

# Sweetness and Sunshine: Solar Drying of Tropical Fruits in Thailand



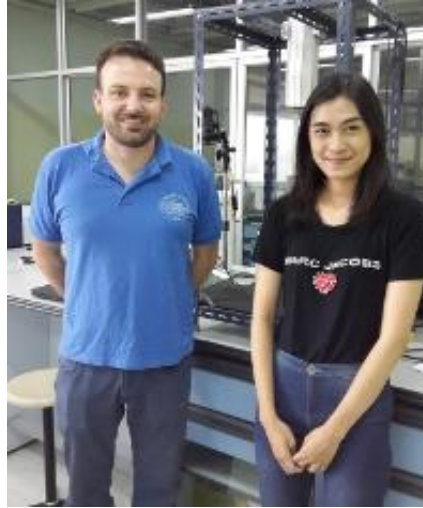
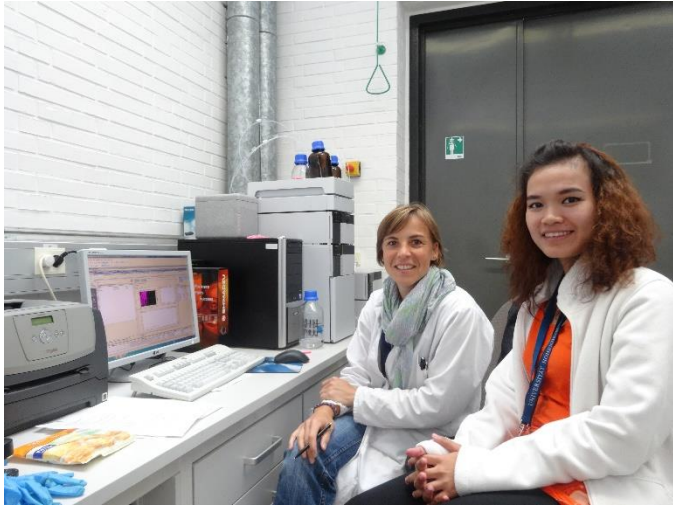
Asst.Prof.Dr. Busarakorn Mahayothee  
Department of Food Technology,  
Faculty of Engineering and Industrial Technology,  
Silpakorn University, Nakhon Pathom, Thailand

# Introduction of Food Technology Department, Silpakorn University, Thailand





# Cooperation between Hohenheim University & Silpakorn University






# Introduction of Food Technology, Silpakorn University, Thailand

www.foodtech.eng.su.ac.th

Department of Food Tech

www.foodtech.eng.su.ac.th/En/EnHome.aspx




Department of Food Technology

Faculty of Engineering and Industrial Technology | Silpakorn University

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Thai / English




**Exchange student at Kyoto University**  
Miss Khwanjai Klinchongkon, a Ph.D. student under supervision of Dr. Pramote Khuwijitjaru went to stay at Graduate School of Agriculture, Kyoto University, Japan as a Special Exchange Student. She will undertake part of her research in Japan from September 2016 to March, 2017.


รายละเอียด



**Short-stay program at Kagawa University**  
Miss Tamonwan Sotachai, undergraduate student was selected to join the International Exchange and Educational Program for Food Safety at Kagawa University, Japan for 1 month from August 19 to September 21, 2016.



**The Royal Golden Jubilee Ph.D. Programme: Scholarships for ASEAN students (RGJ –ASEAN) Year 2017**  
Opening for application: February 1 – March 31, 2017. See <http://rgj.trf.or.th>




**RGJ Ph.D.**  
โครงการปริญญาเอกกาญจนาภิเษก

**Welcome to Department of Food Technology**  
Department of Food Technology offers Undergraduate Program in Food Technology (B. Sc.) with two minor options, [Food Processing](#) and [Food Product Development](#).  
The academic year at Silpakorn University is divided into two terms. Since 2014, the first semester begins in the middle of August and ends in the middle of December. The second semester begins in the middle of January and ends in late May.  
We also look forward to welcoming staffs and students from abroad to our department. Please feel free to contact [our staffs](#) or send an email to [foodtech@su.ac.th](mailto:foodtech@su.ac.th) if you have any questions.




**Exchange student from Germany**  
Mr. Finn Petersen, a master degree student from University of Hohenheim, Germany stayed at the Department of Food Technology to conduct his research entitled Evaluation of solar drying technologies to optimize quality through upgraded processing of traditional medicinal plants in Thailand from June to August, 2016 under supervision of Dr. Busarakorn Mahayothee.



**Japan-Asia Youth Exchange Program in Science**  
Miss Nilobol Komonsing, a Ph.D. student received a grant from the Japan Science and Technology Agency (JST) under a program called "Japan-Asia Youth Exchange Program in Science" to visit Faculty of Agriculture, Kagawa University, Japan during July 10-20, 2016.

