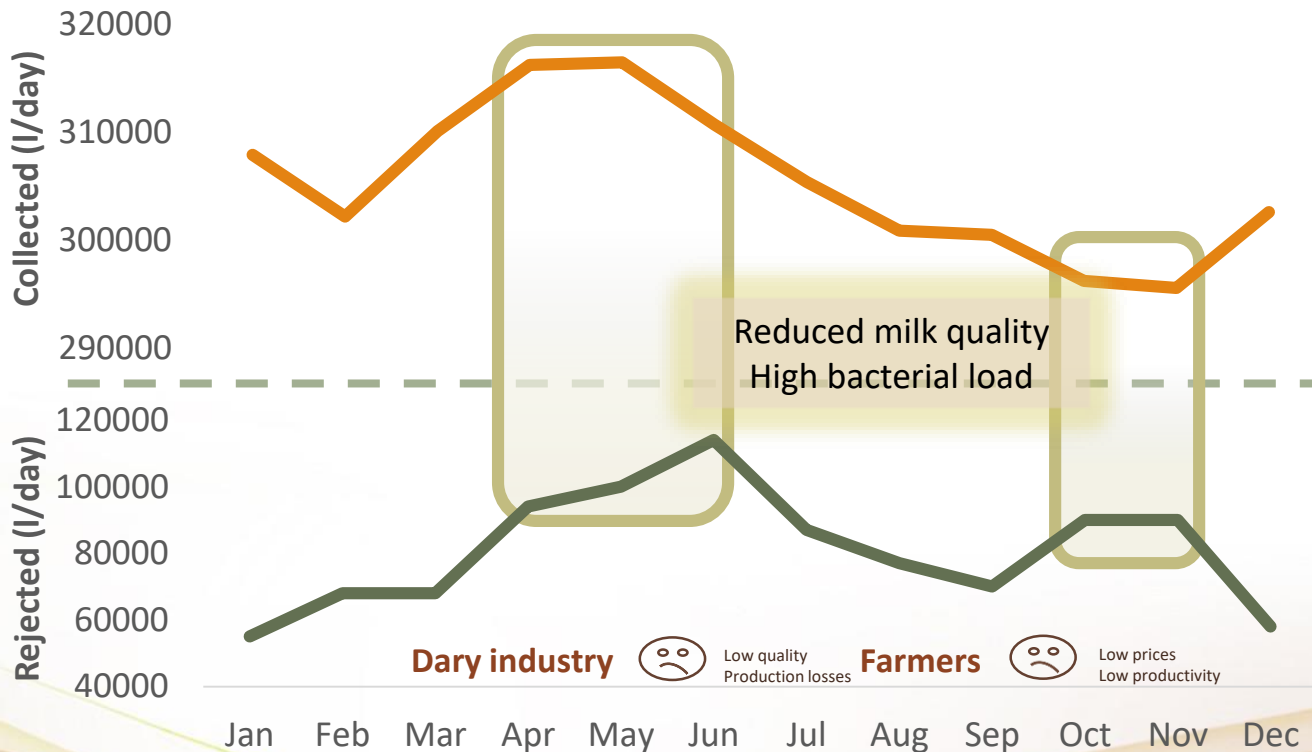
Project Area, Sidi Bouzid

- It is the number 1 governorate in terms of collected milk with a contribution of 11 to 15% to the national volume.
- Small-scale farms (less than 5-6 cows) are dominating
 - landless dairy cattle producers
- On-farm milk cooling doesn't exist
- Network of collecting centers and transporters



Collected milk and post harvest losses

15% of national production (lead by small farms with less than 10 Cows)

