Capacity Development Training Workshop on Crop Simulation Modeling and Effects of Climate Risks on Agricultural Production Systems in Southeast Asia

Geetha Mohan, Ph.D.
Research Fellow
United Nations University Institute for the Advanced Study of Sustainability
Visiting Associate Professor
IR3S, The University of Tokyo, Japan

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Background

- The agricultural productivity growth is a key driver of development in the Southeast Asia, particularly, the countries like Cambodia, Lao PDR, Thailand, Vietnam and Indonesia.
- The capacity development programmes are essential in this region, especially for the agriculture sector in Southeast Asia is the most vulnerable to natural hazards and extreme weather events pose a high risk to agricultural production systems as well as food security.
- To explore the complexity of possible adaptation measures through capacity training workshops and regional collaboration.

Rationale

- The SEA region needs to reduce their vulnerability to climate change by supporting building capacity and developing risk management strategies.
- For strengthening adaptation capacity must acknowledge the farmers stated needs with targeted innovations to create resilience and sustainable agriculture production systems.
- Strengthening agricultural adaptation and developing agronomic models, which brings strong benefits to food systems.
- To increase collaboration with scientists and communities; the crop simulation modelling provides significant strategies and technologies to build cropping systems more resilient against climate change.

Key Objectives

The specific objectives to achieve this main goal are identified as follows:

I) To provide hands-on practical exercise on the proper use and applications of DSSAT and it's associated crop simulation models to solve actual problems.

II) Identifying appropriate promising technologies and to develop adequate strategies to make agricultural production systems profitable, sustainable and resilient through crop simulation methods.

III) Evaluating Integrated assessments, analyzing farm production using DSSAT tools to verify inputs and simulate productivity.

IV) Strengthening technical and scientific abilities by enhancing collaboration between National Agricultural Research System (NARS), policymakers, and local communities with International organizations.

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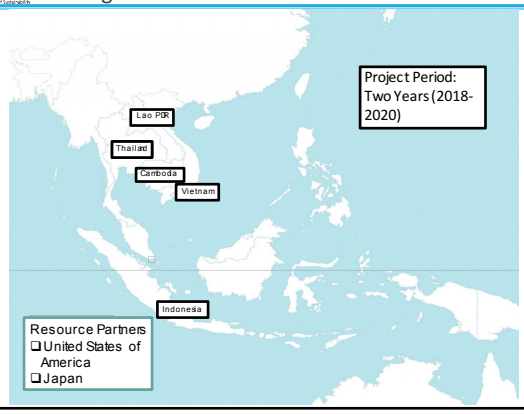
Target Countries



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Project Partners

Major collaborators' information

Name	Organization	Country	Email
Gerrit Hoogenboom	University of Florida	United States	gerrit@ufl.edu
Sithong Thongmanivong	National University of Laos	Lao People's Democratic Republic	sithong@nuol.edu.la
Thi Lang Nguyen	High Agricultural Technology Research Institute for Mekong Delta (HATRI)	Viet Nam	ntlang.prof@gmail.com
Hirotaka Matsuda	The University of Tokyo		matsuda@k.u-tokyo.ac.jp
Nareth Nut	Royal University of Agriculture	Cambodia	nnareth@rua.edu.kh
Chitnucha Buddhaboon	Ubon Ratchathani Rice Research Center	Thailand	chitnuchab@gmail.com
Sukri Banua Irwan	University of Lampung	Indonesia	dekanfp@fp.unila.ac.id

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Role of the partners

- Identify key stakeholders to support directly and indirectly to our project
- Organizing DSSAT training program by inviting multi-stakeholders
- Data support and sharing among stakeholders
- Interaction session between farmers and scientists
- Policy briefs, papers and report submission
- If any others

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First Year Activities (Oct. 2018-Sep. 2019)

Time	Particulars	Organizer	Country
March 04, 2019	Project Preliminary Meeting	Prof. N T Lang	Vietnam
March 05-09, 2019	DSSAT Training Program	Prof. N T Lang	Vietnam
March 31, 2019	Report Submission to APN on the meeting and training program	Prof. N T Lang Dr. Geetha Mohan	
July or August, 2019	DSSAT Training Program	Dr. Chitnucha Buddhaboon	Thailand
July or August, 2019	Report Submission to APN on training program	Dr. Chitnucha Buddhaboon Dr. Geetha Mohan	

Second Year Activities (Oct.2019-Sep.2020)

Time	Particulars	Organizer	Country
November, 2019	DSSAT Training Program	Prof. Irwan	Indonesia
November, 2019	Report Submission to APN on the meeting and training program	Prof. Irwan Dr. Geetha Mohan	
January, 2020	DSSAT Training Program	Dr. Sithong	Lao PDR
January, 2020	Report Submission to APN on the meeting and training program	Dr. Sithong Dr. Geetha Mohan	
June, 2020	DSSAT Training Program	Mr. Nut Nareth	Cambodia
June, 2020	Report Submission to APN on the meeting and training program	Mr. Nut Nareth Dr. Geetha Mohan	
September, 2020	Final Report Submission to APN	Dr. Geetha Mohan	

Open Access and Sharing Plan

- Develop an URL for our project
- Feasibility of sharing data
  - Any difficulties
- Access to all our project collaborators including local stakeholders and others
- Sharing and adding data will help to strengthen networks between scientists and other stakeholders
- What type of data will be considered and restrictions to access
- If any others

Expected Outcomes

The training workshop serve as a platform that promotes

I. To assess economic risks and environmental impacts associated with agricultural production.
II. To make extensive use of hands-on exercise that apply the DSSAT cropping system model in subregions of the Southeast Asia.
III. to define a practical approach for simulating effects of weather, soil, management factors on crop production.
IV. Ultimately, it will help to discuss the potential contribution of innovative strategies and necessary steps to be taken for regional collaboration.

DSSAT Training Program in Thailand

Planning to organize DSSAT Training Program in July/August, 2019

Local Partner:

Dr. Chitnucha Buddhaboon, Director, Uban Ratchathani Rice Research Center, Thailand.

Possibility to combine both our training workshop with regular DSSAT training program organized by **Prof. Dr. Attachai Jintrawet,** Chiang Mai University and his team.

