APN CAPaBLE

- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

Building Capacity of Mekong River Countries to Assess Impacts from Climate Change – Case Study Approach on Assessment of Community Vulnerability and Adaptation to Impact of Climate Change on Water Resources and Food Production

Final Report for APN CAPaBLE Project:
2003-CB01CMY-Chinvanno
2004-CB02CMY-Chinvanno
Project Leader: Suppakorn Chinvanno

Southeast Asia START Regional Center
IHDP · IGBP · WCRP

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Final Report submitted to APN

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Overview of project work and outcomes

Non-technical summary

Climate change is an issue of concern in the Southeast Asia for the reason that, among many other impacts, it may cause shift and change in rainy season pattern that would directly affect agriculture activity and may threaten livelihood of large number of population in the region. In addition, the countries in the region, being developing country, may be vulnerable to climate change impact as they have limited resource to cope with future situation. However, these countries have limited knowledge on the subject and know-how to conduct further study on climate change as well as its consequences.

This project aims to fill the gap by building research capacity in Lao PDR and Thailand. The capacity building approach under this project was not only based on conventional training and workshop alone, but also included pilot research practice on real case study which was conducted under guidance from SEA START RC by using data, method and know-how transferred from other global climate change programs, namely Assessment on Impact and Adaptation to Climate Change in Multiple Sectors and Multiple Regions (AIACC).

These activities covered training and case study research exercise on regional/local climate change analysis and analysis of impacts on water resource and food production (rain-fed rice production) as well as vulnerability & adaptation assessment. Over 60 scientists, academics, government officials, press and local stakeholders were involved in the process. However, these pilot studies were primarily serve as proof of concept on the methodology and research practice as they based on case study, which were conducted in small scale only, but they could lead to the study in larger scale, both at the national level as well as regional level, which could be collaboration initiated out of this capacity building activity.

Objectives

The objective of this capacity building program, which consist of training workshops as well as research exercise on case study basis, is to build personnel as well as institute capacity in Lao PDR and Thailand for research and study on climate change and its impacts, which may expand into the study in multiple scale and various aspects later. This group of trained people may also be able to support preparation of the next National Communication to UNFCCC.

The project aimed to:

- To build human resource and institutional capacity in Lao PDR and Thailand, to understand the process in climate change study and be capable of integrated assessing and formulating adaptation strategy for the impacts of climate change as suggested by UNFCCC to be incorporated in the Second National Communication to UNFCCC (COP8 Decision 17, Paras 25-40);
- To reinforce and enhance the existing regional network for regional cooperation, information exchange, and technology transfer on climate change and impacts on water resource and food production;
- To adapt and refine assessment and analysis technology and techniques developed in other parts of the world to Southeast Asia conditions and limitation by practicing and modifying these know-how to practical study sites in the region;
- To produce guidelines for climate change impact assessment and adaptation policy analysis that are specific for Southeast Asia and Mekong River region using team effort from participants from the region;
- To disseminate technology and techniques gained to wider community in Mekong River countries.

Amount received and number years supported

The Grant awarded to this project was:
- US$ 28,500.- for Year 1 (2003-CB-01)
- US$ 29,585.- for Year 2 (2004-CB-02)

Work undertaken

The work undertaken under this capacity building project covered the implementation of 2 projects, the APN2003-CB01 and APN2004-CB02, which are explained in details as follows;

APN 2003-CB-01

1. Training workshops

1.1 *"The study of future climate scenario and impact of climate change on hydrological regime"* training workshop was held at Burapha University, Thailand, during 12-29 January 2004. The 6 participants from Lao PDR and 6 participants from Thailand were from academic, research institute and government officials had attended the training workshop. Also participated in this workshop as observer were 2 graduate students from Lao PDR who are studying at Mahidol University under scholarship from APN. (see Appendix 1)

1.2 "*The study of impacts of climate change on rain-fed rice production"* training workshop was held at Ubonrachathani University, Thailand during 23 Feb.-1 Mar. 2004. The 4 participants from Lao PDR and 8 participants from Thailand were from academic, research institute and government officials had attended the training workshop. (see Appendix 2)

2. Pilot Research Exercise

As part of the CAPaBLE Program CB-01, in the following up to the training workshops, the scientists who participated in these workshops had further conducted research exercise by using tools, dataset and know-how learned from the workshop. The research exercises were on number of topics as follows,

- Climate change: Summary of future change
  - Climate Change Scenario for Lao PDR
  - Climate Change Scenario for Thailand
- Climate change impact on hydrology
  - Impact of Climate Change on Hydrological Condition in Nam Mun watershed, Thailand
  - Impact of Climate Change on Hydrological Condition in Nam Ngum watershed, Lao PDR
- Climate change impact on food production
  - Climate Scenario Verification and Impact on Rain-fed Rice Production in Thailand
  - Impact of Climate Change on Rice Production in Tung Kula Field, Thailand
  - Impact of Climate Change on Maize, Sugarcane and Cassava Production in N.E., Thailand
  - Impact of Climate Change on Rain-fed Rice Production in Sawannaket Province: Analysis of Climate Change Impact on Low-land Rice Production in Lao PDR

3. Synthesis workshop

A synthesis workshop to synthesize results from number of research exercise was held on 29-30 July 2004 at Lanxang Hotel, Vientiane, Lao PDR. All of the participants to the earlier training workshop had participated in the workshop to present the finding results from all pilot research exercises. Also participated in the workshop were number of policy makers as well as some observers from institutes whose work is related to climate change issue. (see Appendix 3)

APN2004-CB-02

1. Training session - *Workshop on Method and Preparation for the Assessment of Community Vulnerability and Adaptation to Impact of Climate Change / Variability* (Khon Kaen University, Thailand, 28-30 April 2005)

The workshop was to develop a method in assessing community vulnerability and adaptation to climate change impact. The outcomes of the workshop were framework and common method for the assessment vulnerability and adaptation to climate impact and also assessment team formed up for the field assessment in 2 study sites, Vientiane Plain in Lao PDR and Kula Field in Thailand. Total 11 persons from Lao PDR and Thailand had participated in the workshop. (see Appendix 4)

2. Field assessment and data collection exercise (Lao PDR & Thailand, June – July 2005)

The field assessment was part of the research exercise in the assessment on vulnerability of the rain-fed agriculture to impact of climate change. The field assessment was conducted to collect data on household socio-economic information and their coping mechanism as well as capacity to cope with climate impact for use in the analysis on vulnerability to climate impact. The study sites were Vientiane Plain in Lao PDR and Kula Field in Thailand.

3. Synthesis workshop on field assessment analysis (Environmental Research Institute, Lao PDR, 6-7 September 2005)

The workshop was conducted to review the field assessment result and verify preliminary assessment analysis result. Total 8 persons from Lao PDR and Thailand had participated in the workshop. (see Appendix 5)

4. Local stakeholders workshop/focus group activity – stakeholders participation on Adaptation to climate impact (Environmental Research Institute, Lao PDR, 4 November 2005 & Roi-et Land Development Office, Thailand, 7 December 2005)

The workshop was conducted to assess adaptation options from local stakeholder's point of view review toward the adaptation to impact of climate change and variability. Total 23 persons had participated in the workshop in Lao PDR (see Appendix 6) and 16 persons had participated in the workshop in Thailand (see Appendix 7).

Results

This capacity building program has developed research capacity in climate change study for government line agencies and national academic institutes in Lao PDR and Thailand as well as raise awareness in the academic and policy community. In addition, it also created data and information as well as methodology and tool available for future climate change study.

Relevance to the APN CAPaBLE Programme and its Objectives

The CAPaBLE CB-01/CB-02 project has served APN CAPaBLE objectives by enhancing capacity of researchers in developing countries, which focused on Lao PDR and Thailand,

to produce comprehensive scientific information on climate change impacts on water resource and rain-fed food crop production. In addition, it also covered the assessment on vulnerabilities and adaptation opportunities that could be used by policy maker to plan for coping with climate change impact under sustainable development scheme.

Self evaluation

This capacity building activity was a successful initiative in climate change study in the region as it can build reasonable amount of research capacity, network among research community and also raise awareness to the policy maker to understand importance of climate change study and the needs to incorporate the climate change issues into future development plan.

Potential for further work

To continue developing comprehensive research project on climate change impact within the region, ultimately plan toward establishment of virtual research institute on climate change research that is collaboration among various institutes in Southeast Asia countries, which could be built upon the network of researchers who had participated in this capacity building program.

Publications

Proceeding: The APN CAPaBLE CB-01 Synthesis Workshop, Vientiane, Lao PDR – 29-30 July 2004. The Study of Future Climate Change impact on Water Resource and Rain-fed Agriculture Production – Case study in Lao PDR and Thailand

Technical research papers:

- Impact of Climate Change on Rainfed Lowland Rice Production in Savannakhet Province, Lao PDR
- Climate scenario verification and impact on rain-fed rice production in Thailand
- Impact of climate change on rice production in Kula Ronghai Field, Thailand
- Impact of climate change on maize, sugarcane and cassava production in northeastern region of Thailand
- Assessment on impact and adaptation to climate change: The study on vulnerability and adaptation options of rain-fed farmer in Kula Ronghai Field, Thailand
- The study on vulnerability and adaptation of rain-fed farmer to impact of climate change: Case study at Vientiane Plain, Lao PDR

Acknowledgments

Environmental Research Institute and Water Resource Coordinating Committee, Office of Prime Minister, Lao PDR for coordinating the research teams to participate in this capacity building program as well as other local pilot research exercise activity.

Burapha University, Ubonratchathani University and Khon Kaen University, Thailand for hosting the training workshops, which were conducted under this capacity building program.

Multiple Cropping Center of Chiang Mai University, Thailand for providing expertise support in research on climate change impact on crop cultivation on the training as well as pilot research exercises conducted under this capacity building program.

Assessment on Impact and Adaptation to Climate Change (AIACC) Regional Study AS07 for providing dataset, tools and methodology for the use in the training workshop and field assessment & analysis.

Technical Report

Abstract

This project aimed to build research capacity in climate change study for Thailand and Lao PDR. The activities include training workshop as well as research exercise practice on case study basis. Over 60 scientists, academics, government officials, press and local stakeholders were involved in the process. The research capacity has been developed around the understanding of climate scenario, the hydrological analysis and crop yield analysis using modeling approach. In addition, field assessment, which involves direct local stakeholder participation, was conducted in both countries. The result from this activity was not only research capacity developed but also awareness among policy maker as well as public be raised on the climate change issues.