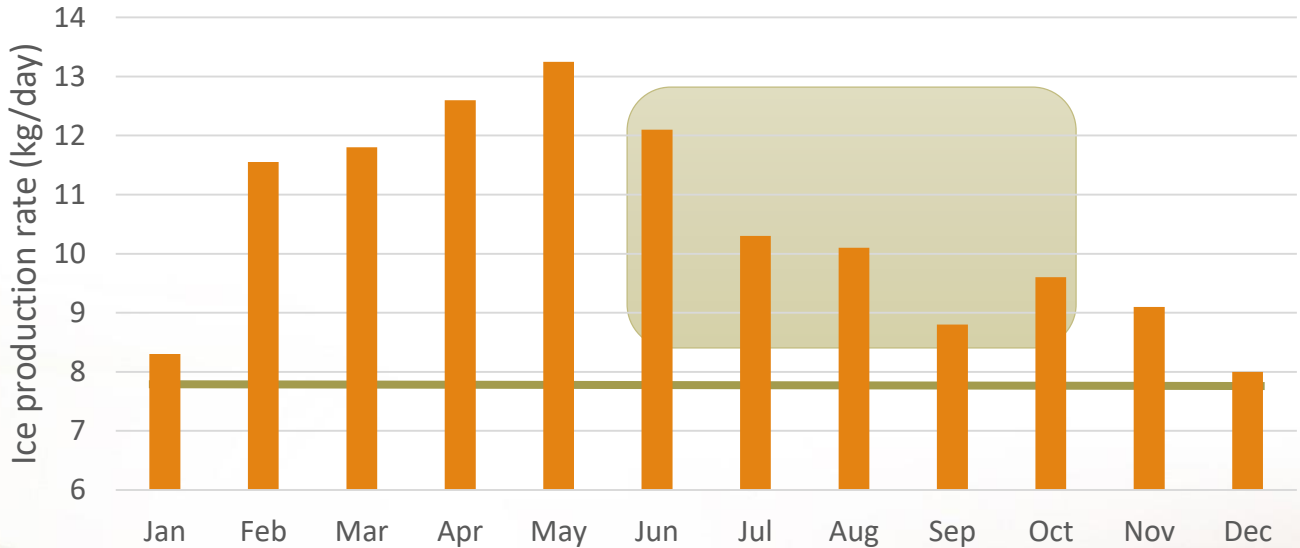


Solar milk cooling system

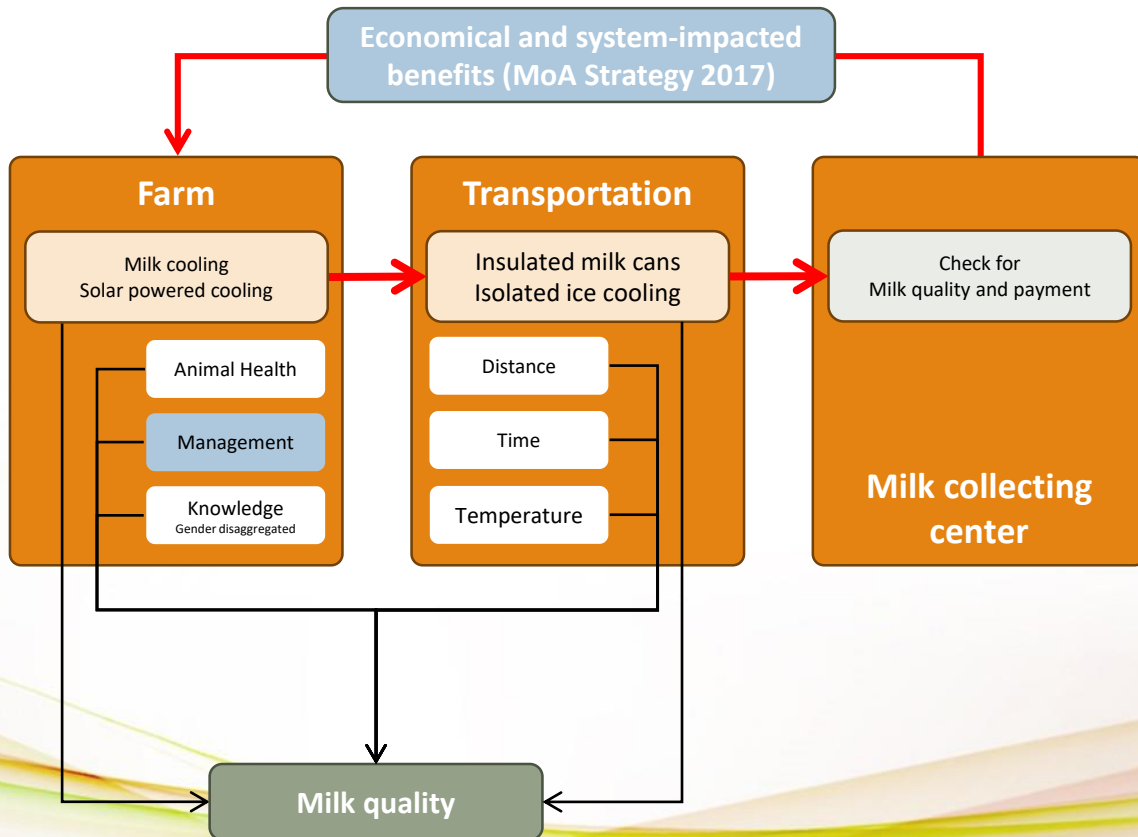


- 2 Milk cans for 60 L/day
- 1 DC-Refrigerator 166 L
- 1 Aluminum frame
- 4 PV Modules 600 Wp PV
- 2 Battery 120Ah
- 25 Ice containers