Visiting Associate Professor at

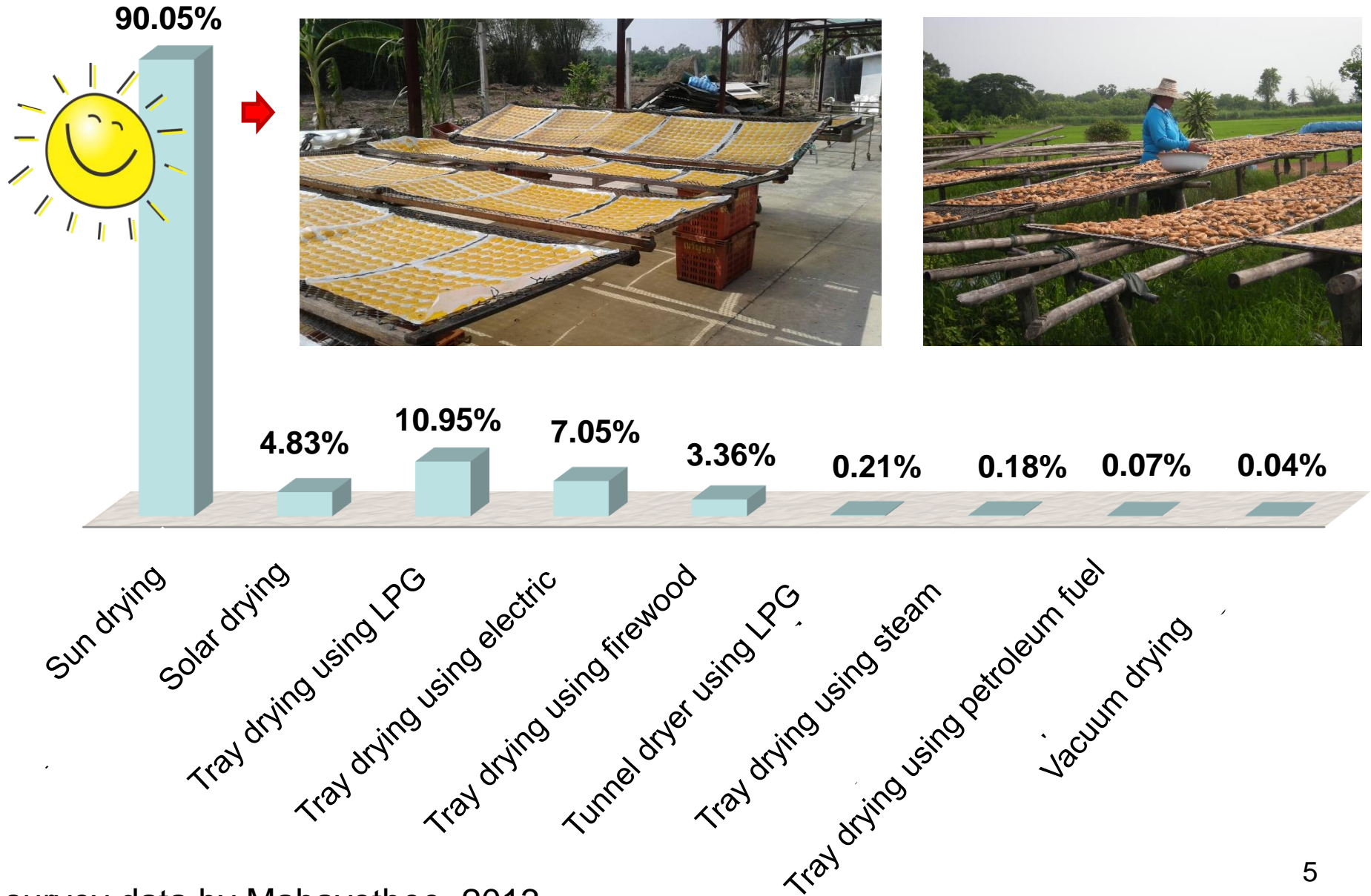
Leaders in Innovation Fellowships



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# Drying in Thailand

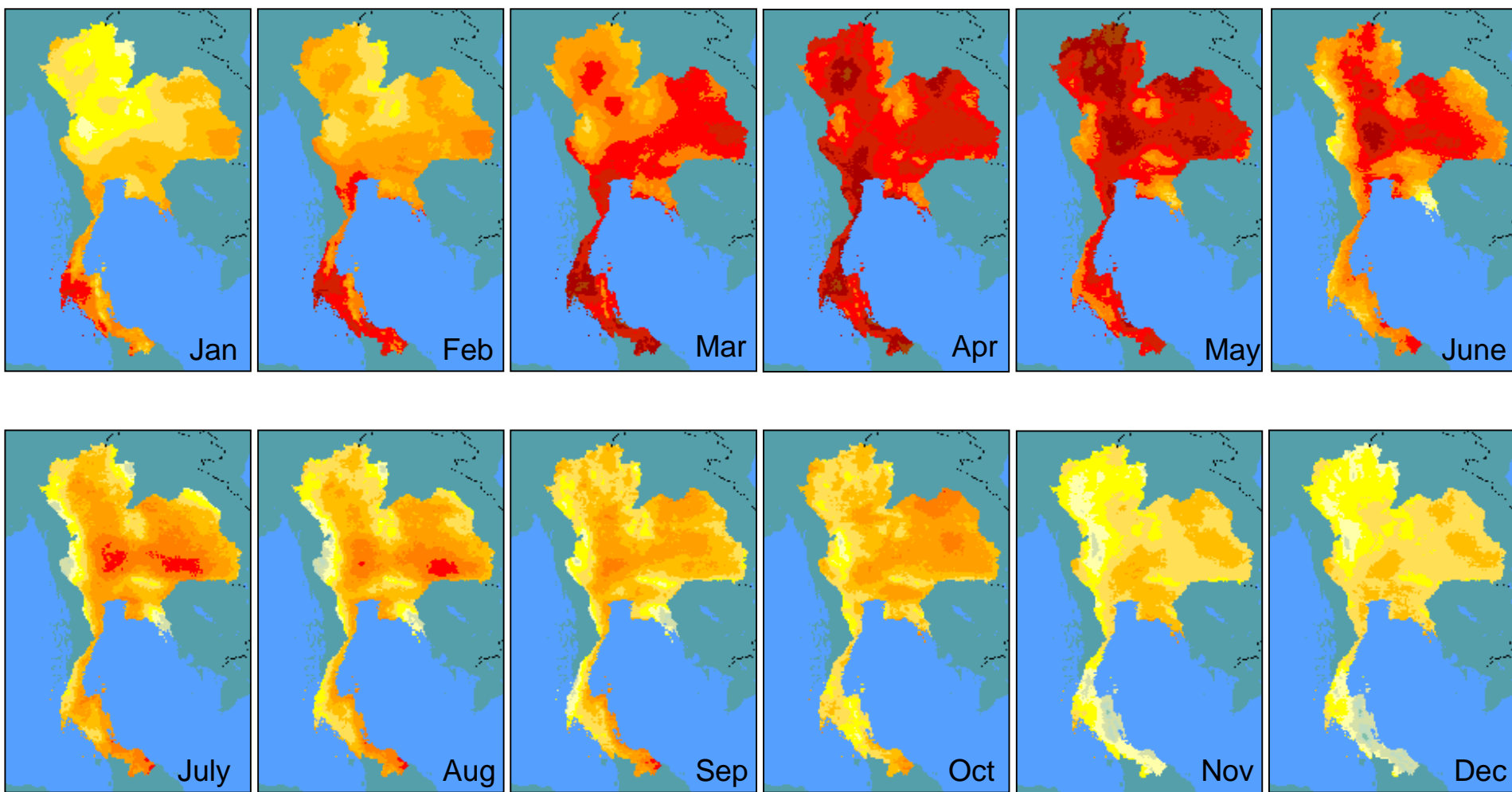


survey data by Mahayothee, 2013

# Solar radiation map of Thailand

Monthly average of daily global solar radiation ( $\text{MJ}/\text{m}^2\text{-day}$ ); satellite data collected from 1993-1998

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Most areas in Thailand received maximum energy from the sunlight in April to May, ranging from 20-24  $\text{MJ}/\text{m}^2\text{/day}$ .