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1.0 Introduction

As the countries in the Southeast Asia are required by UNFCCC to prepare the second National Communication, which is the report on climate change impact of the country, however, the research capacity on the subject in this region is limited. The project CAPaBLE CB-01/CB-02 aim to build research capacity on the climate change study in Lao PDR and Thailand, while hoping that the method and result gain from the research exercises under this project will also be beneficial to the whole Southeast region. The participants, who had participated in this capacity building project, were from both academic institutes as well as government line agencies from Lao PDR and Thailand.

The implementation of the project was based on training workshop on the analysis of climate change and its impact on bio-physical system, particularly hydrology and rain-fed agriculture. Furthermore, the project also covered the assessment on community vulnerability and adaptation to impact of climate change. In addition to the training workshop, the participated researchers also conducted number of pilot study as research exercises, which was base on case study basis.

The training and practiced research exercises under this project include the following subjects:

- Climate change scenario in Thailand and Lao PDR
- Impact of climate change on hydrological regime of the major watersheds in Lao PDR and Thailand: modeling approach study
- Impact of climate change on rain-fed agriculture: modeling approach study
- Assessment on vulnerability and adaptation to climate change: stakeholder participatory approach

2.0 Training and Workshop Outputs

APN 2003-CB-01

1. Training workshops – trained scientists
1.1 Training workshop on “The study of future climate scenario and impact of climate change on hydrological regime” – 12 scientists from Lao PDR and Thailand were trained on the climate scenario and hydrological analysis.
1.2 Training workshop on “The study of impacts of climate change on rain-fed rice production” – 12 scientists from Lao PDR and Thailand were trained on the climate scenario and crop modelling.
2. Pilot Research Exercise – Technical papers
2.1 Climate Scenario Verification and Impact on Rain-fed Rice Production in Thailand
2.2 Impact of Climate Change on Rice Production in Tung Kula Field, Thailand
2.3 Impact of Climate Change on Maize, Sugarcane and Cassava Production in N.E., Thailand
2.4 Impact of Climate Change on Rain-fed Rice Production in Sawannaket Province: Analysis of Climate Change Impact on Low-land Rice Production in Lao PDR
3. Synthesis workshop – Proceeding “The Study of Future Climate Change impact on Water Resource and Rain-fed Agriculture Production – Case study in Lao PDR and Thailand”

APN2004-CB-02

1. Training Workshop on “Method and Preparation for the Assessment of community Vulnerability and Adaptation to Impact of Climate Change / Variability” – 11 trained researchers / research assistants
2. Technical papers
2.1 The study on vulnerability and adaptation of rain-fed farmer to impact of climate change: Case study at Vientiane Plain, Lao PDR
2.2 Assessment on impact and adaptation to climate change: The study on

vulnerability and adaptation options of rain-fed farmer in Kula Ronghai Field, Thailand

3.0 Research Outputs

The research studies under this project were pilot research exercise to ensure that the knowledge gained from the training workshop was put into real practice. The CAPaBLE CB-01 focused on the analysis of climate change and its impact on bio-physical systems, while the CAPaBLE CB-02 focused on the assessment on community vulnerability and adaptation to climate change, which was conducted on study sites in Lao PDR and Thailand.

The brief summary of the research exercises are as follows:

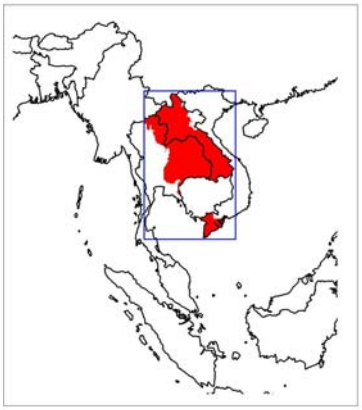
3.1 CAPaBLE CB-01

3.1.1 Climate change scenarios and impact on water resources in major watershed in Lao PDR and Thailand

By

- *Wirote Laongmanee, SEA START RC, Thailand*
- *Oulaphone Ongkeo, Dept. of Irrigation, Ministry of Agriculture, Lao PDR*
- *Keophusone Phonhalath, National University of Laos, Lao PDR*
- *Vivarath Sihabouj, National University of Laos, Lao PDR*
- *Boontium Lersupavithnapa, Ubonratchathani University*

The climate change scenario in this pilot study was part of the research and capacity building project namely, Assessment of Impact and Adaptation to Climate Change in Multiple Regions and Multiple Sectors (AIACC), regional study AS07 “Southeast Asia Regional Vulnerability to Changing Water Resource and Extreme Hydrological Events due to Climate Change” (2003 – 2006). Under the AIACC study, the climate scenario was generated for the whole sub-continent, covering Southeast Asia as well as southern part of China. This CAPaBLE CB-01 had extracted part of the numerical climate data from the original simulation for conducting research exercise in the analysis of climate change in Lao PDR and Thailand.



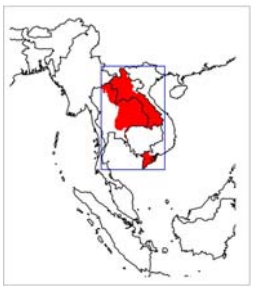
The climate scenario was based on computer simulation using mathematical modelling technique. The simulation of climate scenarios was based on high-resolution climate modelling as the downscaling technique has been proven to be unable to give accurate result for the region. The climate model used for this simulation is Conformal Cubic Atmospheric Model (CCAM), which is the second-generation regional climate model developed specifically for Australasian region by the CSIRO Division of Atmospheric Research in Australia. (McGregor et al, 1998) CCAM has also been evaluates in several international model inter-comparison exercises to be among the best climate model for Asian region. The model uses the principle of stretched coordinate of a global model

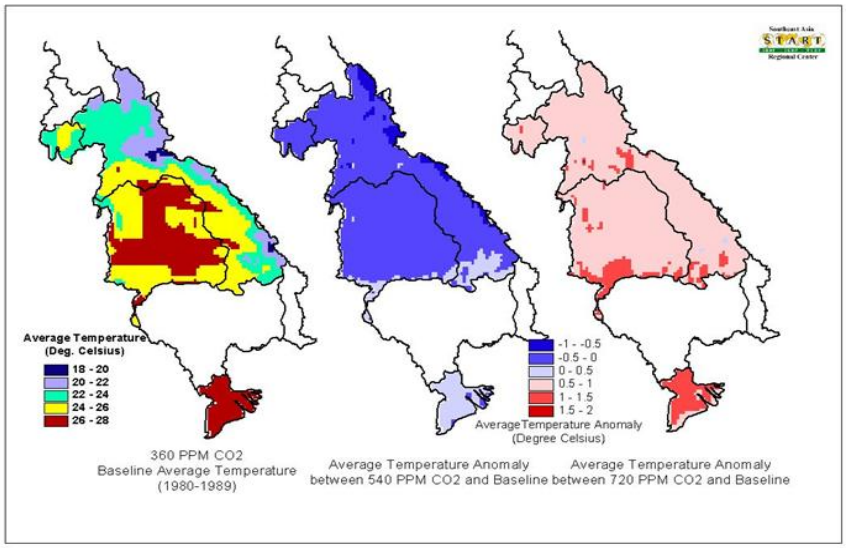
instead of uniform latitude-longitude grid system, which help minimizing 'bouncing' effect at the boundary and runs for 18 vertical levels including the stratosphere. It addresses both climate change and climate variability. In addition, it generates daily climate output which is necessary for downstream impact study, e.g. for use in the modelling of hydrological regime and crop production.

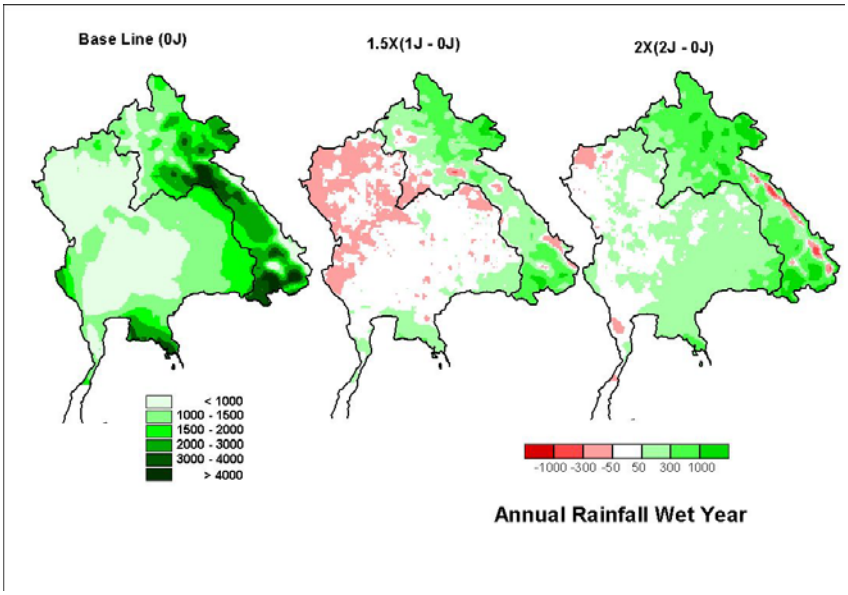
The driving force that was used for the generating of this set of climate scenarios was the rising of atmospheric CO_2 concentration as CO_2 is the largest contributor to anthropogenic radiative forcing of the atmosphere (SRES, 2000). The future climate scenarios were simulated based on the condition of different atmospheric CO_2 concentration levels. The atmospheric CO_2 concentration at 360 ppm, which is the CO_2 concentration level approximately at present time (or to be more precise such condition was around the decade of the 1980s), was used for the simulating of baseline condition climate scenario. The future climate scenarios were simulated at CO_2 concentration of 540 ppm and 720 ppm (or at 1.5 time and double of baseline condition). Rising of atmospheric CO_2 is from the burning of fuel fossil and industry. The increasing of atmospheric CO_2 concentration in the future may vary and would reach the condition used for this scenario simulation at different time in the future depends on the emission condition, which is based upon the world socio-economic condition in the future (see Figure 1). For example, under SRES scenario A1FI, the world atmosphere would reach CO_2 concentration level of 540 ppm and 720 ppm at around the middle and toward the end of this century (approximately in the 2040s and 2070s respectively) (SRES, 2000).