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Communication and Publications

- Research Papers
- Policy Briefs
- Report Submission
- If any others

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Special Credit and Thank You to

Vietnam Team

- Prof. Dr. Nguyen Thi Lang, HATRI, Vietnam
- Prof. Dr. Bui Chi Buu, HATRI, Vietnam
- Mr. Nguyen Trong Phuoc, HATRI, Vietnam
- Mr. Bui Chi Cong, HATRI, Vietnam

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Special Credit and Thank You to

Project Team

- Prof. Dr. Gerrit Hoogenboom, University of Florida, USA
- Prof. Dr. Nguyen Thi Lang, HATRI, Vietnam
- Dr. Hirotaka Matsuda, Tokyo University of Agriculture, Japan
- Dr. Chitnucha Buddhaboon, Uban Ratchathani Rice Research Center, Thailand
- Prof. Dr. Ir. Irwan Sukri Banuwa, University of Lampung, Indonesia
- Dr. Thongmanivong Sithong, National University of Laos, Lao PDR
- Mr. Nareth Nut, Royal University of Agriculture, Cambodia

Project Observers:

- Prof. Dr. Udin Hasanudin, University of Lampung, Indonesia
- Dr. Abdullah Aman, University of Lampung, Indonesia

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Special Credit and Thank You to

Asia-Pacific Network for Global Change Research (APN-GCR)

Agricultural Situation and Challenges in Thailand

By
Dr. Chitnucha Buddhaboon

Ubon Ratchathani Rice Research Center, Rice Department, Ministry of Agriculture, Thailand

Preliminary Project Meeting on Capacity Development Training Workshop on Crop Simulation Modelling and Effects of Climate Risks on Agricultural Production Systems in Southeast Asia
04 March 2019, HATRI, Can Tho City, Vietnam

Contents

- Introduction
- Agricultural situation
- Challenges

Introduction

ource: Department of Field Support Cartographic Section UNITED NATION

The Kingdom of Thailand

Introduction

Country area:	51.132 M.ha
Land area:	51.089 M.ha
Agricultural area:	22.110 M.ha
Forest area:	16.429 M.ha

(http://www.fao.org/countryprofiles/index/en/?iso3=THA)

Population

Total population:	66,413,979
Male:	32,556,271
Female:	33,857,708

(http://stat.dopa.go.th/stat/statnew/upstat_age_disp.php)

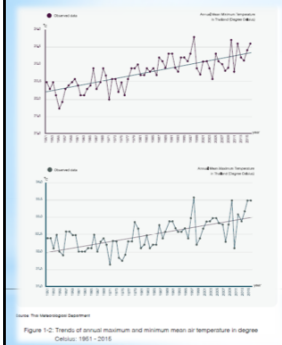
Administration structure:

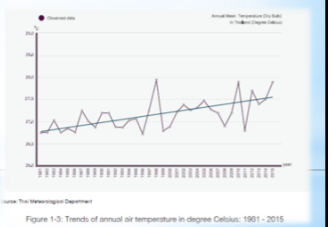
Thailand's public administration is divided into 3 tiers of central, provincial, and local administrations.

Local authorities consist of provincial administrative organizations, district organizations, sub-district organizations, and Tambon Administrative Organizations (TAOs).

(First Biannual Update Report, ONEP.)

Temperature:
-Maximum, minimum and average temperature tend to be increase.





(First Biannual Update Report, ONEP.)

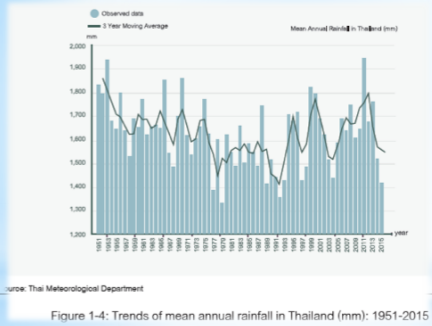
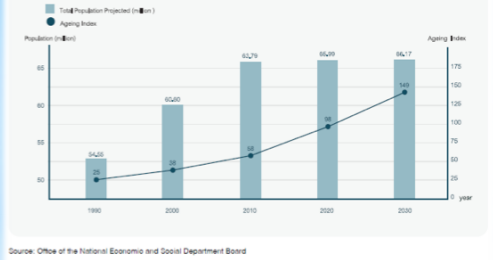


Figure 1-4: Trends of mean annual rainfall in Thailand (mm): 1951-2015

Annual rainfall:
- Mean of annual rainfall varies from 1,300 to 1,950 mm. It is enough for crop production. Anyway the distribution pattern of rainfall is the most important for crop growth and yield.

(First Biannual Update Report, ONEP.)



Source: Office of the National Economic and Social Department Board

Figure 1-6: Ageing Index, total population (1990-2030) and total projected population (2020-2030)

Thailand is now reached the aging society, faster than the trend in this figure.

The proportion of older people (60+ year old) is greater than younger people (<60 year old)

(First Biannual Update Report, ONEP.)

Table 5: Land Use in Thailand, 2008-2013

Unit: Hectare

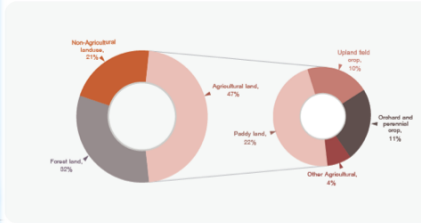
Year	Total Land Area	Forest Land	Agricultural Land	Average Farm Size	Number of Farms	Agricultural Land					Non-Agricultural Land
						Rice	Other Field Crops	Fruit Orchard and Other Permanent Trees	Vegetable, Flower and Ornament Tree	Other Agricultural Land	
2013	51,311,502	16,339,126	23,877,797	4.04	944,656	11,194,378	4,984,640	5,586,444	223,741	1,888,594	11,094,579
2012	51,311,502	17,158,565	23,878,409	4.04	945,727	11,194,876	4,984,781	5,586,338	223,546	1,888,868	10,274,528
2011	51,311,502	17,158,565	23,879,428	4.07	939,368	11,197,705	4,983,901	5,585,189	223,149	1,889,483	10,273,509
2010	51,311,502	17,158,565	23,926,669	4.07	940,069	11,244,481	5,007,527	5,554,796	217,284	1,882,580	10,246,268
2009	51,311,502	17,158,565	23,951,019	4.08	938,356	11,296,605	5,040,893	5,498,302	215,090	1,900,129	10,201,918
2008	51,311,502	17,158,565	23,967,073	4.15	925,138	11,337,303	5,090,384	5,417,627	212,876	1,908,884	10,185,864

Source: Office of Agricultural Economics
Note: Forest Land area is available in a five-year interval reflecting in the unchanged figures from 2008-2012

Forest : 33%
Agricultural land: 46%
Rice area: 22% of the total area and 47% of agricultural area

(First Biannual Update Report, ONEP.)

Thailand has a total land area of approximately 51.3 million hectares. As of 2015, 47% of the nation's total land area (or 24 million hectares) was categorized as agricultural land (Figure 1-12). Non-agricultural land use and forested land accounted for 21 and 32 %, respectively. About half of agricultural land use is attributed to paddy use, equal to 11 million hectares or 22% of Thailand's total land area.