# Drying in Thailand





# Sun drying - coffee





# Sun drying - banana





# Sun drying - banana





# Sun drying - Mango leather





# Sun drying - longan



Longan flesh drying





# Sun drying - Tamarind





# Sun drying - Indian Gooseberry





# Sun drying

## Evaluation of Sun Drying Methods



Hygienic problem

Does not follow Good Manufacturing Practices, GMP

# Sun drying

## Evaluation of Sun Drying Methods



High contamination



# Sun drying

## Evaluation of Sun Drying Methods



Insufficient protection against weather



# SUN DRYING VS SOLAR DRYING

## Drying of banana



Low quality product  
from sun drying



Good quality product  
from solar drying



# Solar Drying in Thailand

1995



Solar tunnel dryer – Hohenheim type

1992

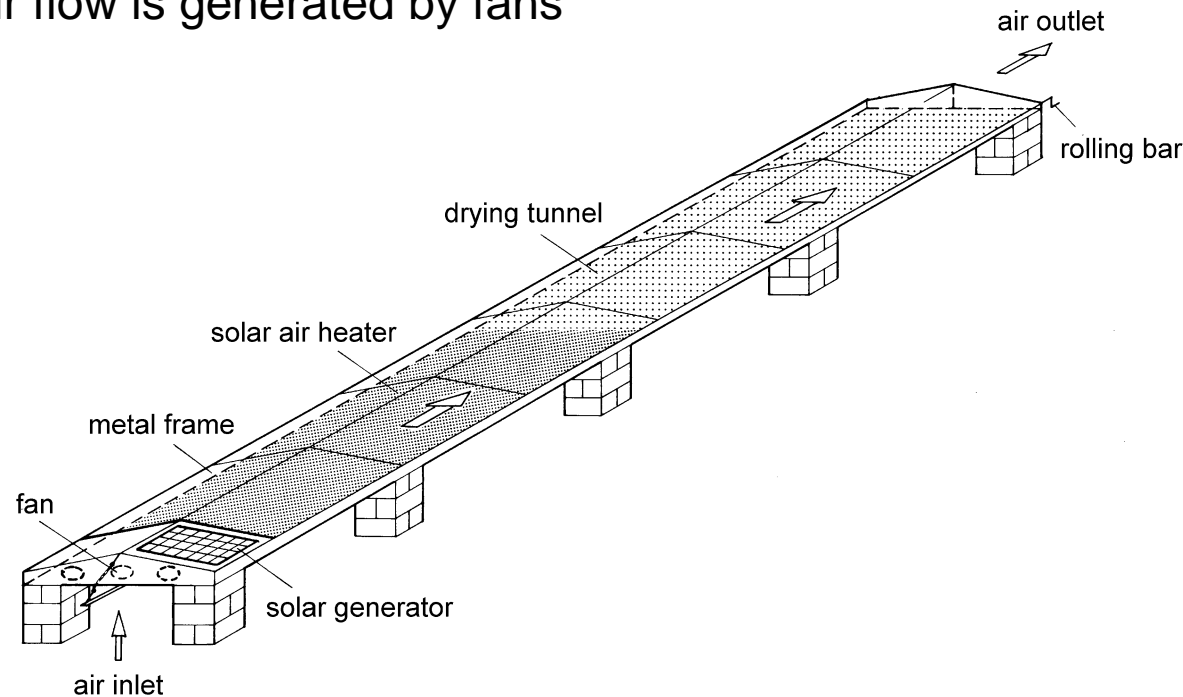




# Solar tunnel dryer – Hohenheim type

## Solar Tunnel Dryer with Integrated Solar Air Heater

- Solar air heater and dryer are arranged in series
- Product is spread out in a thin layer
- Solar air heater and dryer are covered with a transparent plastic foil
- Air flow is generated by fans