From the analysis of climate scenarios in the research exercise under this study, the result indicates that the region in general is expected to be slightly warmer and possibly wetter when the atmospheric CO_2 is raised to 540 ppm. On average over the region, the daily maximum temperature would be changing by $\pm 0.5\ ^{o}C$. Some simulated 'cooling' effect could be due to more cloud in the region. When the CO_2 is further elevated to 720 ppm, most of the region is expected to be significantly warmer by about $1\ ^{o}C$ relative to the baseline period. The night-time temperature would be more affected especially during the cool period of the year (Dec-Jan-Feb) and the number of cool days should be significantly less. Rainfall is also expected to more prominently increase, especially nearer to the coast.

The climate of the Lao PDR part of the Mekong is expected to be most affected by elevated atmospheric CO_2 where the area would be clearly warmer and wetter, especially during the wet period of the year (March to August). Mean rainfall during the wet period could be up by over 30% both at 540 and 720 ppm CO_2. On the other hand, the Upper Chao Phraya River in Thailand is expected to be least affected by elevated CO_2, where only temperature increase is clearly seen, but rainfall is expected to only increase during the dry period of the year (September to February).

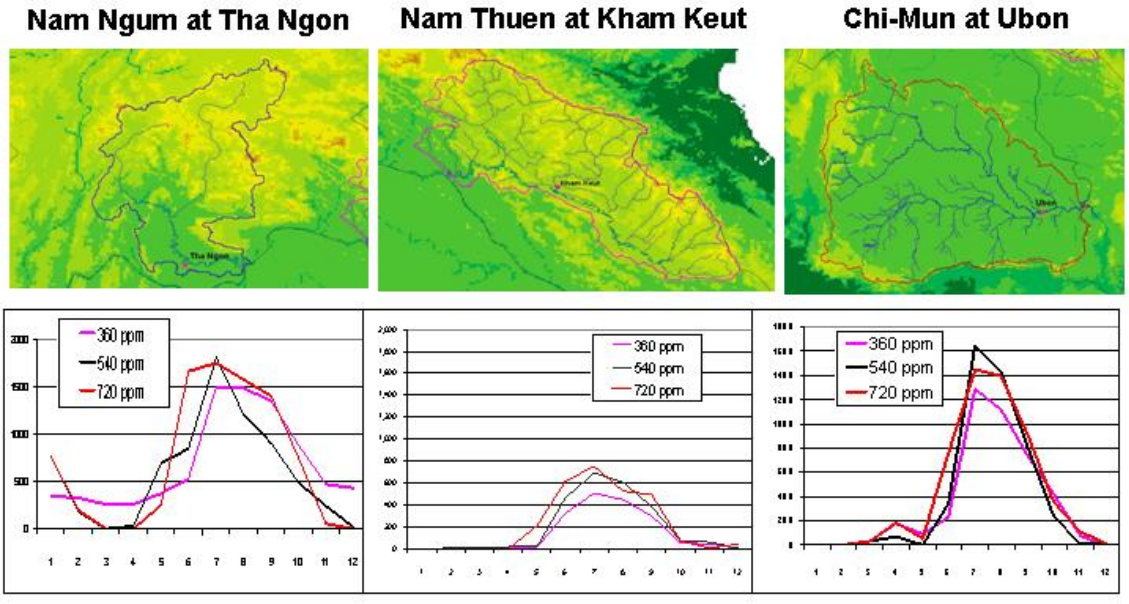






The training workshop conducted in the CAPaBLE CB-01 also covered the hydrological analysis using Variable Infiltration Capacity (VIC) hydrological model. VIC is a macro-scale hydrologic model that solves full water and energy balances, originally developed by Xu Liang at the University of Washington. The research exercise selected 3 major watersheds in Lao PDR and Thailand as case study, Nam Ngum and Nam Thuen watersheds in Lao PDR and Chi-Mun watershed in Thailand. The analysis deom the research exercise shows result in higher discharge from all 3 watersheds in the future under influence of climate change. This may due to increasing of annual precipitation in the region.

Simulated watershed discharge under different climate scenarios



3.1.2 Climate Scenario Verification and Impact on Rain-fed Rice Production

By

- *Chitnucha Buddhaboon, Prachinburi Rice Research Center*
- *Sahasachai Kongton, Land Development Department, Ministry of Agriculture and Cooperatives, Thailand*
- *Attachai Jintrawet, Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, Thailand*

Three selected provinces in Thailand for conducting the research to verify climate scenarios and its' potential impact on rain-fed rice production were Chiang Rai, Sakonnakorn and Sakaeo province. They were located at high, medium and low latitude along Mekong River Basin (MRB), in Thailand side. Climate data were separately generated to be three scenarios by the Conformal Cubic Atmospheric Model (CCAM) under governing of SEA START RC (Southeast Asia START Regional Center), base year line (1xCO_2, 1980-1989), 1.5xCO_2 (2040-2049), and 2.0xCO_2 (2066-2075). While the observed weather data were recorded and provided by the Department of Meteorology.

Chiang Rai weather data comparisons

Annual rain fall, maximum rain fall per day and average temperature was not significant difference between simulated and observed weather data. The agreement of seasonal pattern of temperature was good. Average of annual rain fall, maximum rain fall per day (Figure 3) and average temperature of simulation (Figure 4) were 1,413 ($\pm$74) mm, 63 ($\pm$12) mm and 24.4 ($\pm$0.6) ^{o}C, compared with 1,648 ($\pm$23) mm, 102 ($\pm$33) mm and 24.7 ($\pm$0.2) ^{o}C of observation, respectively. Number of rain fall day per year of observation weather data (140 $\pm$8 days) was higher than simulation data (115 $\pm$8 days). Consideration of maximum/minimum temperature, the gap between maximum and minimum temperature of simulation (32.0 $\pm$0.8 - 16.7 $\pm$0.5 ^{o}C) was greater than observation (30.7 $\pm$0.3 - 18.8 $\pm$0.2 ^{o}C). However, average temperature was not significant difference between simulated and observed weather data.

There was a good agreement of observation and simulation weather data in term of annual precipitation and daily temperature pattern (Figure 4). But in terms of precipitation distributions (Figure 1) and the gap of maximum and minimum of air temperature would be a little readjusted for more accurate generation scenario.

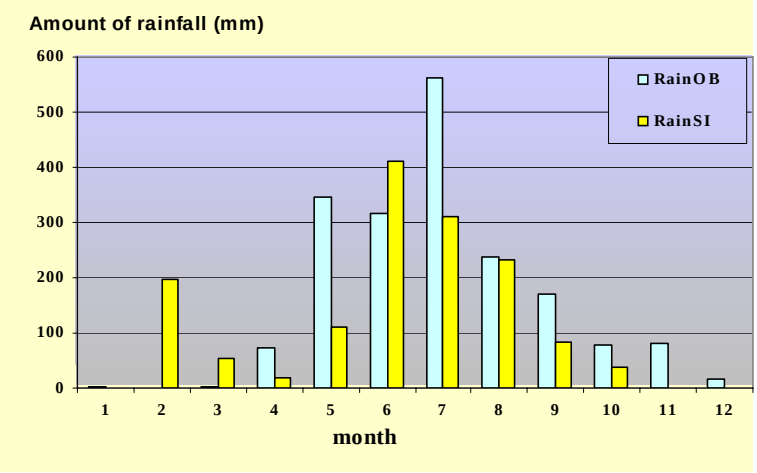


Figure 1. Simulated and observed amount of monthly rain fall comparisons of Chiang Rai province, 1981 (RainOB = observation rain fall RainSI = Simulation rain fall)

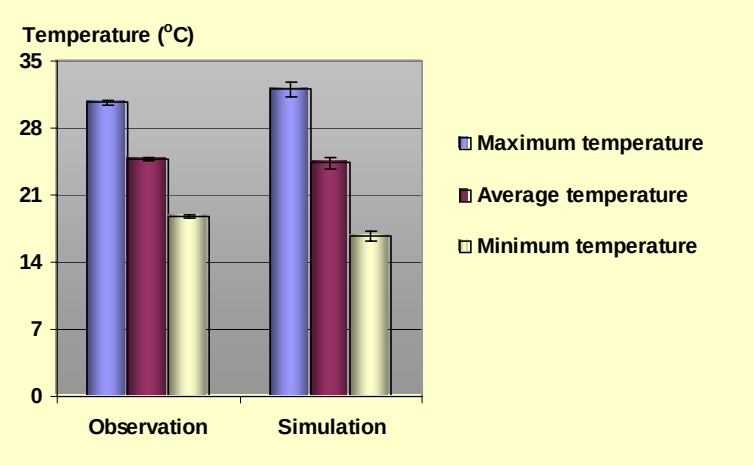


Figure 2. Minimum/minimum and average temperature of observation and simulation weather data comparison of Chiang Rai, 1981 (I = standard deviation)

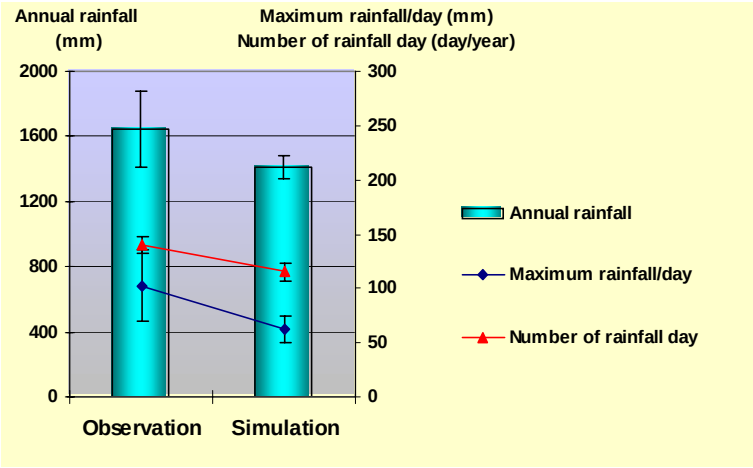
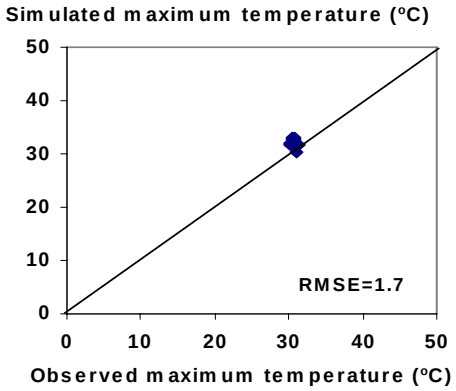


Figure 3. Annual rain fall, maximum of rain fall per day and number of rain fall day per year of observation and simulation comparison of Chiang Rai province, 1981
(I = standard deviation)