How SPMC works



The chain



Milestones

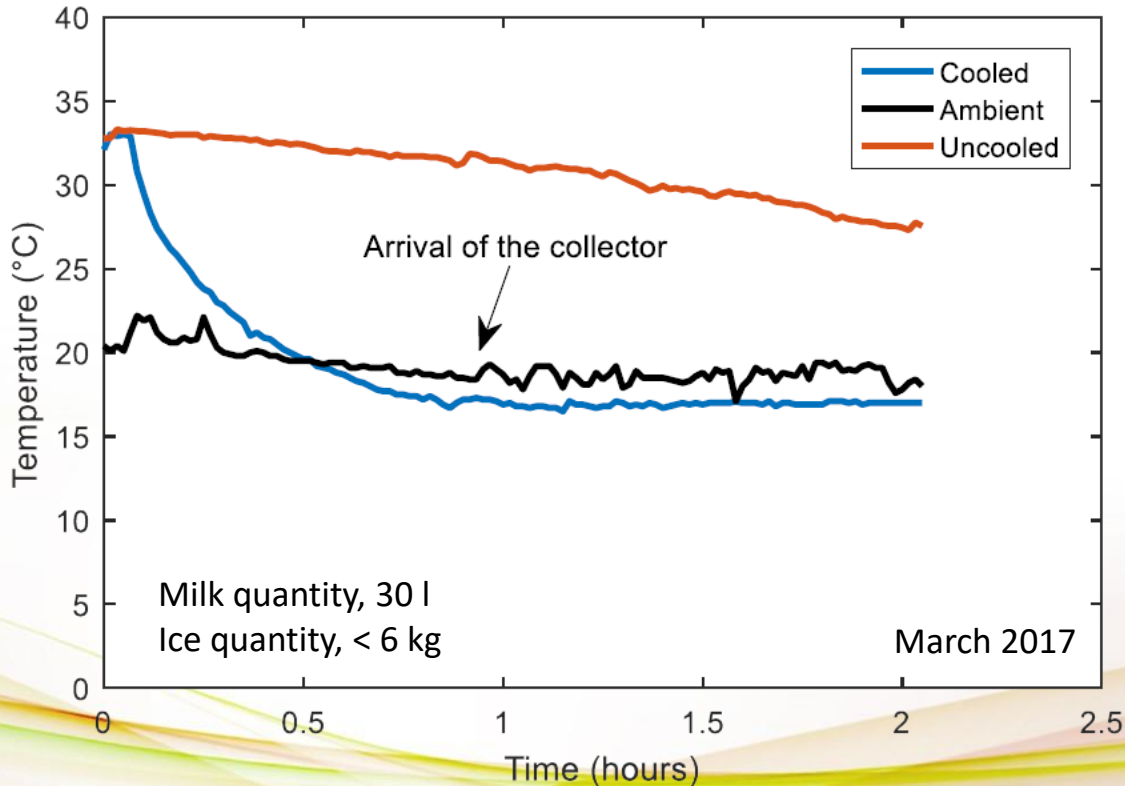
Main milestones are

- reduction of milk post-harvest losses,
- enhancement of farmers' productivity
- capturing the added-value of milk cooling technology.