# Solar tunnel dryer – Hohenheim type



Donated by DaimlerChrysler to the  
Royal Chitralada Project, Bangkok



# Solar Drying in Thailand



Sukhothai province



Narasuan University,  
Pitsanulok province

During 1996-2000



Jaehom, Lumpang province



Sakhon Nakorn province



Royal Chitrada Project

Source: Janjai



# Solar tunnel dryer, loading and unloading modification by Prof. Janjai





# Solar Greenhouse Dryer in Thailand



Capacity: banana 100-200 kg

Source: Janjai



# Solar Greenhouse Dryer in Thailand

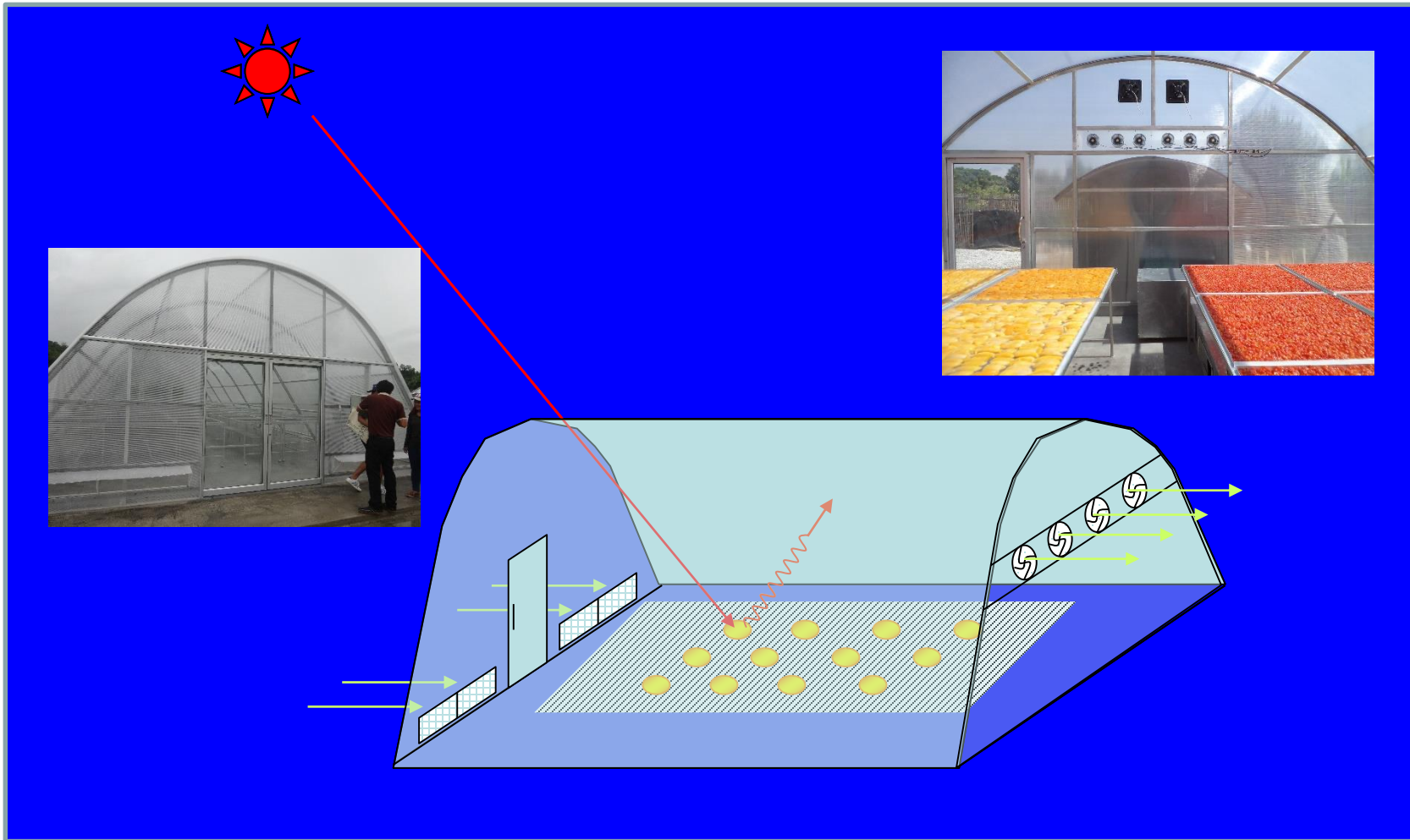


Capacity:  
Banana 1300 kg





# Solar Greenhouse Dryer, Silpakorn Type



Capacity: 1000 kg fresh fruits or vegetables  
Area: 166.4 m<sup>2</sup>  
Size: W x L = 8 m x 20.8 m