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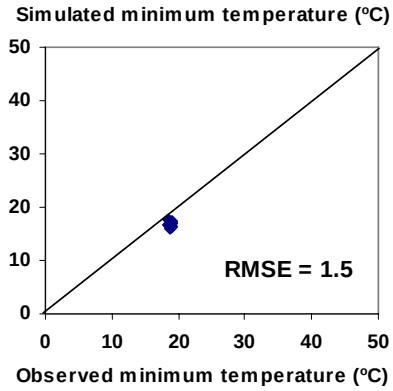

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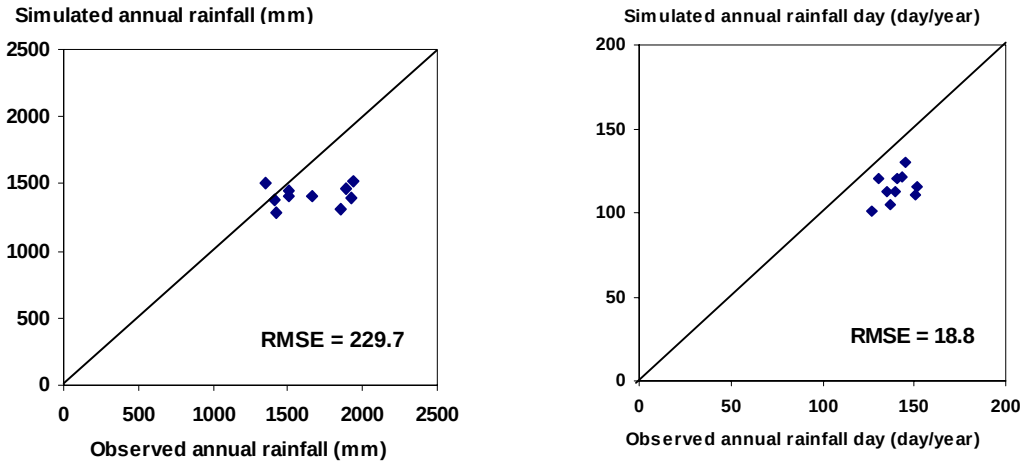


C D

Figure 4. Comparisons of observed and simulated weather data of Chiang Rai province during 1980-1989, A = maximum temperature, B = minimum temperature C = annual rain fall and D = number of rain fall day per year.

Sakonnakorn weather data comparisons

There was no significant difference of annual rain fall, maximum rain fall per day (Figure 10), maximum/minimum and average temperature of simulated and observed weather data (Figure 6). The agreement of seasonal pattern of temperature was good (Figure 7). Even the average ten years of annual rain fall of observation (1,576 mm) was higher than simulation in term of average value, but standard deviation (286) of which was high, so that there was no significant difference. Same as Chiang Rai province, there was a significant difference of the number of rain fall day per year. The average ten year of rain fall day of simulation was 89 ($\pm$9) days per year compared with 130 ($\pm$10) days of observation. The over all agreement of weather data between simulation and observation was good, both quantity and seasonal pattern (Figure 8), except the distribution of precipitation (Figure 5).

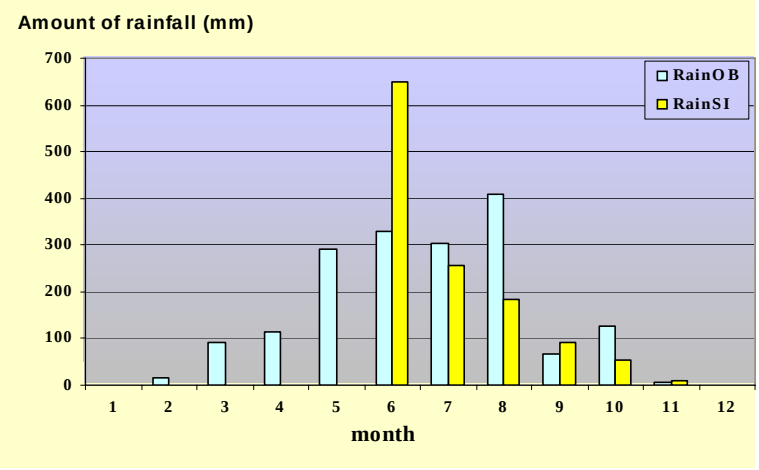


Figure 5. Simulated and observed amount of monthly rain fall comparisons of Sakonnakorn province, 1981 (RainOB = observation rain fall, RainSI = Simulation rain fall)

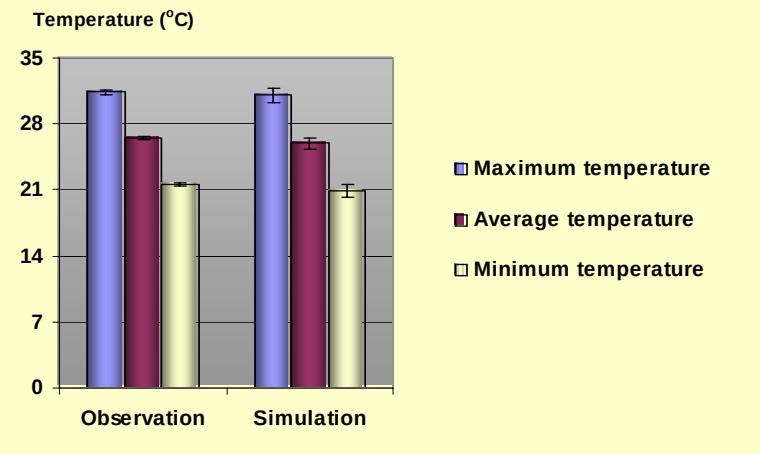


Figure 6. Maximum/minimum and average temperature of observation and simulation weather data comparison of Sakonnakorn province, 1981 (I = standard deviation)

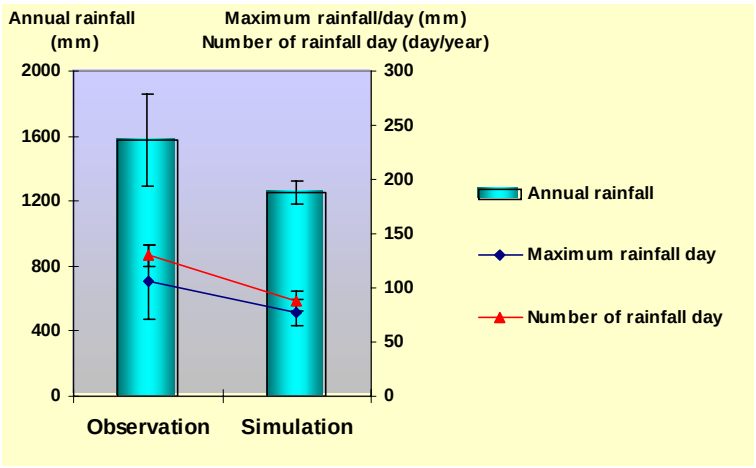
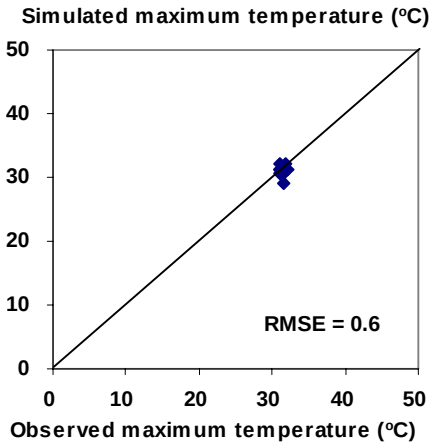


Figure 7. Annual rain fall, maximum of rain fall per day and number of rain fall day per year of observation and simulation comparison of Sakonnakorn province, 1981 (I = standard deviation)



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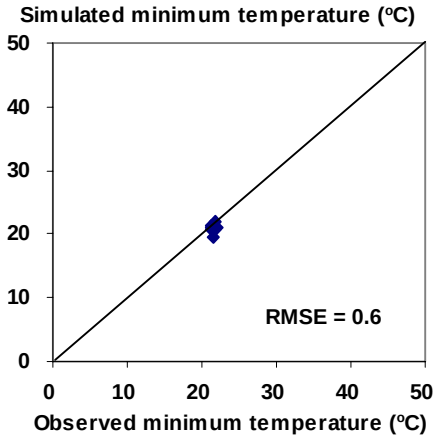

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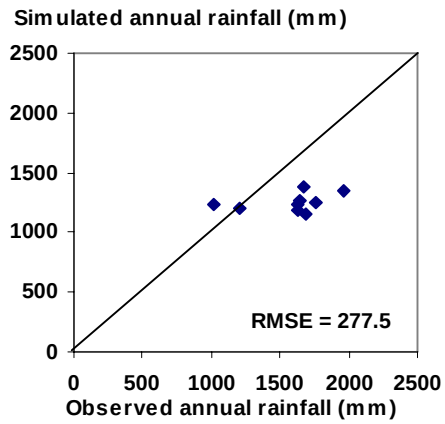
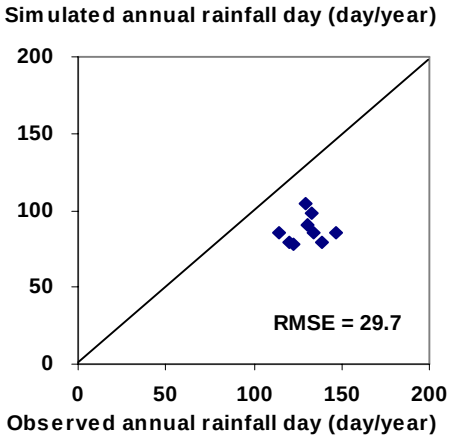




C D

Figure 8. Comparisons of observed and simulated weather data of Sakonnakorn province during 1980-1989, A = maximum temperature, B = minimum temperature C = annual rain fall and D = number of rain fall day

Sakaeo weather data comparison

The agreement of seasonal pattern of temperature was good. The annual rail fall and the number of rain fall day per year was not significant difference between simulation and observation data (Figure 11). Maximum rain fall per day of observation was 84 (±20), which was higher than 48 (±14) of simulation (Figure 11). The maximum/minimum and average temperature of observations were 33.4 (±0.3), 23.3 (±0.2) and 28.3 (±0.3) ^{o}C, which were higher than 31.9 (±0.6), 20.6 (±0.3) and 26.2 (±0.5) ^{o}C of simulation, respectively (Figure 10). The agreement of precipitation pattern of simulation and observation was good, in term of rain fall distribution compared with the other two provinces (Figure 9). The over all agreement of weather data between simulation and observation was good (Figure 12).