On field measurements






Average of milk temperature and ambient temperature recorded



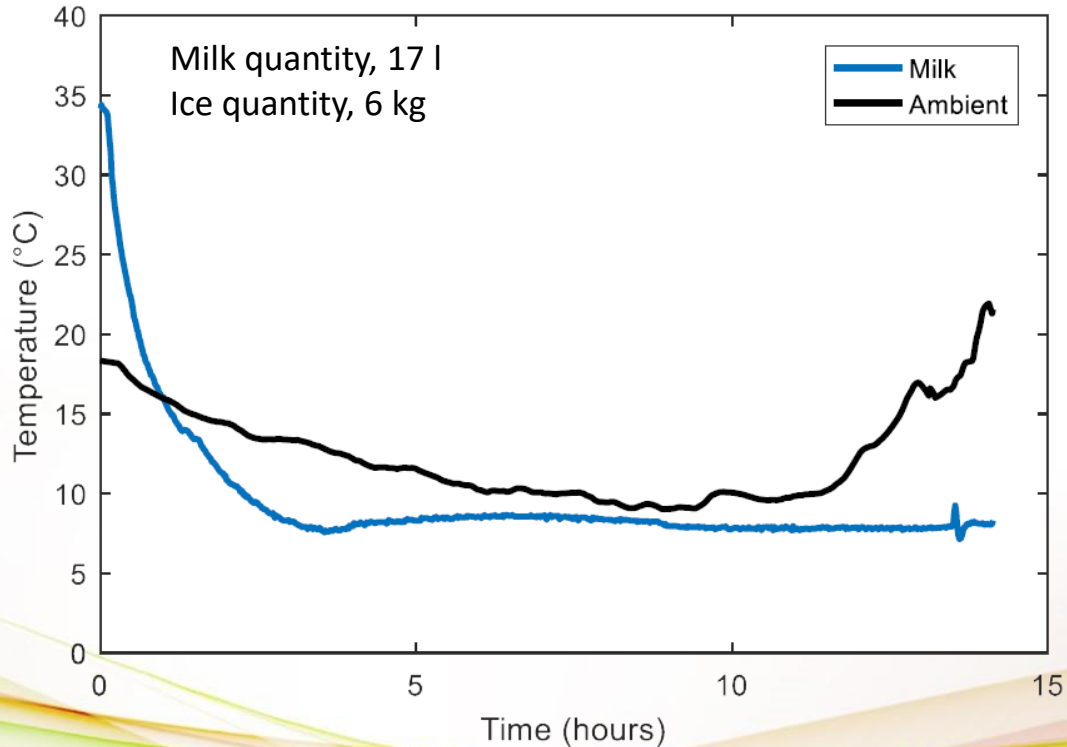
Milk quality at collecting center

Location	TRT	Temperature °C	Density	Acidity °D	Fat %	Protein %	Lactose %	Conductivity mS/cm
Hania	Control	20.33	1.0289	14.33	3.27	2.96	4.56	4.60
	SPMC	11.33	1.0291	14.11	3.34	2.99	4.59	4.59
Zeitouna	Control	22.34	1.0282	14.28	2.96	2.85	4.26	3.72
	SPMC	13.04	1.0290	14.06	3.07	2.92	4.42	6.96

Microbial load estimates at the collecting center

Description	EC	Alcohol Test	
First milk sample after 4 hours without cooling at ambient temperature	4.58	Positive	
Collector's tank (Ambient temperature)	4.49	Positive	
Milk mixture after two hours without cooling at ambient temperature	4.51	Tends to be Positive	
Milk mixture sample after milking	3.22	Negative	
Milk mixture after two hours with cooling	4.17	Negative	

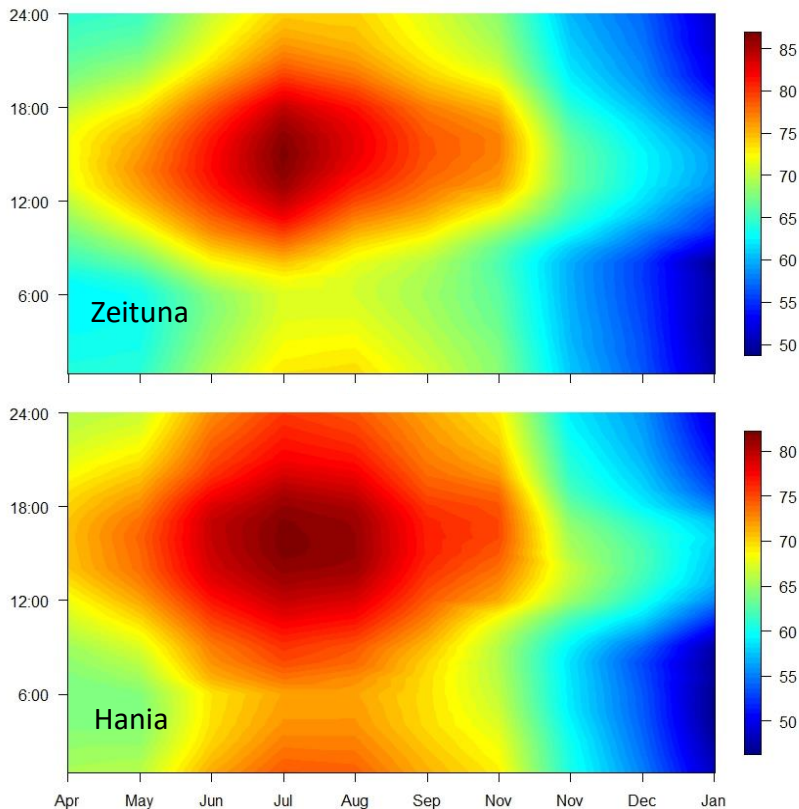
The potential of SPMC



Temperature Humidity Index

- THI > 72, begin of heat stress and calf rates will be affected.
- THI > 78, milk production is seriously affected.
- THI > 82, very significant losses in milk production due to severe stress

Temperature Humidity Index (THI)



Herd characteristics

Herd characteristics

- Cows with 4 years old are the dominant, followed by those of ages of 3 and 2 years, respectively.
- The average age at first calving is within the range 18 to 20 months
- Most cows in the herds are at their 3rd lactation followed by cows with 4 lactations