# IMPREMENTING SOLAR GREENHOUSE DRYER IN THAILAND



small



medium



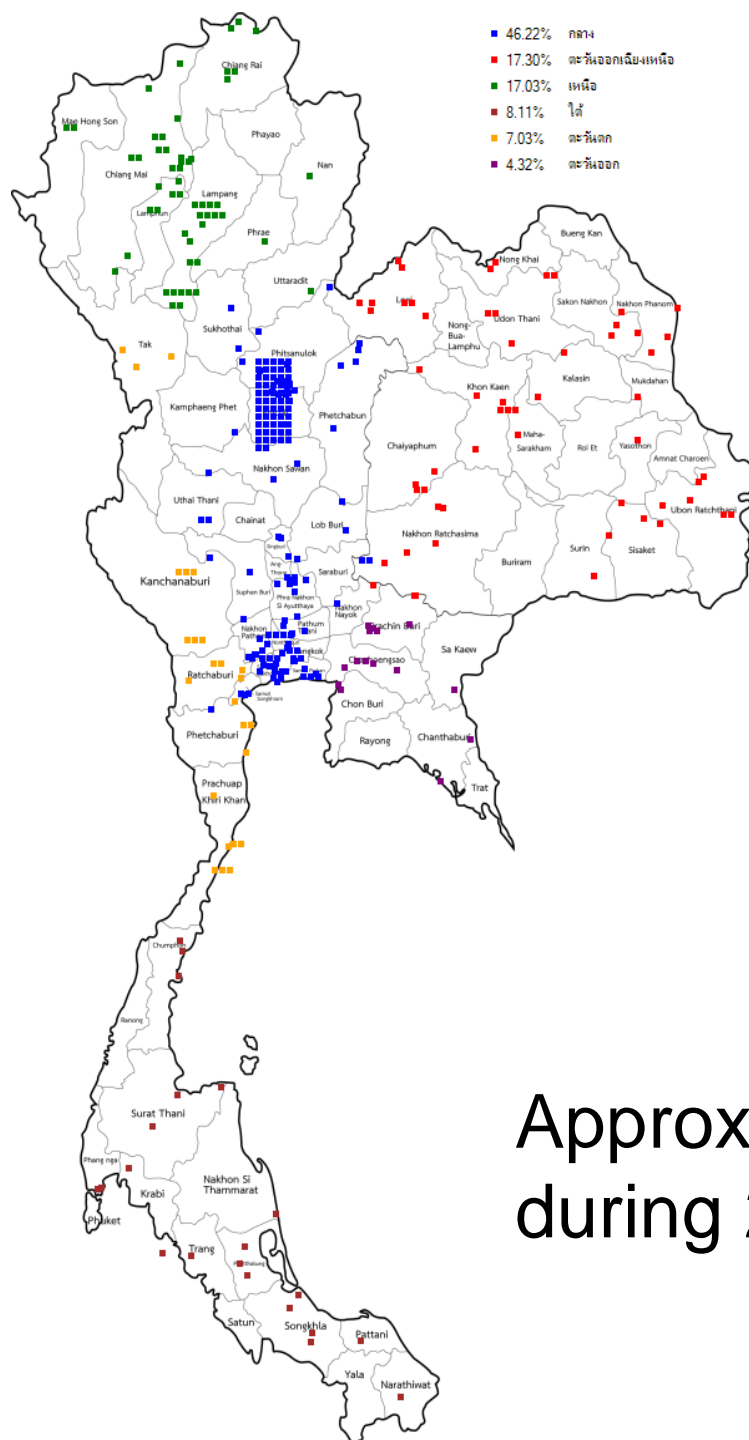
large

Small size = W 6.00 x L 8.20 m<sup>2</sup> Area 49.2 m<sup>2</sup>

Medium size = W 8.00 x L 12.40 m<sup>2</sup> Area 99.2 m<sup>2</sup>

Large size = W 8.00 x L 20.80 m<sup>2</sup> Area 166.4 m<sup>2</sup>





# IMPLEMENTATION OF A SOLAR GREENHOUSE DRYER IN THAILAND



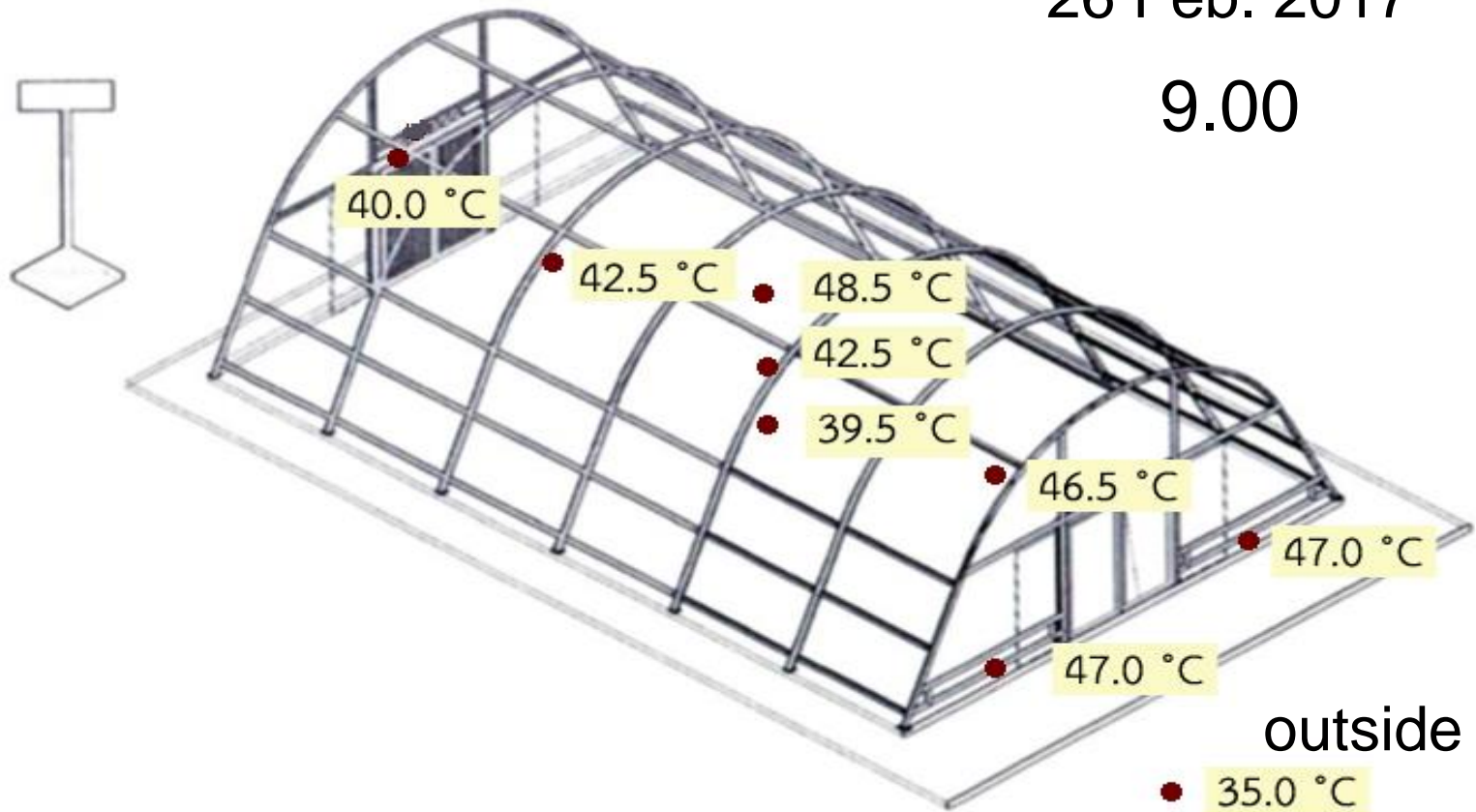
Approximately > 370 units were installed during 2011–2016.