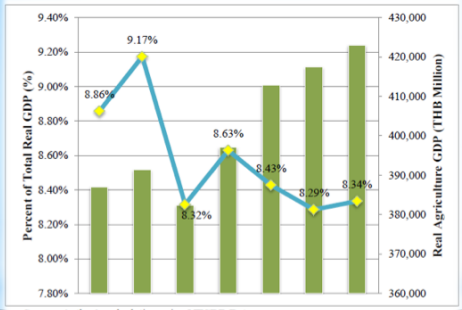


Source: Agricultural Statistics of Thailand 2015, Office of Agricultural Economics

Figure 1-12: Share of land use in Thailand in 2015

Agriculture is the biggest share in term of land use and rice production system is also the biggest share in agricultural production systems

(First Biannual Update Report, ONEP.)

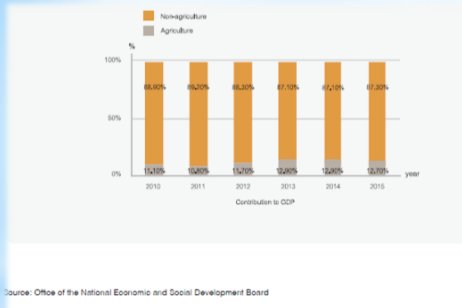


Source: Author's calculation using NESDB Data

Figure 9: Agriculture Share of Gross Domestic Products, 2008-2014

Proportion of agriculture sector to the GDP is low.

(First Biannual Update Report, ONEP.)



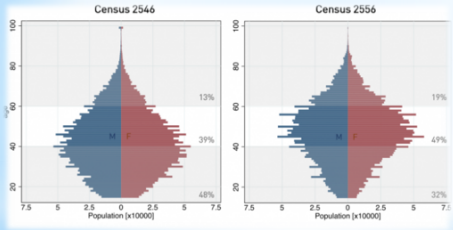
Source: Office of the National Economic and Social Development Board

Figure 1-14: Agriculture and Non-Agriculture contribution to GDP in THB billio

Proportion of agriculture sector to the GDP is low.

(First Biannual Update Report, ONEP.)

Agricultural situation

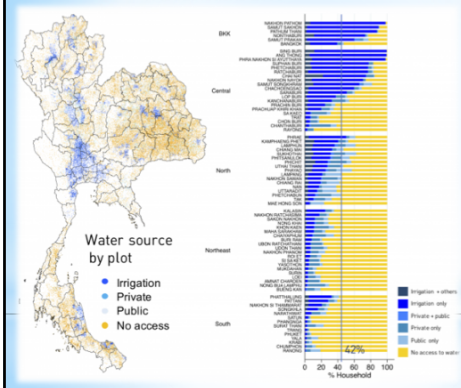


Agricultural labor:
- Age of agricultural labor is higher , young people move to other sector.

(https://www.pier.or.th/?abridged)

Far mer

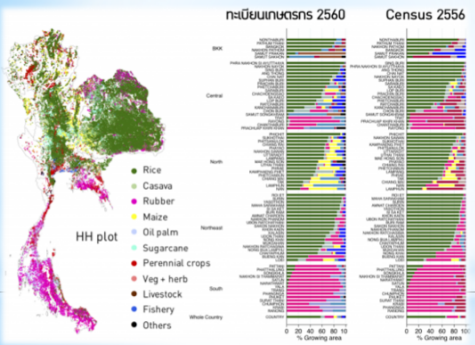
Average: 57 years old



Water resource accessibility of farmer:

- The most of famers in central plain is quite good in term of water access
- ≥ 40% of farmer household in the North is able to access water
- Most of farmer in Northeast and South depend on rainfed, anyway South is much higher rainfall than the Northeast.

(https://www.pier.or.th/?abridged)



Distribution of agricultural area:

- Rice covers the area of North, Central and Northeast.
- Rubber cover the South and East.

(https://www.pier.or.th/?abridged)

Challenges

Challenges

Internal challenges:

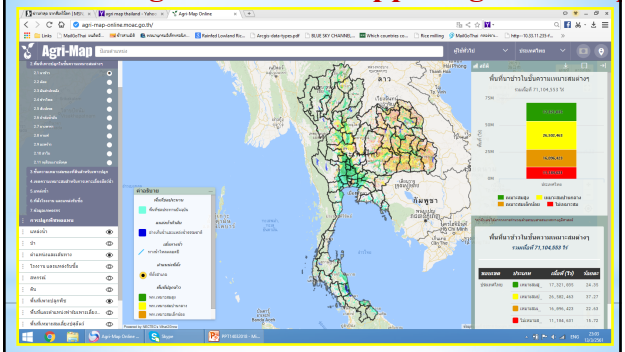
- Aging society
- Cost and competitiveness
- Food safety
- Soil/Water chemical contamination
- Deforestation
- Policy

Challenges

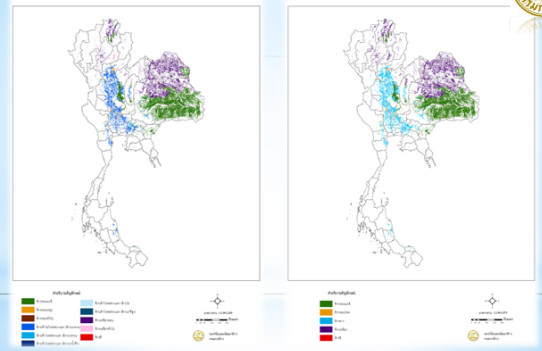
External challenges:

- World agricultural commodity price and competitiveness
- Technology, innovation, AI and Big Data
- Demand trend, safety product, functional food, healthy and cosmetic
- Non tariff barrier, carbon/water footprint
- Climate change

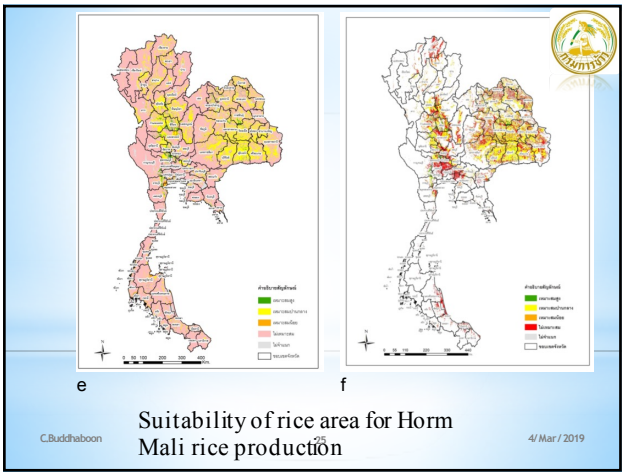
Knowledge and data to support agricultural



Agri-Map of the MOA (http://agri-map-online.