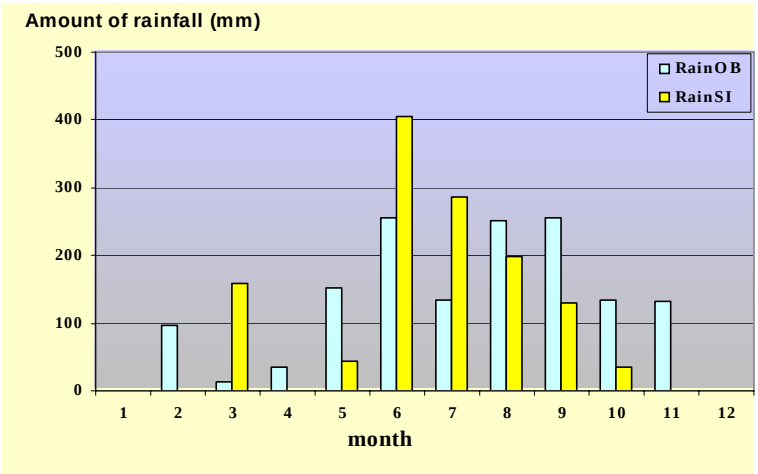


Figure 9. Simulated and observed amount of monthly rain fall comparisons of Sakaeo province, 1981 (RainOB = observation rain fall, RainSI = Simulation rain fall)

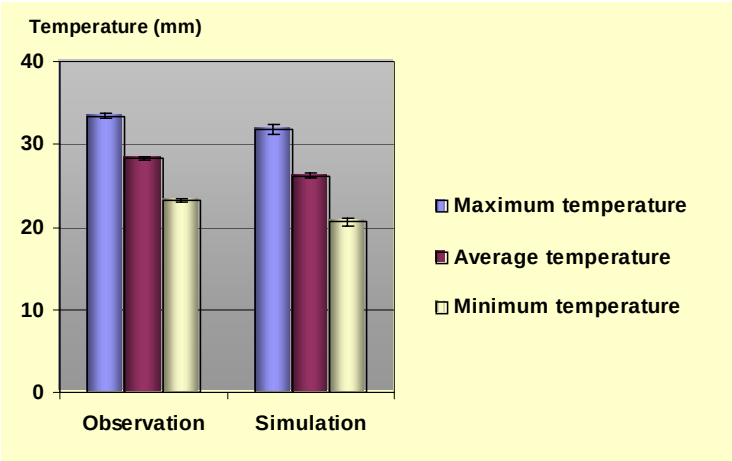


Figure 10. Maximum/minimum and average temperature of observation and simulation weather data comparison of Sakaeo province, 1981 (I = standard deviation)

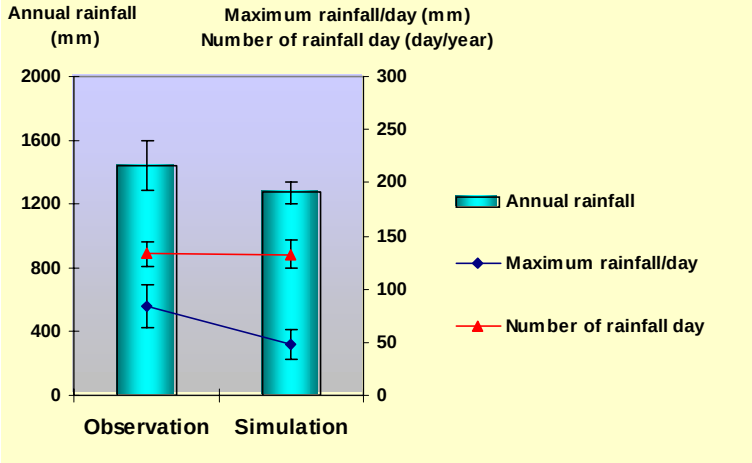


Figure 11. Annual rain fall, maximum of rain fall per day and number of rain fall day per year of observation and simulation comparison of Sakonnakorn province, 1981 (I = standard deviation)

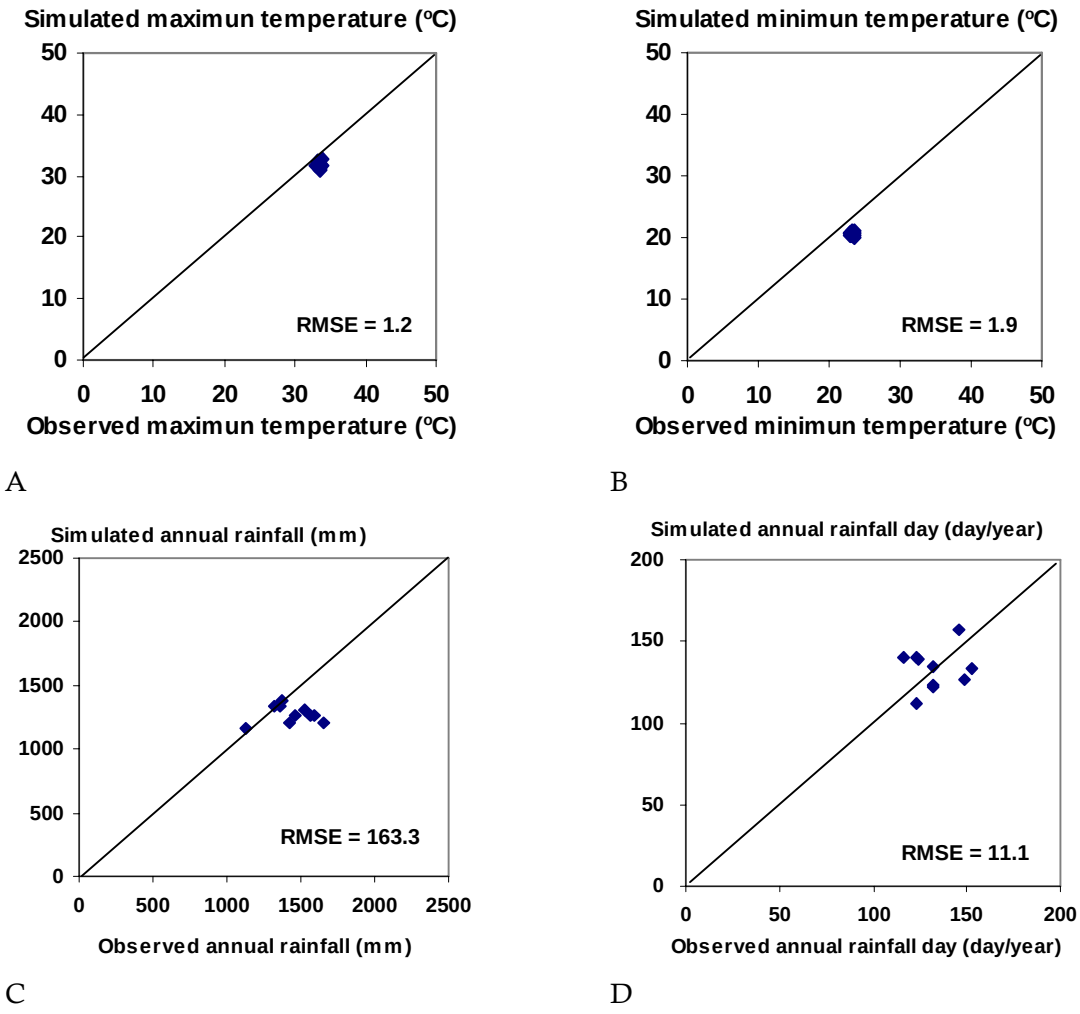


Figure 12. Comparisons of observed and simulated weather data of Sakaeo province during 1980-1989, A = maximum temperature, B = minimum temperature C = annual rain fall and D = number of rain fall day

Impact of climate change on rice productivity

Simulated and observed weather data of each location were compared and were used to run simulation model for assessment their impacts on rice production. Yield of KDML105 rice variety was simulated by MRB-rice shell. Weather comparisons found that the observed annual rain fall tended to be slightly higher than simulated value. The agreements between observed and simulated value of minimum and maximum temperature were good. The seasonal pattern of the temperature was also good agreement. Simulated rice yields on the baseline year were not significant difference to observed yields. The agreement between simulated and recorded rice yields was good. Simulated rice yields under three climate scenarios were not significant difference. Even though, the average rice yields of 2.0 CO_2 scenarios tended to be slightly increased, compared to other two scenarios, but it was also higher standard deviation. Over three locations of 1.0, 1.5 and 2.0 CO_2 scenarios, the average rice yields were 2522 ($\pm$216), 2552 ($\pm$270) and 2836 ($\pm$540) kg ha^{-1}, respectively. In addition, dry, medium and wet year scenarios did not affect on rice yields.

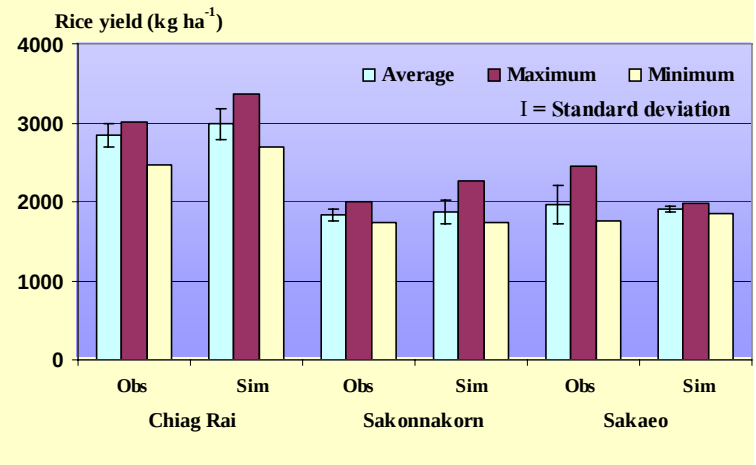


Figure 13. Comparison of simulated rice yields under observation and generated weather data on base year line (1981-89) of Chiang Rai, Sakonnakorn and Sakaeo province

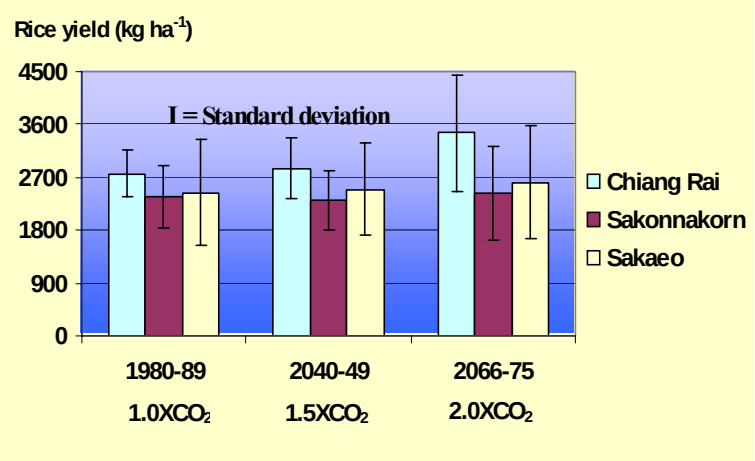


Figure 14. Simulated rice yields under three scenarios of three provinces

3.1.3 Impacts of Climate Change on Rice Production in Kula Ronghai Field

By

- *Vichien Kerdsuk, Research and Development Institute, Khon Kaen University, Thailand*
- *Sahaschai Kongton, Land Development Department, Ministry of Agriculture and Cooperatives, Thailand*
- *Attachai Jintrawet, Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, Thailand*

The objectives of this study are 1) to study the potential of climate change impacts on KDML105 rice 2) to study adaptation of rice farmer to climate change situations and 3) to propose the short and long term policy for rice production in Tung Kula field. The study uses MRB-Rice shell, which link the CERES-Rice model V4.0 and spatial databases. We use simulated weather data from the CCAM climate model, which cover three periods (year 1980-89, 2040-49 and 2066-75). The simulation setting are as follows; growing KDML105 rice on June1 by direct seeding method and set CO_2 concentration at 1.5, 2.0 times of normal year (year 1980-89) in the year 2040-49 and year 2066-75 simultaneous.