# Temperature inside the Solar Greenhouse dryer

26 Feb. 2017

9.00



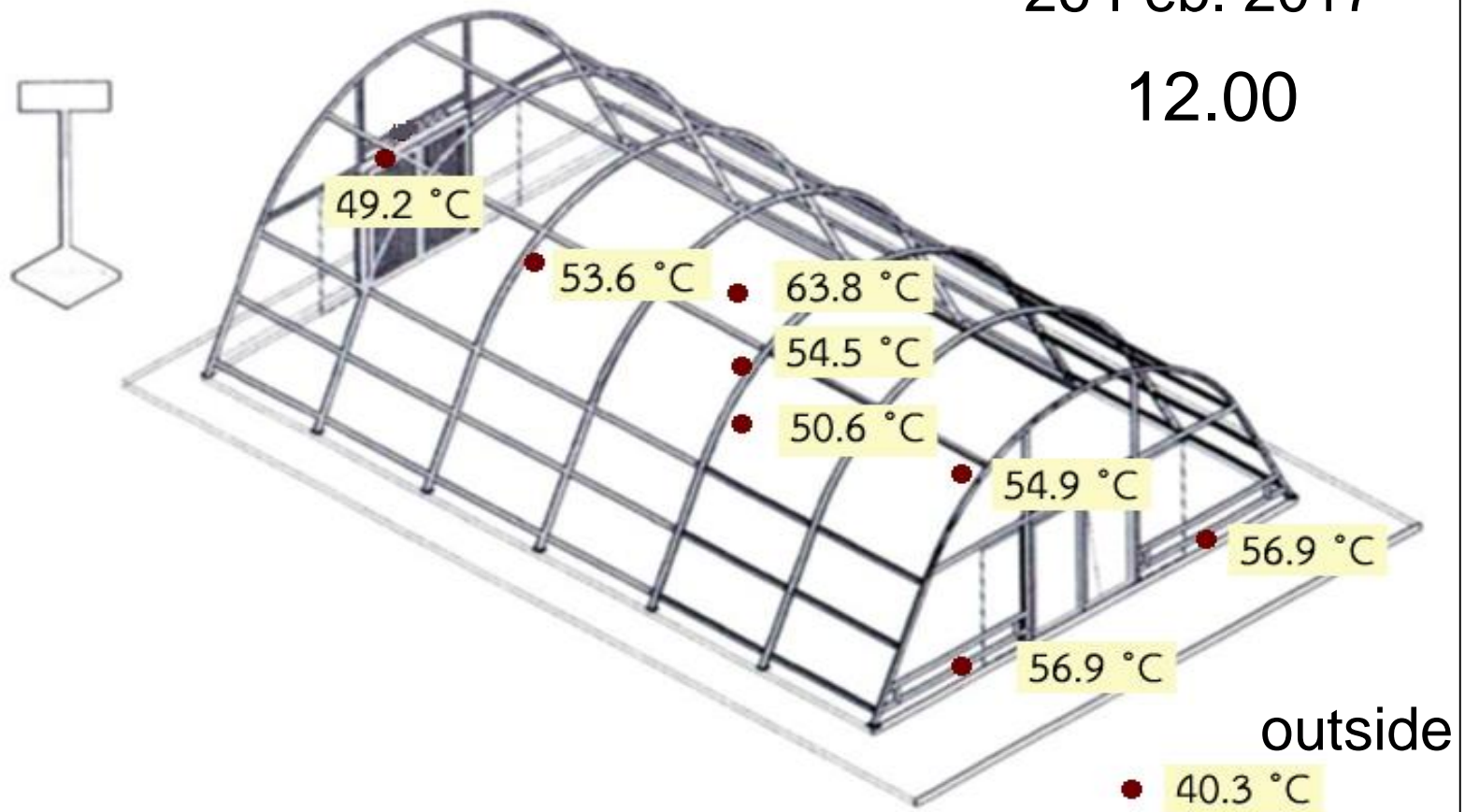
outside



# Temperature inside the Solar Greenhouse dryer

26 Feb. 2017

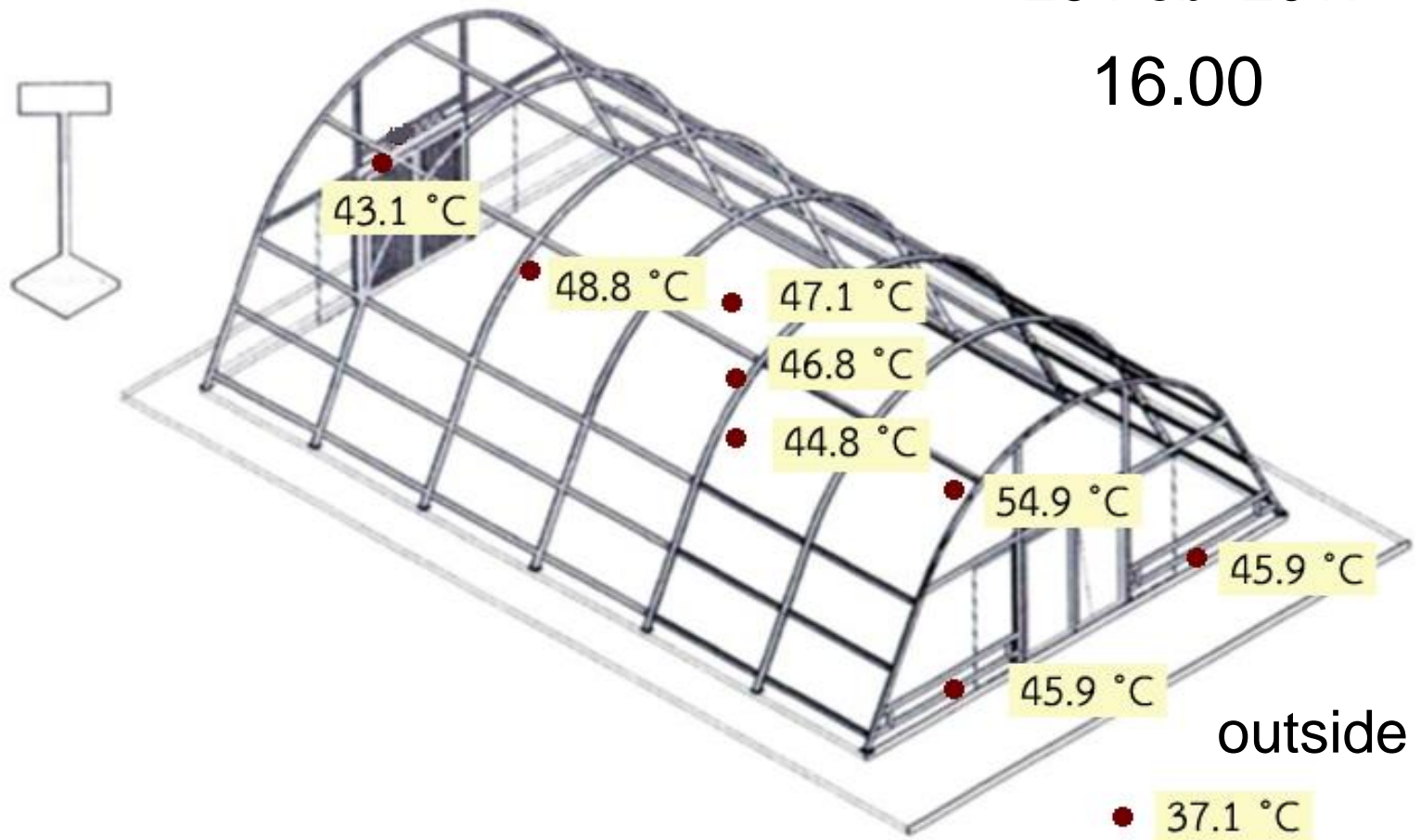
12.00



# Temperature inside the Solar Greenhouse dryer

26 Feb. 2017

16.00





# Banana drying in Thailand



# Drying Process

Mature green banana



Ripening



Ripe banana



Peeling and Trimming



Drying 3-4 d



Pressing → Drying 1 d → Packing





# Processing

## Ripening





# Processing

## Peeling and trimming



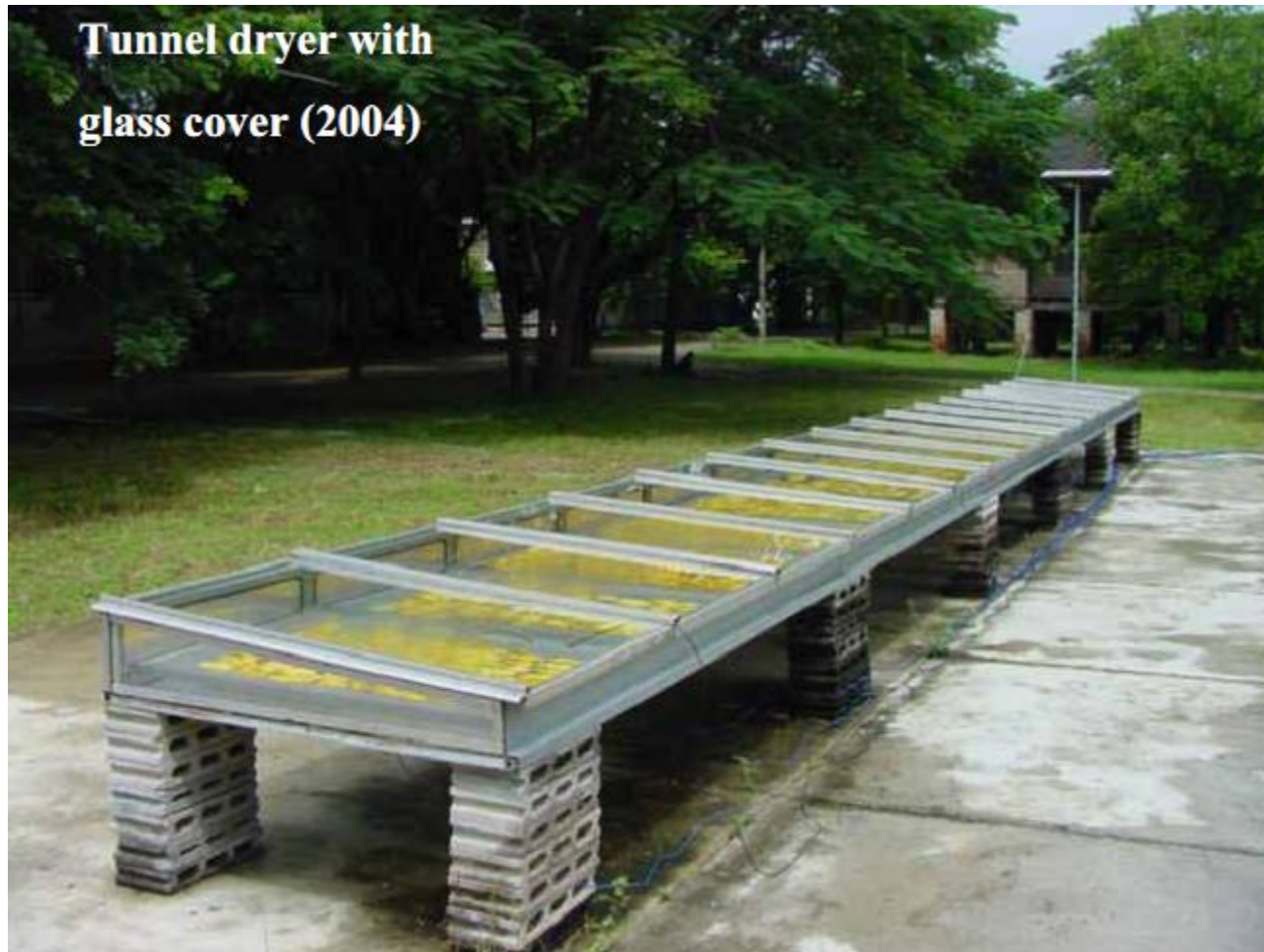


# TRADITIONAL SUN DRIED BANANA





# SOLAR TUNNEL DRYER





# SOLAR GREENHOUSE DRYER, SILPAKORN TYPE



# SOLAR GREENHOUSE DRYER, SILPAKORN TYPE

For drying banana

With the subsidy from Minister of Energy, Thailand

In 2016 = 35%

Large size system

Payback period = 2.22 year

Without the subsidy program

Payback period = 3.7 year



Production: 72000 kg/year Drying time 3-4 days