Area of 11 and 5 rice groups in wet season 2



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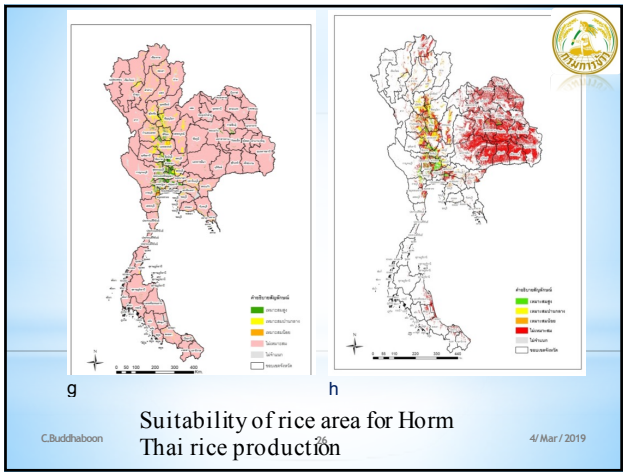
C.Buddhaboon Suitability of rice area for Horm Mali rice production 25 4/ Mar / 2019



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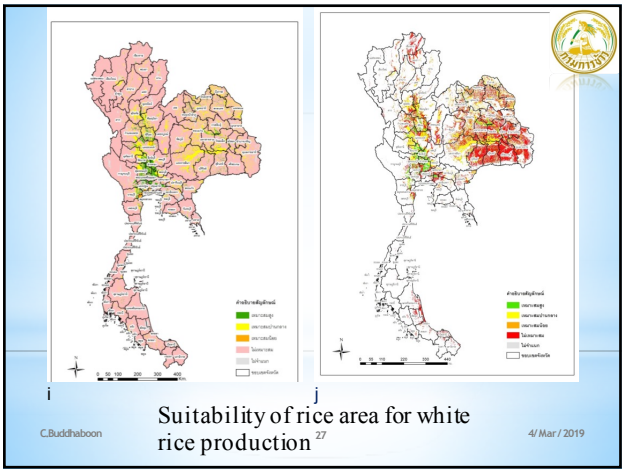
C.Buddhaboon Suitability of rice area for Horm Thai rice production 26 4/ Mar / 2019



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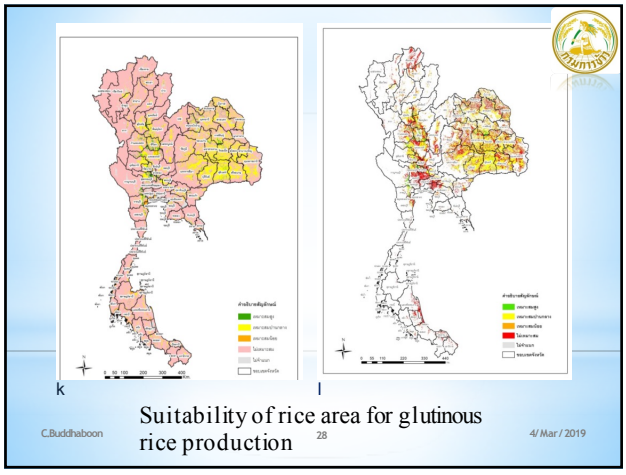
C.Buddhaboon Suitability of rice area for white rice production 27 4/ Mar / 2019



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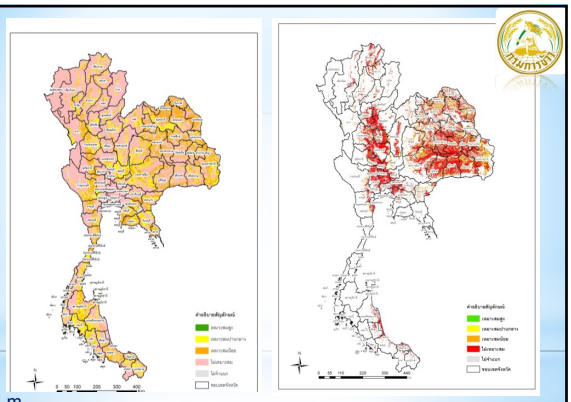
C.Buddhaboon Suitability of rice area for glutinous rice production 28 4/ Mar / 2019



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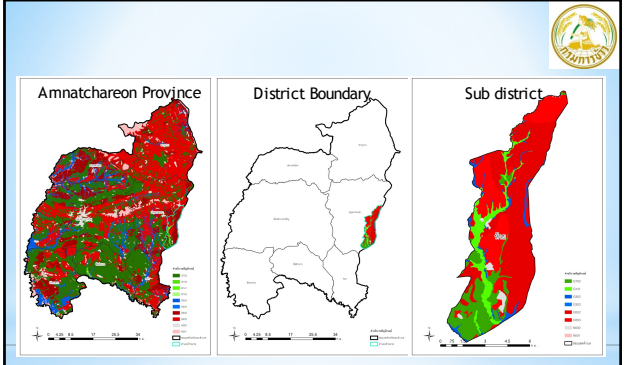
Suitability of rice area for other rice group (Color rice and rice for niche market)



การใช้ประโยชน์แผนที่โซนนิ่งระดับจังหวัดอำเภอ

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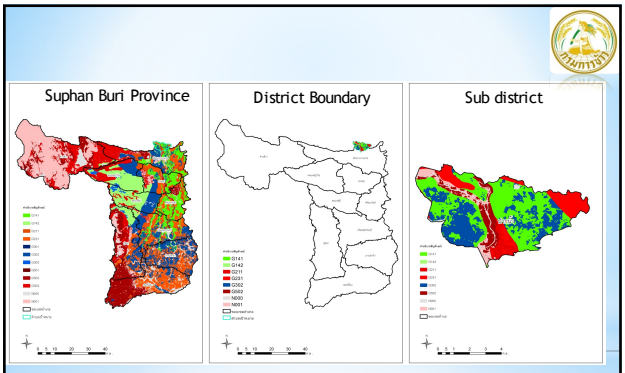


การใช้ประโยชน์แผนที่โซนนิ่งระดับจังหวัดอำเภอ

(กรมการข้าว 25

Rice Knowledge Bank of Rice Departm

http://www.ricethailand.go.th/web/

Disruptive forces and transformation strategies of agricultural systems

5 disruptive forces	Transformation
1. Rapid urbanization	New production process New products • Functional foods
2. Aging society	Large-scale farms • Effective cooperatives • New organizations for small holders, e.g., new form of contract, entrepreneur farmer partner
3. Technological change	New private standards • Cross-border investment • Resource conservation • Re-defining government role
4. Climate change	
5. Globalization : trade, investment, politics, social/environmental concerns	

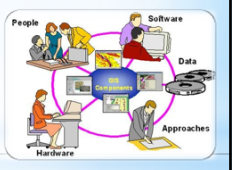
TDRI

Modern agriculture:

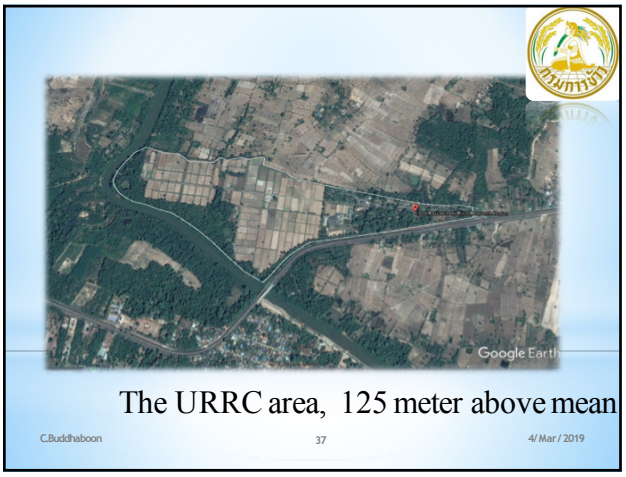
- Precision farming
- New technology, innovation
- Enough food, fuel and fiber for growing world population,
- Minimize the environmental footprint, carbon/water footprint

Agricultural Policy:

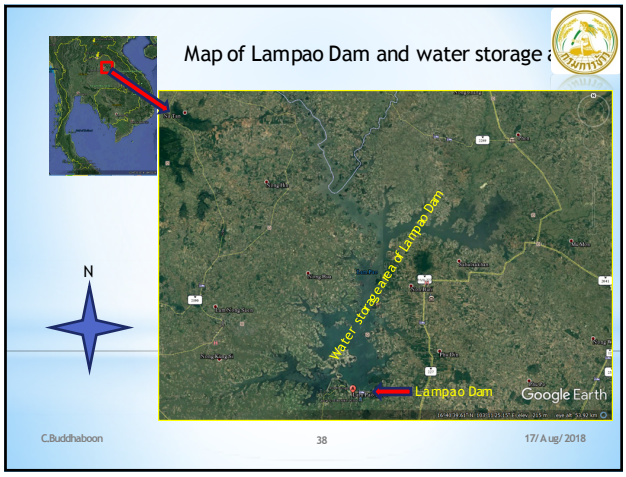
- Consolidate farming (Big farm production system)
- Organic farming
- Linking between producer and consumer (MOU Supply side and Demand side)
- Smart farmer
- Precision agriculture (technology for site specific appl., data collection, analysis and make a decision,

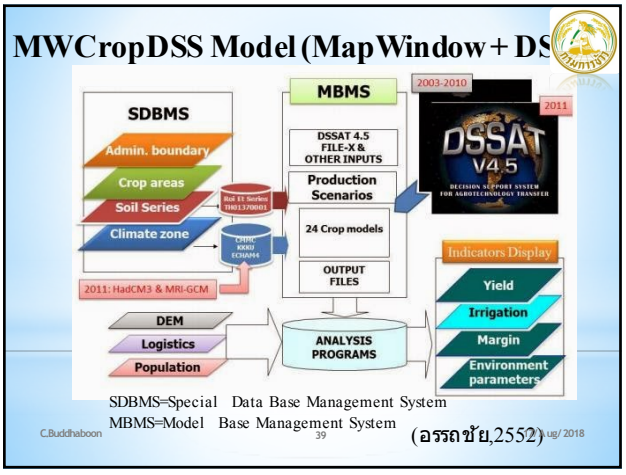


Rice Area in Prachin Buri Province, 2 m above r

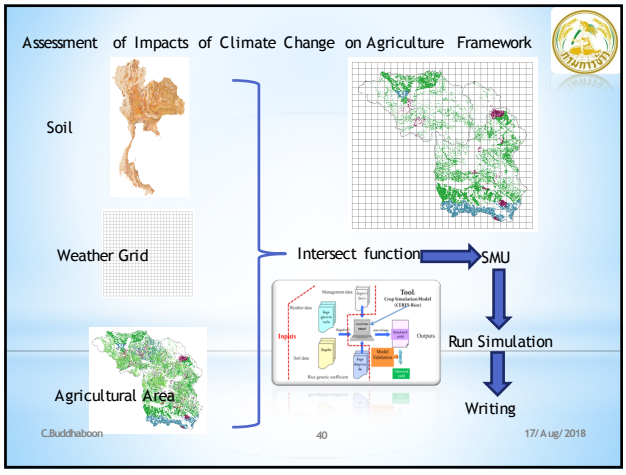


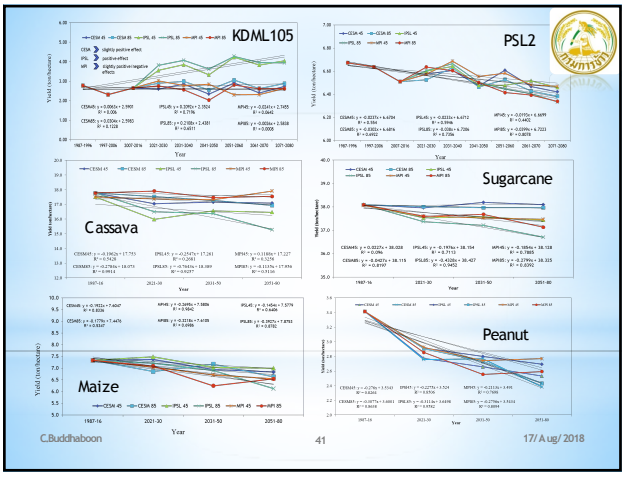
The URRC area, 125 meter above mean





(อรรถชัย,2552)




KDML105
PSL2
Cassava
Sugarcane
Peanut
Maize
Year
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NSTDA
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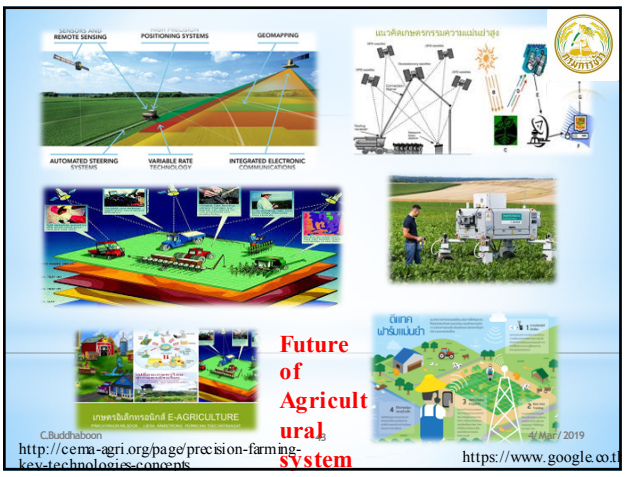
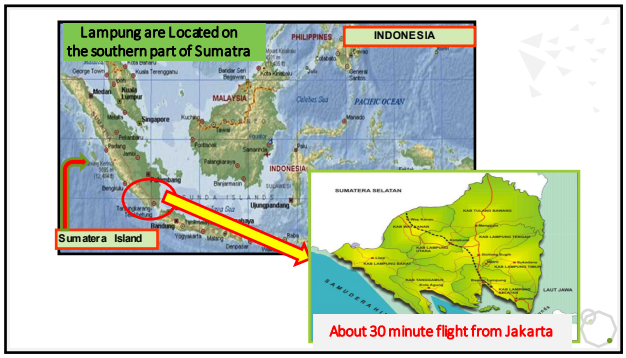