Major difficulties that impede

- Local degraded infrastructures, mainly rural
 - market access
 - feed supply
 - veterinary services
 - milk collection
- lack of professional organizations and associations
- Limited knowledge and technical skills of the farmers



Milk production and performance

Farm essential data

Herd data

Cow data

تقرير حول مراقبة إنتاجية الألبان

وزارة الفلاحة والموارد المائية والصيد
ديوان تربية الماشية و توفير المرعى
الإدارة الجهوية بسبدي بوزيد

ديوان تربية الماشية وتوفير المرعى بسبدي بوزيد		فريق المراقبة		تاريخ ومكان إصدار التقرير		التاريخ ومكان المراقبة السابقة		القطيع		الضعية	
				23-08-2016		22-07-2016		1		06025753	
				سيدى بوزيد		تاريخ المراقبة السابقة		اسم العربي: كمال بن ضو عمري		رقم العربي P 06025753	
عدد		عدد الأبقار		عدد		عدد		متوسط		متوسط	
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التاريخ	رقم	تاريخ الوضع	إنتاج الحليب		ملاحظات حول المراقبة بتاريخ		نتائج المراقبة بداية من تاريخ الوضع الأخير		توصيات عملية		التكاثر
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1	1	28-06-2016	21	21	2829	2.62	0	21	21	28-06-2016	TN4300097306
4	4	24-06-2016	22	22	735	3.78	4.3	22	22	24-06-2016	TN4300061385
2	2	05-06-2016	26	26	172	3.13	3.31	3	3	05-06-2016	TN4300062018
2	2	01-01-2016	20	20	1013	2.72	0	1-	1-	01-01-2016	TN4300096863
4	4	01-11-2015	1	20	3309	2.65	4.68	1	20	01-11-2015	TN4300021556
6	6	01-10-2015	7	16	562	2.8	4.83	7	16	01-10-2015	TN4300018684
3	3	01-09-2015	6	20	78	2.9	5.69	6	20	01-09-2015	TN4300075284
2	2	01-07-2015	0	6				0	6	01-07-2015	TN4300088563
1	1	07-08-15									

Gender Indicators

- Farm Level
 - Changing Gender Roles
 - Access to & Control over of Assets
 - Women Empowerment
- Collector's Level
 - Response of the youth and job opportunity
- Collection Centre Level
 - Stuffing

Business model

The project aims to motivate companies to disseminate the technology.

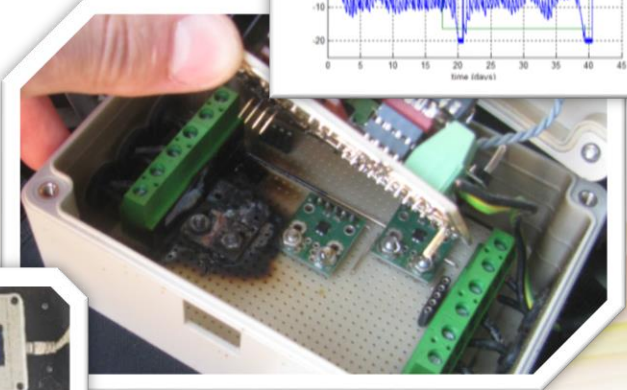
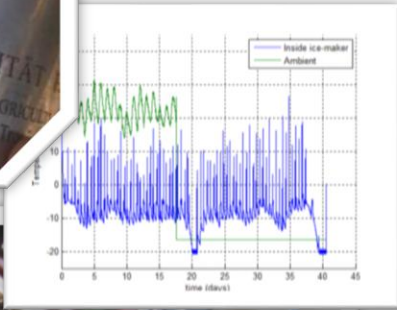
National Agency for Energy Conservation

- Solar energy provider companies
 - Shams Energy Access
 - Ater
 - Coala

Use of commercial components

- Local milk cans
 - Société de production Metallique de Sud
 - Ste tunisienne d'equipements laitiers

Technical issues faced



Students

- Farah Mrabet. Assessment of a Solar Powered Milk Cooling System under Field Conditions in Tunisia, MSc Thesis, December 2016. University of Hohenheim
- Safa Bel Hadj Abdallah, 2016. A contribution to the characterisation of the dairy sector in Sidi Bouzid. A Bachelor of Science (BS) in animal sciences, ESA Mateur, Tunisia (In French).

Publications

Field testing of an innovative solar powered milk cooling solution for the higher efficiency of the dairy subsector in Tunisia

Short communication:
New isolated milk can concept for solar milk cooling

July 25th 2016

University of Hammamet, Institute of Agriculture Engineering
Prof. Dr. Joachim Müller (joachim.mueller@giz.de)
Victor Torres Toledo (victor.torres@icarda.org) / victor.torres@univ-hammamet.tn

1. Acceptance of the handmade isolated milk cans.

After two months on field operation with the isolated milk cans prototypes produced by farmers and transporters indicated on the importance to having an acceptable products related to the weight of the cans and handling by milking.