The analysis results shown that climate change have positive impact on KDML105 rice yield in Tung Kula field in the future. Adaptation of farmers for growing KDML105 rice could be by changing the planting date from 1 June to 15 May. It is shown

KDML105 rice yield is not significant in three periods of climate and lower than grow its on 1 June very much. The recommend from this study are: 1) the government have to the master plan to improve KDML105 rice variety to a suitable for Tung Kula field. 2) It has work plan for protecting the area from flood. And 3) Studying a suitable of planting methods and managements for KDML105 rice in the future.

3.1.4 Impact of Climate Change on Rainfed Lowland Rice Production in Savannakhet Province, Lao PDR

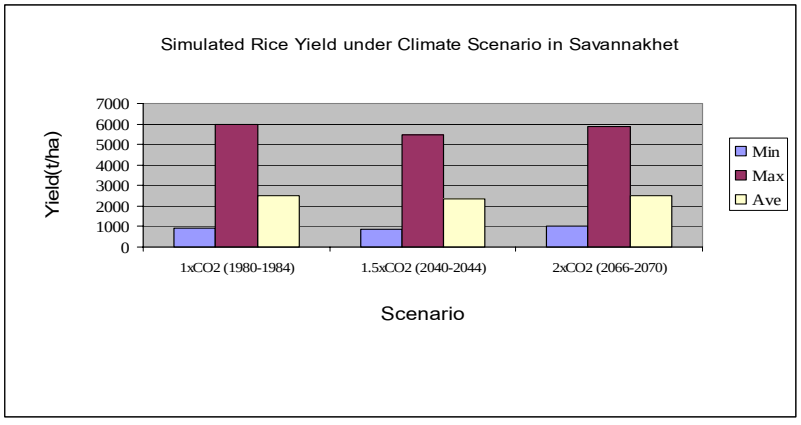
By

- *Thavone Inthavong, National Agriculture and Forestry Research Institute, Vientiane, Lao PDR*
- *Attachai Jintrawet, Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, Thailand*
- *Suppakorn Chinvanno, Southeast Asia START Regional Center, Chulalongkorn University, Thailand*
- *Anond Snidvongs, Southeast Asia START Regional Center, Chulalongkorn University, Thailand*

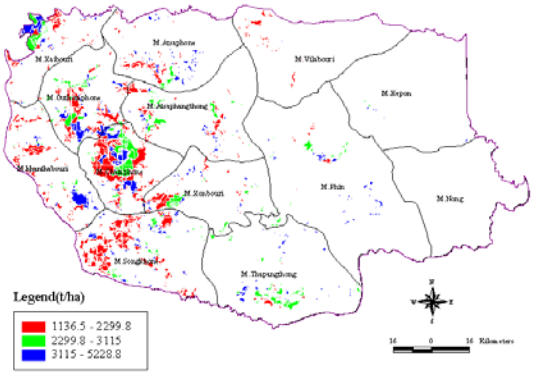
The objective of this study is to estimate the impact of climate change on rice production in rain-fed lowland rice growing area in Savannakhet Province, which is one of the six important rice-growing areas in Lao PDR.

The MRB Rice Shell of the CERES-Rice Model was used to simulate the impact of climate on processes that control growth, physiology and morphology of rice. The rice variety 'Tha Dok Kham 1' (TDK1) which was an improved variety widely grown in the area was used in this study. The model was run for present baseline climate (at 360 ppm CO_2) and at 1.5 times (540 ppm CO_2) and at 2 times (720 ppm CO_2) to represent some future climate scenarios. The daily climate from Conformal Cubic Atmospheric Model (CCAM) was empirically rescaled using the observed data at 8 meteorological stations in Lao PDR using the Sigmoid Curve Relationship before the adjusted climate were used to drive the rice model.

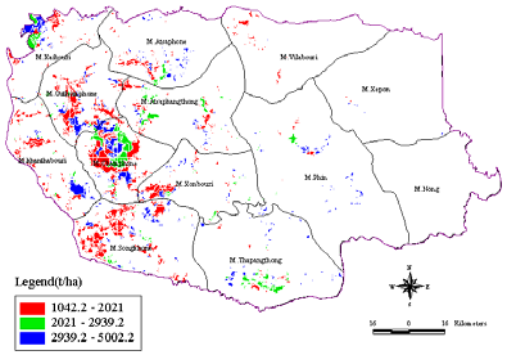
The results showed that the production of TDK1 rice under present climate condition (360 ppm CO_2) without any uses of fertilizer was between 1,800-5,100 kg/ha. However, the future climate change condition driven by elevated CO_2 under this study had small effect on rice production as the production yield under climate condition at CO_2 concentration of 540 and 720 ppm remain to be 2,000-5,900 and 2,000-5,600 kg/ha, respectively.



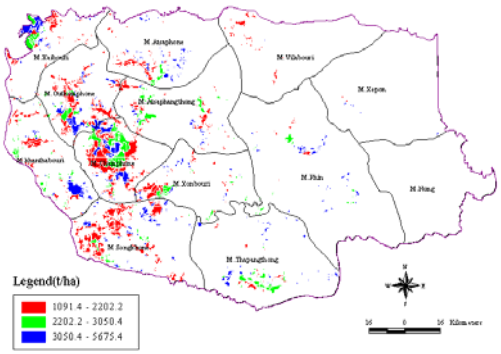
Average Rice Yield on Scenario1xCO2 of Savannakhet



Average Rice Yield on Scenario1.5xCO2 of Savannakhet



Average Rice Yield on Scenario2xCO2 of Savannakhet

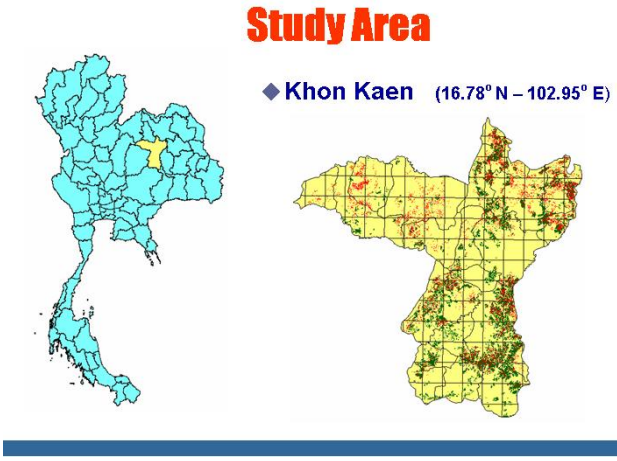


3.1.5 Impact of climate change on maize, sugarcane and cassava production in Northeastern region of Thailand : Study area at Khon Kaen province

By

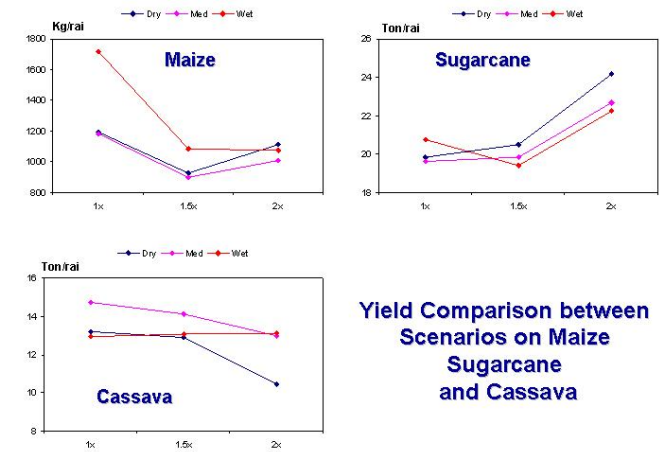
- *Vinai Sarawat, Khon Kaen Field Crop Research Center*
- *Sukit Ratanasriwong, Roi Et Agricultural Resources Service Center*
- *Sahaschai Kongton, Land Development Department, Ministry of Agriculture*

Comparison between the yields of maize, sugarcane and cassava among the scenarios of GHGs generated by CCAM models using as input to analyze the impact of climate change at Khon Kaen province as the representative area of North-eastern region of Thailand.



The results from the models show that under different scenarios of CO_2 conditions affected the flowering and maturity days of maize and some characterization of sugarcane and cassava phenology. Effect of with and without fertilizer application is determined separately. The result of the simulation using scenarios of 1.5 – 2X of CO_2 derived from CCAM models developed in Australia shows relatively change with maximum temperature increased 1-2 ^{0}C while precipitation increased when compared to 1X scenarios.

The analysis result also shows that future climate condition under climate change increase maize and sugarcane production yield in Khon Kaen but cassava yield will decrease. Applying fertilizer could reduce the fluctuation of impact and even reduce 2 – 4 anthesis days and 3 – 10 maturity days. The period of sugarcane development is shorter while CO_2 increase however cane biomass at 14 th leaf stage shows slightly increase. It is obvious that for wet year biomass at 14 th leaf stage decrease while CO_2 increased. Both sucrose and stalk yield showed the same trend as biomass at 14 th leaf stage for dry year at 2X CO_2 has noticeable increased. Storage root yield of cassava evidenced decrease in the dry and median year but remarkable increased for the wet year while first branching date generally decrease between 1.5 and 2X compare to 1X. In case of harvest index show that it decreased while CO_2 increased but contrast with maximum LAI except in dry year.