REMOTE SENSING
POSITIONING SYSTEMS
GEOMAPPING
AUTOMATED STEERING SYSTEMS
VARIABLE RATE TECHNOLOGY
INTEGRATED ELECTRONIC COMMUNICATIONS
Future of Agricultural System
C.Buddhaboon
4/ Mar/ 2019
http://cema-agri.org/page/precision-farming-key-technologies-concepts
https://www.google.co.th


Thank You
C.Buddhaboon
4/ Mar/ 2019

AGRICULTURE SITUATION AND CHALLENGES IN INDONESIA

Irwan Sukri Banuwa
Udin Hasanudin
Abdullah Aman Damai

CAN THO CITY, MARCH 4, 2019. VIETNAM

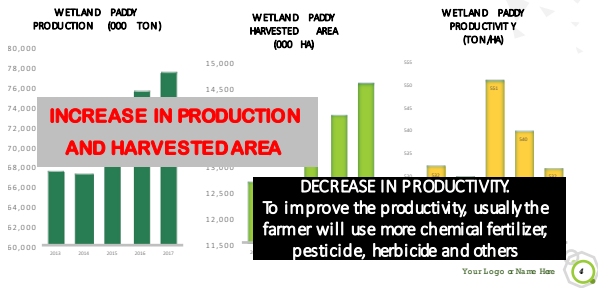


AGRICULTURAL LANDS DISTRIBUTION BASED ON AGROECOSYSTEM

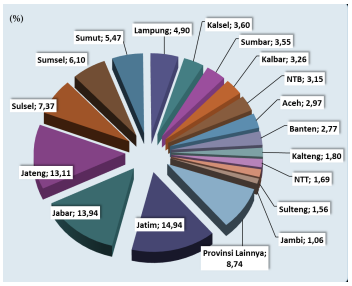
Ecosystem	Total Area (Ha)	Acid Soil		Non Acid Soil	
		Total Area (Ha)	%	Total Area (Ha)	%
Dry land	144,473,211	107,357,633	74,3	37,115,579	25,69
Swamp	34,926,552	33,419,323	95,68	1,507,229	4,32
Wet Land	8,638,537	5,684,231	65,8	2,954,306	34,2
others	3,054,832				
Total	191,093,132	146,461,187	76,62	41,577,114	21,75

- ✓ Agricultural land in Indonesia is dominated by Dry land with categorize as Acid land.
- ✓ Total acid land in Indonesia agricultural land is about 76.62%

WETLAND SITUATION



Largest contributor Province by harvest area



1. Java island is still the biggest contributor for national paddy production
2. Lampung is one of major contributor for national paddy production

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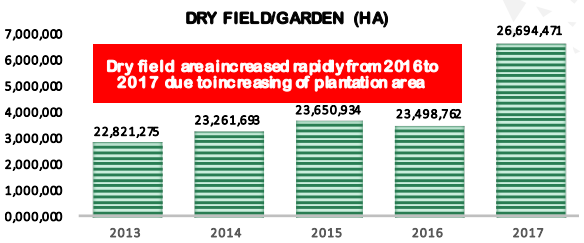
5

Rice production (dry husk) has been up from 75 mill ton in 2016 to 77 million tonnes in 2017 or up by 2,5%. But occasionally still imported around 2 million tonnes in 2018 which relate to dry season or poor climate condition. Rice consumption per capita has been constant at around 125 kg per cap per year.

6

DRY FIELD/GARDEN/PLANTATION SITUATION



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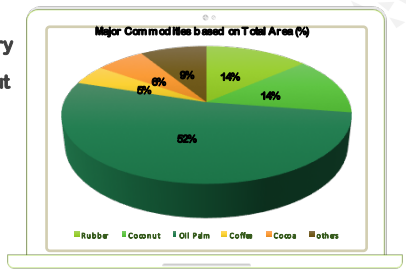
MAJOR COMMODITIES OF DRY FIELD/GARDEN/PLANTATION

- The biggest proportion of dry field is palm oil plantation about 52 %



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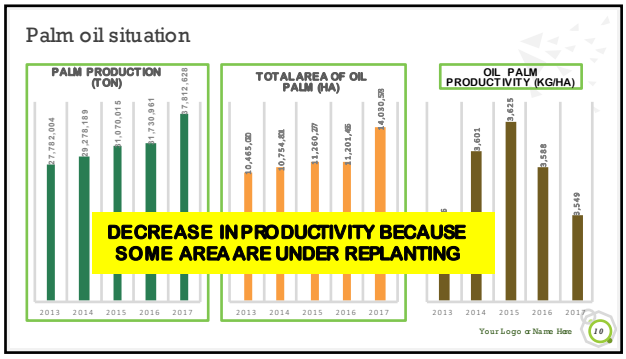
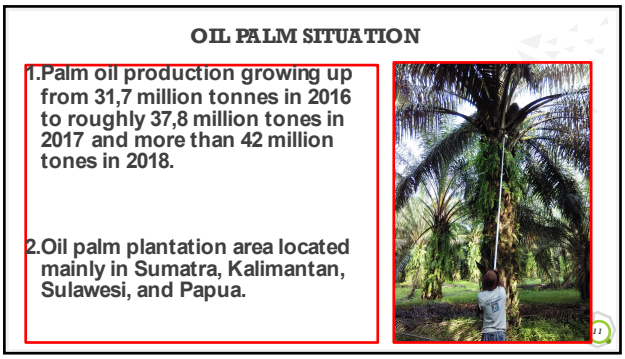
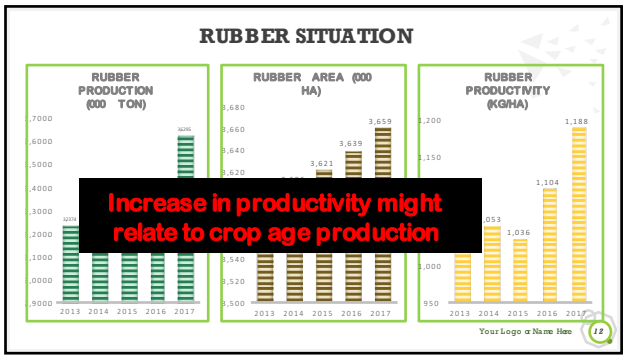
Palm Oil Plantation
Your Logo or Name Here