A new concept of isolated milk cans has been developed based on a commercial available following guidelines has been presented:

- Weight reduction (around 3 kg less than the handmade milk cans)
- Reusable solution for higher handling on farm and off farm for better practice.
- Better access to the inside of the milk cans to improve and cleaning.
- Smooth inside surfaces in contact with milk.
- Based on a commercial materials milk cans.

10 models of the new isolated milk can will be shipped to Sidi Bouceidj by the end of September 2016

New concept for isolated milk-cans July 25th, 2016

Field testing of an innovative solar powered milk cooling solution for the higher efficiency of the dairy subsector in Tunisia*

Technical report 3/3
"Heat performance and transport evaluation"
December 30th 2016

* Regional Center for Agricultural Research of Sidi Bouceidj
* National Institute for Agricultural Research of Tunisia

Field testing of an innovative solar powered milk cooling solution for the higher efficiency of the dairy subsector in Tunisia

Victor Torres Toledo, Klaus Meisner, Ana Salvatierra Rojas, Joachim Müller
Institute of Agricultural Engineering, Tropical and Subtropical Group
University of Stuttgart, Stuttgart, Germany

Design and performance of a small-scale solar ice-maker based on a DC-freezer and an adaptive control unit

Victor Torres-Toledo¹*, Klaus Meisner², Philipp Tackner³, Selimouy McTourea-Balestin⁴, Joachim Müller¹

¹ Institute of Agricultural Engineering, Institute of Agricultural Engineering, University of Stuttgart, Stuttgart, Germany; ² GIZ, GIZ, Germany; ³ Institute of Agricultural Engineering, University of Stuttgart, Stuttgart, Germany; ⁴ National Institute for Agricultural Research of Sidi Bouceidj, Sidi Bouceidj, Tunisia

ABSTRACT

The production of milk in the form of a commercial product is possible only when the production of milk is done in a controlled environment. The production of milk in a controlled environment is possible only when the production of milk is done in a controlled environment. The production of milk in a controlled environment is possible only when the production of milk is done in a controlled environment.

1. Introduction

The effects of research institutions, government institutions and academia, the use of alternative energy sources and the use of alternative energy sources may be produced effectively but also a great deal of work is required to ensure that the system is effective. The operational aspects of local solar energy systems are often limited by the availability of solar energy. The operational aspects of local solar energy systems are often limited by the availability of solar energy.

2. Materials and Methods

The design and performance of a small-scale solar ice-maker based on a DC-freezer and an adaptive control unit was evaluated. The design and performance of a small-scale solar ice-maker based on a DC-freezer and an adaptive control unit was evaluated.

Project visibility

- Salon International de l'Investissement Agricole et de la Technologie (SIAT), Tunis, October 20-22
- International Green Week, Berlin, January 28-29



Field testing of an innovative solar powered milk cooling solution for the higher efficiency of the dairy subsector in Tunisia

Objective

Foster small-scale dairy producers in inland zone of Central Tunisia towards increased productivity, income, production and consumption of safer and more nutritious products by adopting a solar-powered, climate smart, off-grid solution for milk cooling in the district of Sidi Bouardj in Tunisia

The project area

This project is implemented in the region of Sidi Bouardj in the district of Sidi Bouardj in Tunisia

Solar milk cooling system

The solar milk cooling system consists of a solar panel array, a solar water pump, and a solar-powered milk cooling unit. The system is designed to be off-grid and climate-smart.

Milestones and impact

Capacity covered milk will be distributed to quality and higher storage life will result better milk quality for farmers and collection centers and will result in better milk quality for end users

- Production of milk cool boxes system for 1000 farmers
- Empowering the sustainability of milk cooling technology



Solution innovante pour le refroidissement du lait à la ferme par l'utilisation de l'énergie solaire

PROBLÉMATIQUE

La production de lait est une activité économique importante pour les agriculteurs tunisiens. Cependant, le manque de moyens adéquats pour le refroidissement du lait à la ferme entraîne des pertes importantes de lait et de revenus. L'objectif de ce projet est de développer une solution innovante pour le refroidissement du lait à la ferme en utilisant l'énergie solaire.

OBJECTIF GLOBAL

Appuyer les petits producteurs laitiers tunisiens à améliorer leur production et leur consommation de lait en adoptant une solution innovante pour le refroidissement du lait à la ferme en utilisant l'énergie solaire.