Product price: 3 Euro/kg (domestic market)



# SOLAR GREENHOUSE DRIED BANANA

## *Healthy Snack: Solar Dried Banana*



*is the first innovation of dried  
banana production in Thailand.*

*With modern manufacturing system in standardized Parabola Dome according to GMP standards, Parabola Dome can control temperature, moisture and drying period resulting in spotless, smooth color, tasty and bigger size of dried banana, aiming to preserve environment and creating internationally accepted quality.*

# Solar Drying of Mango Leather in Eastern Thailand





# Solar Drying of Mango Leather in Eastern Thailand



Greenhouse Solar Drying

# Solar Drying of Mango Leather in Eastern Thailand



Mango Leather





# Solar Drying of Sweet Tamarind in North central Thailand



Large system  
Capacity = 2400 kg  
Drying time 3-4 days

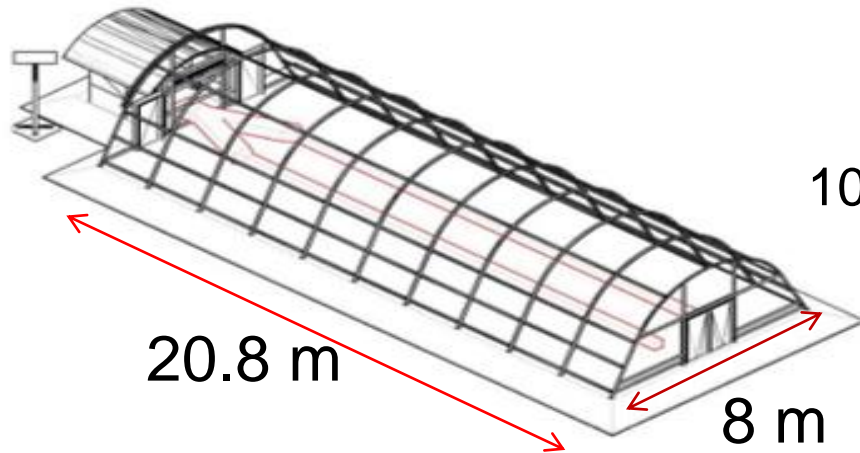


# Solar Drying of Coffee in Northern Thailand





# Solar Drying of Chili in Central Thailand



108 trays (1x1 m<sup>2</sup>)