Palm oil situation
PALM PRODUCTION (TON)
TOTAL AREA OF OIL PALM (HA)
OIL PALM PRODUCTIVITY (KG/HA)
DECREASE IN PRODUCTIVITY BECAUSE SOME AREA ARE UNDER REPLANTING
2013 2014 2015 2016 2017
Your Logo or Name Here
10


OIL PALM SITUATION
1.Palm oil production growing up from 31,7 million tonnes in 2016 to roughly 37,8 million tones in 2017 and more than 42 million tones in 2018.
2.Oil palm plantation area located mainly in Sumatra, Kalimantan, Sulawesi, and Papua.
11


RUBBER SITUATION
RUBBER PRODUCTION (000 TON)
RUBBER AREA (000 HA)
RUBBER PRODUCTIVITY (KG/HA)
Increase in productivity might relate to crop age production
2013 2014 2015 2016 2017
Your Logo or Name Here
12

COCOA SITUATION

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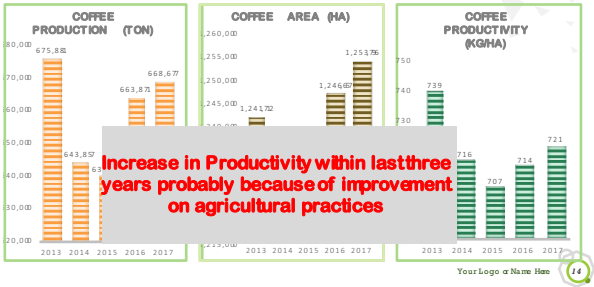
Coffee Condition



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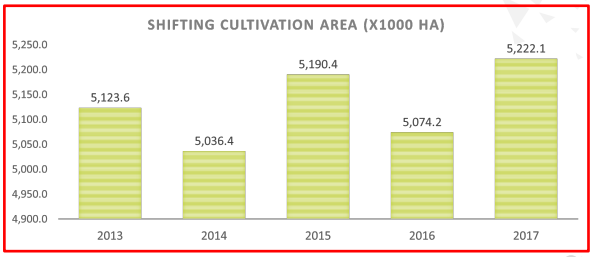
SHIFTING CULTIVATION/UNIRRIGATED AGRICULTURAL FIELD



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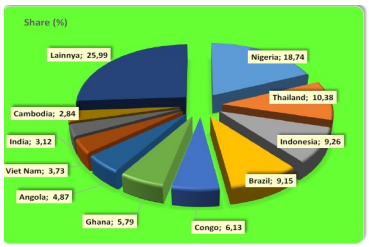
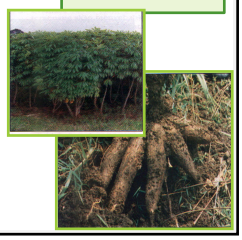
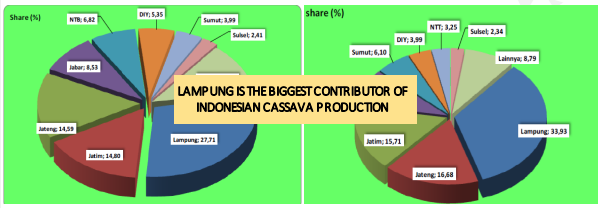
Cassava : Indonesian contribution



1. Indonesia contribute 9,26% of total cassava production of the world
2. Indonesia become the third largest cassava producer in the world



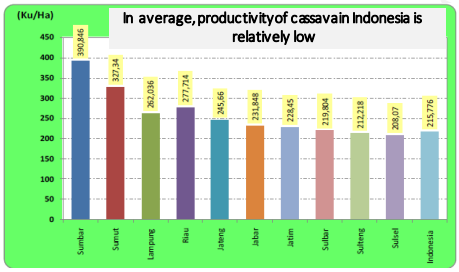
Cassava Situation



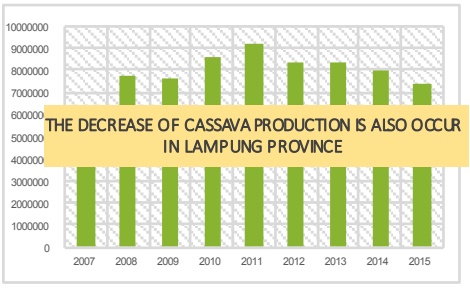
Share of Cassava harvestedarea byprovince

Share of cassava production by province

Cassava situation



Cassava productivity by province



Cassava Production of Lampung Province (ton)

(Sumber : *Outlook* Komoditas Pertanian Subsektor Tanaman Pangan UbiKayu, 2015)

The Problems

Acid and Marginal Soil

- As much as 76,64% of Indonesian land is considered acid and marginal soil
- Those condition might cause low soil fertility both physically, chemically and biologically

Land Conversion

- Rate of National paddy field conversion rate was as high as 96,512 ha/year (2013-2015 data)
- Under moderate conversion rate estimation, there will be 200.000 Ha paddy field left in 2045

Uncertainty of Climate

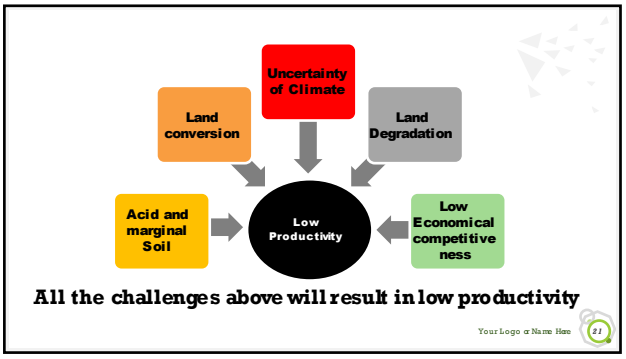
- Explosion of plant pests and diseases
- Decrease in production due to extreme dry season

Land degradation

- Erotion and run off are occur especially in steep land
- Excessive use of chemical fertilizer and pesticide

Low Economical Competitiveness

- The farmers have to deal with low purchase price of the commodities
- Low B/C ratio, NPV and IRR



All the challenges above will result in low productivity

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The Solutions

1. Research on the use of organic materials to improve soil fertility
2. Improvement of management plant pests and diseases
3. Implementation of Agrofishery, Agropastural and agroforestry
4. Implementation of soil and water conservation practices