CADRE DU TRAVAIL ET LES PARTENAIRES CLÉS

Le projet est financé par le Gouvernement tunisien et le Gouvernement allemand. Les partenaires clés sont le Ministère de l'Agriculture, de la Pêche et de l'Élevage, l'ICARDA, et les associations de producteurs laitiers.

PRINCIPES ET COMPOSANTES DU SYSTÈME DE RECHERCHES

Le projet est basé sur les principes de la recherche participative et de l'innovation sociale. Les principales composantes du système de recherches sont :

- L'identification des besoins et des attentes des producteurs laitiers.
- Le développement de prototypes de solutions innovantes.
- L'évaluation des solutions innovantes en termes de faisabilité technique, économique et sociale.
- La mise en œuvre des solutions innovantes à l'échelle locale.

ACTIVITÉS

Le projet comprend les activités suivantes :

- Appui technique aux producteurs laitiers pour améliorer leur production.
- Développement de prototypes de solutions innovantes pour le refroidissement du lait à la ferme.
- Évaluation des solutions innovantes en termes de faisabilité technique, économique et sociale.
- Mise en œuvre des solutions innovantes à l'échelle locale.

ADDITIONAL DOCUMENT

Le document additionnel est disponible en français et en anglais sur le site internet du projet.

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The images illustrate the field testing of the solar-powered milk cooling solution. The top image shows the solar panel array and the milk cool boxes. The middle image shows a person using the solar-powered milk cooling unit. The bottom image shows a group of people, including farmers and project staff, standing in front of the solar panel array and milk cool boxes.

National policy for the dairy sector

The Ministry of Agriculture and the Office de l'Élevage et Pâturages organized a meeting on the November 23rd 2016 to plan the national strategy of the dairy sector.

All main players of the sector were invited

GIVRLait, the dairy industry and dairy association

Payment structure and modality (*media started to advertise in February*)

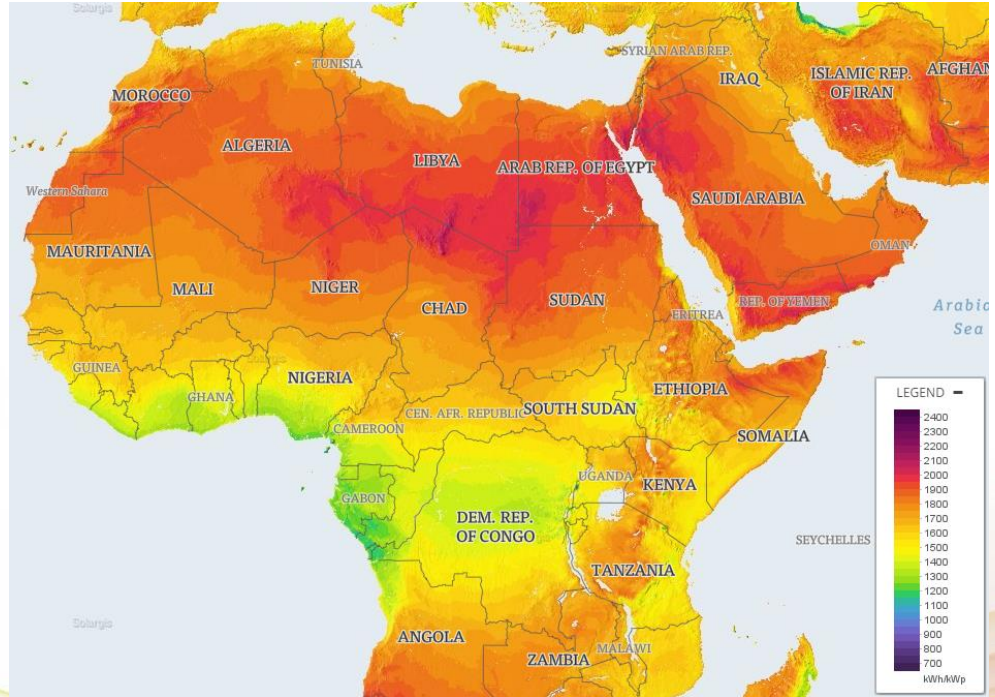
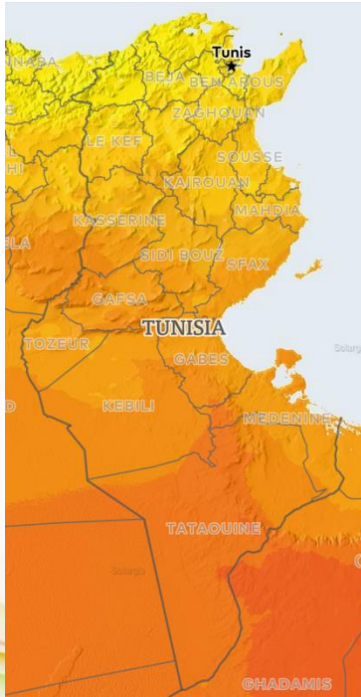
Levels	Response	Payment TN/l
Level 1	Minimum price	0.736
Level 2	Fat	± 0.003-0.004 per g/l
	protein	± 0.006-0.008 per g/l
	Freezing point (>-0.52)	-
	SCC (500,000)	±
	Microbial load	±
Level 3	Cooled milk	0.025-0.035