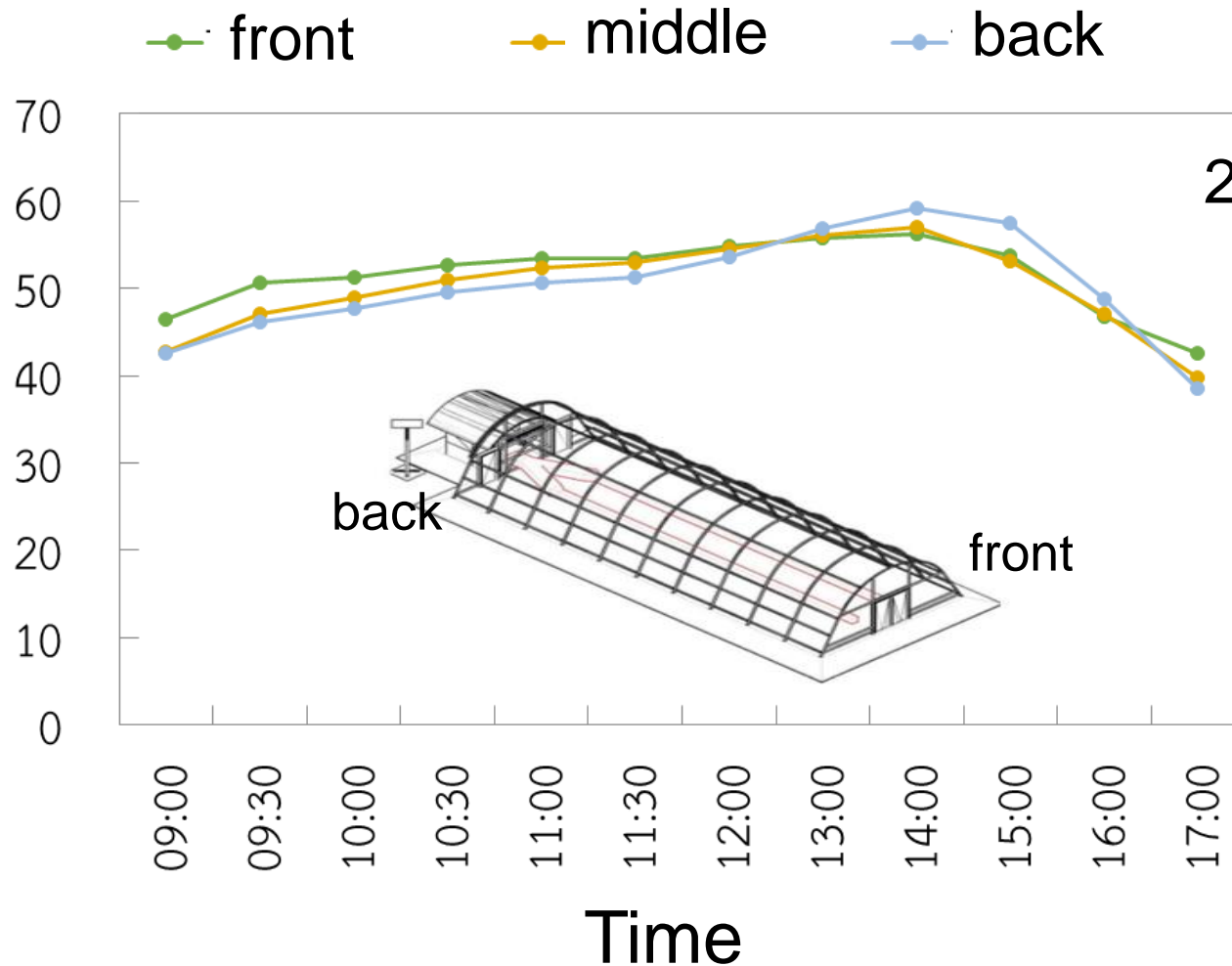
Capacity: 600 kg of fresh chili

Drying time: 3 days

MC. Fresh= 82% MC Final= 10%<sup>46</sup>

# Solar Drying of Chili in Central Thailand

Temp.  
inside  
the  
dryer  
(°C)





# Solar Drying of Pandan leaves in Central Thailand



# Greenhouse solar dryer for mango in Senegal



Drying using Solar Dryer



# Green house solar dryer for banana in Senegal



For  
banana  
slice

Optimum ripening stage of banana after washing and then air drying using a fan

# Green house solar dryer for banana in Senegal



Peeling



# Green house solar dryer for banana in Senegal



Dry banana slice



# Green house solar dryer for banana in Senegal



After 2 days of drying



# Greenhouse solar dryer for mango in Senegal



Washing



Peeling

# Greenhouse solar dryer for mango in Senegal



Slicing



Homogenizing





# Greenhouse solar dryer for mango in Senegal



Natural dried mango

[www.soldryerdede.com](http://www.soldryerdede.com)

<https://www.facebook.com/Soldryerdede/>



โครงการสนับสนุนการลงทุนติดตั้งใช้งานระบบอบแห้งพลังงานแสงอาทิตย์

จัดแสดงงานในส่วนต่างๆ อีกมากมาย ลองมาเยี่ยมชมกันนะคะ

Thaidrawing  
การต่อเติมบ้าน

สนใจวิถีพอเพียง ฟ...  
ธุรกิจท้องถิ่น

โครงการส่งเสริมระ...  
การศึกษา

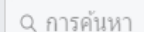
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Thank you