The analysis of potential climate change impacts of 3 crops, despite its limitations, suggests that Thailand is exposed to the risk of such negative effects. Since the impacts of climate change are expected to occur over a long-term horizon, vulnerability and adaptation also depends on the structural change in the agriculture

sector in the future. It is difficult to envisage the structure of agriculture in Thailand over the next 50 – 100 years. Nevertheless, it was forecasted that about 40 – 50 % of population would still be dependent on the agriculture sector over the next 25 years. The major economic crops in Thailand would probably remain the same, though others crops such as fruit tree and market vegetables will increase. Livestock would also be important in the future soon.

3.2 CAPaBLE CB-02

3.2.1 The study on vulnerability and adaptation of rain-fed farmer to impact of climate change: Case study at Vientiane Plain, Lao PDR

By

- *Soulideth Souvannalath, Environmental Research Institute, Science, Technology and Environment Agency, Lao PDR*
- *Souphasay Komany, Environmental Research Institute, Science, Technology and Environment Agency, Lao PDR*

This assessment aims to assess risk and vulnerability of rain-fed farmer to different levels of climate impact by using the rice productivity as climate impact proxy. The household livelihood condition was evaluated mainly based on the household production compare to household consumption condition and structure. Risk to climate impact was analyzed and vulnerability was assessed based on multi-criteria analysis method, by using multiple indicators to indicate the state of risk by taking under consideration the sensitivity to climate impact (household economic condition), exposure to climate impact (household dependency on on-farm productivity) and coping capacity to climate impact into the evaluation process.

The study site selected for this case study was Vientiane plain covering field interview on 290 farmer households. The field interview, which covered 300 households, was conducted together with team from National University of Laos and Institute for Cultural Research, Ministry of Information and Culture as well as cooperation from number of town officials during June – July 2005.

From the survey, the household average income (total productivity) is approximately 31 million Kips and income is highly diverse. The majority portion of total income, which is over 70%, is from agricultural activities while the major portion of household consumption is on food. Majority of the farmer household, which is 90% of the surveyed household, has sustained livelihood condition with some saving, which is mostly in form of livestock.


From the baseline climate risk analysis, by taking sensitivity and exposure as well as coping capacity to climate impact into consideration, almost 2/3 of the surveyed population is classified as low risk category and approximately 1/3 of the surveyed population is classified as moderate risk category, while only few households are considered as high risk. The study showed that these farmer households are resilience to climate impact, which in most cases are flood or drought. By using decline in rice productivity as proxy of climate impact, the structure of household risk does not deviate much from the baseline condition. The analysis was based on decline in household rice productivity by 30%, 50% and 70% and the result shows small number of households moved from low risk category to moderate risk category while the high risk category only increased by few household only. This is due to the income diversification of the household and the relying on non-timber forest products to support household livelihood when rice productivity is declined by climate impact.

Number of adaptation options was suggested by the local stakeholders as guideline to improve their livelihood condition and at the same time to raise the resilience to climate impact further, of which some of the suggested options are extensions to the current practice. The suggested adaptation options aim to increase climate resilience on the agricultural activity, e.g. new seed variety, new crop, new agriculture technique, source of fund. In addition, some adaptation options also aim toward income diversity, e.g. livestock, value added to the current agriculture product - small scale food processing facilities. In addition, some options also aim to increase the role and strength of institution that could reduce risk to climate impact, e.g. early warning system, cooperative village network.

3.2.2 Assessment on Vulnerability and Adaptation to Climate Change impact: Case study on rain-fed farmer in Kula Field, Thailand

By

- *Vichien Kerdsuk, Research and Development Institute, Khon Kaen University, Thailand*
- *Vachiraporn Kerdsuk, Research and Development Institute, Khon Kaen University, Thailand*
- *Somsak Sukjan, Land Development Dept.*

The objectives of this study were 1) to study the impacts of climate change on farmer livelihood 2) to assess the vulnerability of rain-fed rice farmers and 3) to study the coping ability and the adaptation to climate change. Community participatory approach was used as the assessment tool, which include household and group interview in the selected study sites. Total 628 households were interviewed during April – May 2005.


The risk analysis was based on multi-criteria by taking under consideration sensitivity, exposure and coping capacity to climate impact as criteria for frame of analysis. These criteria used household economic condition, farmers' dependence on their farms production the coping capacity to climate impact as proxy of each criterion, of which each criterion was explained by multiple indicators. The results from risk analysis shows that under normal climate condition, the farmer could be categorized into low risk, moderate risk and high risk to climate impact at 8.8%, 61.6% and 29.6%, respectively.

In the past decade, the climate related disaster that affected the rain-fed farmers were mostly from drought and followed by flood. This caused damage to rice production at average of 45.5% of total household's productivity. When applied this factor as proxy of climate impact to the risk analysis, number of household at risk under stress from extreme climate event changed to 7.6%, 50% and 42.0% for the low risk, moderate risk, and high risk category respectively.


Vulnerability of rain-fed farmers was based on the analysis of the sensitivity in the risk profile of farmer's livelihood to climate impact. By comparison between the risk profile under normal climate condition and the risk profile under climate stress, the analysis shows that 77% of total surveyed household are vulnerable to climate impact from the extreme climate event, while only 23% may be consider as non-vulnerable, climate resilience group. Majority of the household's livelihood is not sustained as main income came from rice production. Most of the vulnerable household has high debt and if the climate change may cause more frequent extreme climate event, these farmers are likely to unable to recover the debt condition and may be forced out of the rice production system to other sectors.


Some of the current adaptation strategies include water management, crop management, change cropping technique as well as crop calendar and seed variety, multiple crops and livestock. Some suggested adaptation to cope with future condition aim to increase or extend the current strategies. The early warning system on climate variability, which may be implemented by the government, will also help the farmer to plan to cope with climate impact better.

4.0 APN-Funded Participants

The fund was used mainly in 3 major categories in the projects as follows;

- Conducting workshop and training
- Support some pilot research exercises and field assessment activity
- Publishing paper and dissemination

As far as the APN-Funded participants is concerned, the project had involved large number of researchers in different manners and in addition to that also involved larger number of academic and policy related person who had attended the workshop also as participants as well as observers. This report focuses only on selected participants who had attended the training workshop and also received grant to support their case study research exercise.

Participants from Lao PDR:

- Mr. Soulideth Souvannalath
  Technical Division,
  Water Resources Coordination Committee Secretarial,
  Prime Minister's Office
  Vientiane, Lao PDR
  Tel: 856 21 215010
  Fax: 856 21 215011
  souli2002@hotmail.com

  Mr. Soulideth's work is focused on the water resource planning for the government of Lao PDR. Participating in this CAPaBLE CB-01/02 project had made him understand potential of the future climate impact and the process to study and assess long term risk of various sectors from climate impact, especially on the water resource issues. In addition, he also actively participated in the assessment of vulnerability and adaptation to climate impact too. Mr. Soulideth had also gain connection to many academic institutes in Thailand through the activity in this CAPaBLE project, which partly has led him to continue his study and establish some research projects with Khon Kaen University. Mr. Soulideth still maintains contact with other participants who had attended the CAPaBLE project to pursue further research on global change and water resource planning.

- Mr. Thavone Inthavong
  National Agriculture and Forestry Research Institute
  Ministry of Agriculture and Forestry
  Vientiane, Lao PDR
  Tel: 856 21 770093 (office)
  i_thavone@yahoo.com

  Mr. Thavone's work is focused on GIS and soil science and works in crop planning for the government of Lao PDR. Participating in this CAPaBLE CB-01 project had made him understand potential of the future climate impact and the process in the use of crop modelling to analyze and project potential crop yield under different climate conditions as well as different crop management scheme. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his

work in the future.

- Mr. Oulaphone Ongkeo,
  Dept. of Irrigation,
  Ministry of Agriculture,
  Vientiane, Lao PDR
  Tel: 856 21 415364
  Fax: 856 21 416556
  oulaphone@hotmail.com

  Mr. Oulaporn's work is focused on hydrological analysis for the government of Lao PDR. Participating in this CAPaBLE CB-01 project had made him understand potential of the future climate impact and the process in hydrological modelling to analyze and project potential future hydrological regime of the watershed under different climate conditions. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his work in the future. Experience from attending this CAPaBLE project may be useful for him to become human resource for the preparation of the next National Communication to UNFCCC.

- Ms. Keophusone Phonhalath
  Department of Civil Engineering,
  Faculty of Engineering and Architecture,
  National University of Laos
  Vientiane, Lao PDR
  Tel: 856 21 350125, 351926
  Fax: 856 21 314382
  keophousone@yahoo.com

  Ms. Keophusone's work is a lecturer in the National University of Laos. Her interest in hydrology had been enhanced by the participating in the CAPaBLE CB-01 training workshop, especially the training on hydrological modeling by working with various climate conditions to analyze future impact of climate change on hydrological regime in major watershed in Lao PDR. The knowledge gained from the attending CAPaBLE workshop may be useful in her teaching career and also made her a human resource for the preparation of the next National Communication to UNFCCC.

- Mr. Vivarath Sihabouj
  Irrigation Engineering Department,
  National University of Laos
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  Fax: 856 21 215019
  Vivarath@yahoo.com

  Mr. Vivarath's work is a lecturer in the National University of Laos. His interest in hydrology had been enhanced by the participating in the CAPaBLE CB-01/02 training workshop, especially the training on hydrological modeling by working with various climate conditions to analyze future impact of climate change on hydrological regime in major watershed in Lao PDR. The knowledge gained from the attending CAPaBLE workshop may be useful in her teaching career and also made him a human resource for the preparation of the next National Communication to UNFCCC.

- Mrs. Somkhith Boulidam
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  National University of Laos
  Vientiane, Lao PDR
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Mrs. Somkhith's work is a lecturer in the National University of Laos. Her interest in impact of changing environmental condition to community livelihood had been enhanced by the participating in the CAPaBLE CB-02 training workshop, especially the training on the assessment of vulnerability and adaptation to climate change impact and also conducting field interview to assess community risk to climate impact and potential adaptation strategy. The knowledge gained from the attending CAPaBLE workshop may be useful in her teaching career and also made her a human resource for the preparation of the next National Communication to UNFCCC.