Future plans and ideas

- Fabrication of insulated tank for collective cooling
- Manufacturing the system locally

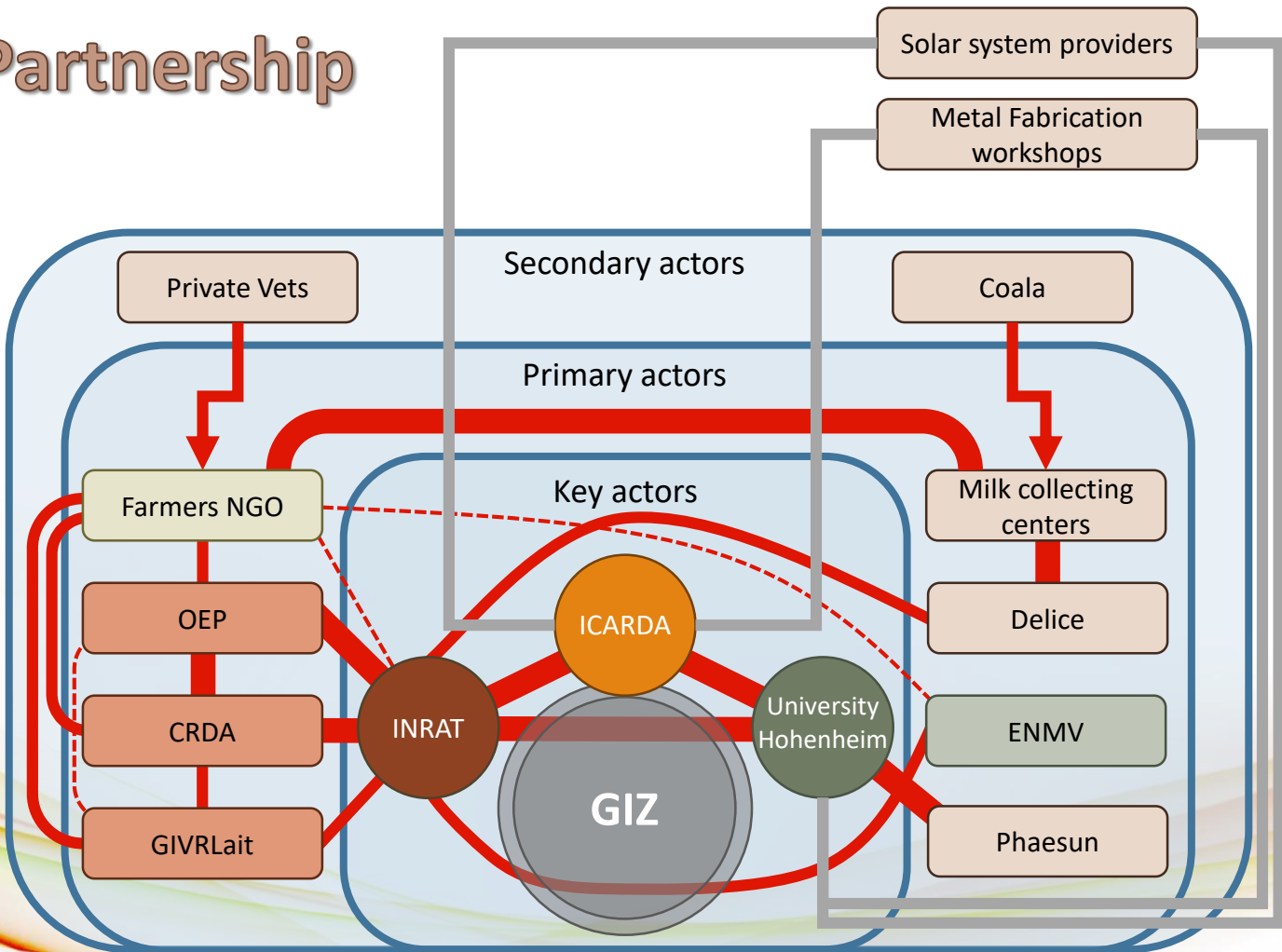


Out scaling



Source: <http://globalsolaratlas.info>

Partnership





Thank you



Financed by: Grants for Innovation Transfer into Agriculture –
Adaptation to Climate Change (ITAACC) in Africa