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Team

Prof. Irwan S. Banuwa
Dean of Agriculture Faculty, Unila

Dr. Abdullah A. Damai
Vice Dean of Financial Affair

Prof. Udin Hasanudin
The Head of Tropical Biomass Research Center

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Thank You very much

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Major agricultural commodities of Lampung Province

No	Commodities	Total Area (ha)	Total Production (ton)	National Ranking
1	Cassava	279.337	7.387.084	1
2	Sugar Cane	12.002	75.124	1
3	Coffee	126.888	117.016	2
4	Pepper	54.503	20.854	2
5	Coconut	88.021	81.256	7
6	Cocoa	23.224	12.447	8
7	Rubber	67.771	42.117	10
8	Palm oil	79.338	158.115	11

(Sumber : Dinas Perdagangan Provinsi Lampung, 2018)

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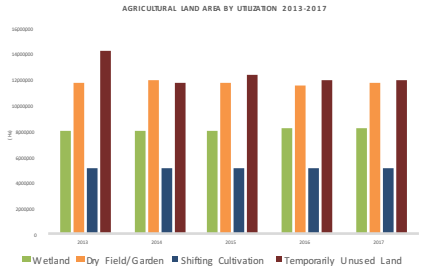
AGRICULTURAL LAND AREA BY UTILIZATION



1. Dry Field/Garden/Plantation is the largest agricultural Land Area
2. Land use changes occur, especially on wetland/paddy field

Source : Statistics of Agricultural Land 2013-2017

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Royal University of Agriculture

3

Project Preliminary Meeting in Can Tho

Challenges in Agriculture in Cambodia

MR. NARETH NUT, Project Collaborator

09TH FEBRUARY, 2019

I. Country Review

- Total area: 181,035 km²
- Total population in 2016
  - *15.9 millions (51 % are women)*
- Population by Urban - Rural residence
  - *Urban = 20%*
  - *Rural = 80 %*
- Population growth: 1.64% per annum

I. Country Review – *cont'd*

- **Agrarian country**: 80% of population live in rural areas:
  - Central lowland along Mekong River: 49 %
  - Around Tonle Sap Lake: 33 %
  - Around coastal zone: 7 %
  - High land or plateau zone: 11 %

I. Country Review – *cont'd*

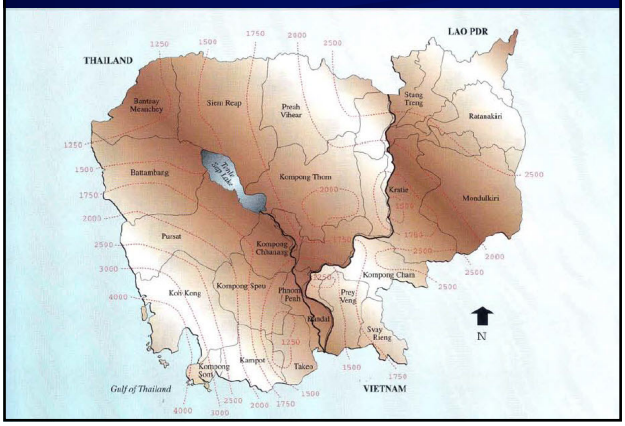
- **Climate: Tropical climate/Monsoon**
  - Rainy season: May - October
  - Dry season: November - April
  - Average annual monsoon rainfall:
    - ✓ Minimum: 1,441 mm
    - ✓ Maximum: 1,968 mm
  - Average annual temperature:
    - ✓ Minimum: 23.3 °C
    - ✓ Maximum: 34.9 °C
  - 25 provinces, Phnom Penh municipality, and 26 cities/krongs.

I. Country Review – *cont'd*

- **Total cultivated area of 4,505,267 ha in 2013**
  - Rice: 68%
  - Subsidiary and industrial crops: 21%
  - Permanent crop: 4%
  - Rubber plantation: 7%
- **Employment in agriculture**: Approximately 70% of the total population.

5

Rainfall distribution in Cambodia



II. Challenges in Agriculture in Cambodia

There are different inter-related challenges facing agricultural development in Cambodia. These are poor performance in regional trade, speculative land price distortions, un-performing economic land concessions, finance, market information, and infrastructure etc.

- ***Poor performance in regional trade***: Cambodia has not benefited as it should have from regional markets (only 13 percent of its trade is intra-regional, against an average of 49 percent). A tremendous potential to integrate further into the Asia region with preferential market access to development partner countries, like China, India, Australia, New Zealand, Japan, and South Korea.
- ***Weak cross border trade facilitation:*** In the World Bank "Doing Business" rankings for 2010, Cambodia is ranked 22nd out of 24 East Asia and Pacificnations in the overall index and 21st out of 24 in the "trading across frontiers" index.

- ***Speculative land price distortions:*** Cambodia still suffers from the perverse effects of the land price distortions arising from the speculative bubbled of the pre-global financial crisis years, which is diluting Cambodia's perceived comparative advantages of a country with a relatively abundant land, natural assets, and inexpensive labor.
- ***Underperforming Economic Land Concessions (ELC):*** The ELC approach has not delivered the expected results. Out of some 60 ELCs, but only a small fraction of these are have actively invested in the concessions, and many of others still entangled in numerous conflicts with indigenous communities over traditional use of land and forest and, by law, a right to this use).

- ***The intractable sanitary and phytosanitary issues:*** Cambodia does not have a compliant basic Sanitary and Phyto-Sanitary management system in place at the moment, which allows its exports of livestock and the fisheries products to key markets like the EU and China, for example.
- ***Finance Shortage:*** There are four main challenges for the rice export of Cambodia: lack of capital to buy unmilled rice surplus from farmers is the most important issue, lack of rice storage capacity, low level of unmilled rice drying capacity, and not enough middlemen. For the year 2010, Cambodia's local middlemen could buy only 0.5 million tons while 3 million and 8 thousand tons of rice were exported to Thailand and Vietnam for further processing and packaging. According to some experts, it needs additional $800 million in order to buy all unmilled rice surplus from the local farmers.

- ***Weak production infrastructure***
  - ***Lack of irrigation facilities:*** Approximately 7 percent of cropland is irrigated, the lowest in all of South-East Asia. The dependence of the agriculture sector on rainfall subjects the sector to weather vulnerability.
  - ***Inadequate fertilizer usage:*** Fertilizer usage in Cambodia is significantly lower than in neighboring countries at about 5-6 kg/ha, much lower than the average in the region. Only 27 percent of rain-fed farms use inorganic fertilizers, compared to 70 percent of dry season farmers who have access to irrigation.
  - ***Weak collective actions:*** Currently no credible private sector organization for collective action exists in the agriculture sector as a whole or at the sectoral level, like rice or cashew, although there are numerous rice milling associations whose membership is diffuse both geographically and politically.