Participants from Thailand:

- Mr. Chitnucha Buddhaboon
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  Prachinburi, Thailand
  Tel: 0-9803-2295 (mobile)
  chitnucha@yahoo.com

  Mr. Chitnucha's work is focused on the research on rice cultivation for Thai government. Participating in this CAPaBLE CB-01 project had made him understand potential of the future climate impact and the process in crop modelling to analyze and project potential crop yield under different climate conditions as well as different crop management scheme. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his work in the future in long term rice cultivation planning and also made him a human resource for the preparation of the next National Communication to UNFCCC. Mr. Chitnucha still maintains contact with other participants who had attended the CAPaBLE project to pursue further research on global change issues.

- Mr. Sahasachai Kongton
  Land Development Department
  Ministry of Agriculture
  Bangkok, Thailand
  Tel: 0 9527 9197 (mobile)
  sahaschaik@yahoo.co.uk
  sahask@access.inet.co.th

  Mr. Sahaschai's work is focused on the agricultural planning and zoning for Thai government. He was also part of the team who had conducted study on climate change impact on agriculture in the preparation of the First National Communication to UNFCCC. Participating in this CAPaBLE CB-01 project had enhance his understanding on the use of new generation of climate scenario to analyze and project potential crop yield under different climate conditions as well as different crop management scheme by using crop modelling technique. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his work in the future in long term rice cultivation planning and also made him a human resource for the preparation of the next National Communication to UNFCCC.

- Mr. Vichien Kerdsuk
  Research and Development Institute
  Khon Kaen University
  Khon Kaen, Thailand
  Tel: 0-9862-0803 (mobile)
  vich_ke@kku.ac.th

  Mr. Vichien's work is focused on the research on agriculture and also teaching at Khon Kaen University. Participating in this CAPaBLE CB-01/02 project had enhance

his understanding in potential of the future climate change impact on rice production. In addition, the CAPaBLE project also expand his research capacity onto the new discipline for him by conducting assessment on vulnerability and adaptation of farmer community from impact of climate variability and change. The knowledge gained from this CAPaBLE is useful and also made him a human resource for the preparation of the next National Communication to UNFCCC. Mr. Vichien still maintains contact with other participants who had attended the CAPaBLE project to pursue further research on global change issues.

- Mr. Vinai Sarawat
  Khon Kaen Field Crop Research Center
  Khon Kaen, Thailand
  Tel: 0-9788-0139 (mobile)
  vinsar@kku.ac.th

  Mr. Vinai's work is focused on the agricultural research for Thai government. Participating in this CAPaBLE CB-01 project had made him understand potential of the future climate change impact on various crop productions by using different climate scenarios to analyze and project potential crop yield under different climate conditions. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his work in the future in long term crop planning and also made him a human resource for the preparation of the next National Communication to UNFCCC. Mr. Vinai still maintains contact with other participants who had attended the CAPaBLE project to pursue further research.

- Mr. Sukit Ratanasriwong
  Roi Et Agricultural Resources Service Center
  Roi-et, Thailand
  Tel: 0-9841-5372 (mobile)
  sukit_r@hotmail.com

  Mr. Sukit's work is focused on the agricultural research for Thai government. Participating in this CAPaBLE CB-01 project had made him understand potential of the future climate change impact on various crop productions by using different climate scenarios to analyze and project potential crop yield under different climate conditions. The knowledge and tools gained from this CAPaBLE is useful and can be applied to his work in the future in long term crop planning and also made him a human resource for the preparation of the next National Communication to UNFCCC. Mr. Sukit still maintains contact with other participants who had attended the CAPaBLE project to pursue further research.

5.0 Conclusions

The research exercises reveal that the climate change, as per climate scenarios used in this project, will affect the climate system in the Southeast Asia region, including Lao PDR and Thailand. Even though, the climate change impact may vary from places to places, but the analysis on the climate scenarios show tendency of higher precipitation in the future. In addition, the seasonal pattern may also be altered. Future changes in climate pattern will create impacts on bio-physical systems, of which the analysis under this project focused on the water resource and rain-fed agriculture systems. In addition, people in the region may also face higher risk to climate impact in the future. Under this project, the assessment on community risk to impact of climate change/variability and vulnerability was conducted. The analysis suggests that the vulnerability is a place-specific issue; therefore, the adaptation strategy to cope with future condition should take local context under consideration.

It should be noted that the important issue of this project is not mainly on the technical finding itself, but it is the fact that knowledge on climate change study had been

transferred, process and methodology were understood by number of researchers, so the procedure and plan for future study can be laid out, perhaps in larger scale, by the participants who had involved in the activities under this capacity building project.

This capacity building had got number of researchers involved in the process and had also provided ground for the multiple disciplinary expertises to work together around the issue on climate change. These researchers got to know each other and form up relationship around the common interest in global change research. Such relationship and this loose network may lead to more organized research collaboration in the region to form up a regional wide study program on the climate change issues.

In addition to the research capacity building, this project had also involved number of policy related person to witness the outcome of the pilot research exercise via synthesis workshop, in order to raise awareness to the policy community on the climate change issue as well as the research capacity on the issue that has been developed through this project. In addition, public awareness had also been raised through press.

Even though, climate change issue is still considered as the not-so-urgent issue to be taken under consideration for policy planning immediately, but this activity may have raised its awareness and priority somewhat. One of the key messages passed to the policy maker was that the climate is changing and it will have vast affect on multiple systems and sectors, there are a lot more to be learned and the capacity is being developed. This group of researchers may be considered as pioneer and will be key resource person in the region in the climate change study with more to come in the future, perhaps further developed by these trained scientists who had participated in this CAPaBLE CB-01/02 activity.

Appendix1:

APN2003-CB-01

CAPaBLE Course A workshop "The Study of Future Climate Scenarios and Impact of Climate Change on Hydrological Regime"

- 12-29 January 2004
- Burapha University, Thailand

Workshop agenda:

12-Jan-04	**Opening Ceremony**
0900 - 0905	Welcome Address by Dr.Suwanna Panutrakul, Dept. of Aquatic Science, Burapha University
0905 - 0920	Background of CAPaBLE Program and BUU - CU joint academic cooperation activity by Dr.Anond Snidvongs - Director of SEA START RC, APN Liaison Offcer for Southeast Asia
0920 - 0930	Opening Remark by Asst. Prof. Kachain Chalermwat, Dean - Faculty of Science, Burapha University
0930 - 0940	Special Remark by Mr. Phonchaleun Nonthaxay - Director General of Environmental Research Institute, APN Focal Point - Lao PDR
0940 - 0950	Special Remark from Dr.Jariya Boonjawat - SEA START RC, APN SPG - Thailand
0950 - 1030	Group photo session and coffee break
	Introduction to Climate Change
1030 - 1045	Overall workshop structure overview
1045 - 1200	Introduction to climate change
1200 - 1300	**Lunch break**
1300 - 1700	Climate scenario / Climate model
13-Jan-04	**Tutorial session on GIS techniques**
0900 - 1000	Principle of GIS
1000 - 1030	GIS data types
1030 - 1200	Introduction to Arcview and ArcInfo
	Future climate scenario analysis
1200 - 1300	**Lunch break**
1300 - 1700	Climate theme management (on Arc View) *Data query* *Interpolation* *Grid function*
14-Jan-04	**Future climate scenario analysis (con't)**
0900 - 1200	Static and dynamic downscaling (excel/Arc View)
1200 - 1300	**Lunch break**
1300 - 1700	Data assimilation / verification
15-Jan-04	**Exercise workshop on climatre scenarios: Various watersheds in Lao PDR and Thailand**
0900 - 1700	Exercise on watersheds in Lao PDR - Thailand: *Wang, Yom, Nan, Pasak, Sakaekrung, Thachine, Mae Klong, Songkram, Chi, Mun, Nam Ou, Nam Khan, Nam Ngiep, Nam Ngum, Nam Theun/Nam Krading, Se Done, Se Bang Hien, Se Bang Fai*
16-Jan-04	**GIS for Hydrological analysis**
0900 - 1000	Hydrological features
1000 - 1200	Flow direction
1200 - 1300	**Lunch break**
1300 - 1400	Flow direction (con't)

	Hydrological modeling technique
1400 - 1700	WINVIC Concept
17-Jan-04	**Reserve for Climate Scenarios tutorial**
Upon appointment	Tutorial session on climate scenarios
19-Jan-04	**Hydrological modeling technique (con't)**
0900 - 1200	WINVIC Data preparation *Watershed delineation* *Flow direction and accumulation*
1200 - 1300	**Lunch break**
1300 - 1700	WINVIC Data preparation (con't) *Preparation of soil type and land cover data*
20-Jan-04	**Hydrological modeling technique (con't)**
0900 - 1200	WINVIC Data preparation (con't) *Forcing data - preparation and interpolation*
1200 - 1300	**Lunch break**
1300 - 1500	WINVIC Data preparation (con't) *Forcing data - preparation and interpolation (con't)*
1500 - 1700	WINVIC Simulation process *Forcing module*
21-Jan-04	**Hydrological modeling technique (con't)**
0900 - 1200	WINVIC Simulation process (con't) *Soil & Vegetation module* *VIC-2L execution*
1200 - 1300	**Lunch break**
1300 - 1700	WINVIC Simulation process (con't) *Routing execution* *Calibration*
22-27 -Jan-2004	**Exercise workshop on hydrological regime analysis: Various watersheds in Lao PDR and Thailand**
22-Jan 0900 - 1700	Exercise on watersheds: *Wang, Thachine , Chi, Nam Ou, Nam Ngiep, Se Bang Hien*
23-Jan 0900 - 1700	Exercise on watersheds: *Wang, Thachine , Chi, Nam Ou, Nam Ngiep, Se Bang Hien (con't)*
24-Jan 0900 - 1700	Reserve for hydrological modelling - specific watershed by participant(s)
26-Jan 0900 - 1700	Exercise on watersheds: *Yom, Sakaekrang, Mun, Nam Khan, Nam Theun/Nam Krading, Se Done*
27-Jan 0900 - 1700	Exercise on watersheds: *Yom, Sakaekrang, Mun, Nam Khan, Nam Theun/Nam Krading, Se Done (con't)*
28-Jan 0900 - 1700	Exercise on watersheds: *Nan, Pa-sak, Mae Klong, Songkram, Nam Ngum, Se Bang Fai*
29-Jan-04	**Conclusion summary – Climate risk on water resource in various watersheds in Lao PDR & Thailand**
0900 - 1500	Discussion - result summary
1500 - 1600	Closing ceremony by Dr.Anond Snidvongs

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คณะวิทยาศาสตร์

Appendix 2:

APN2003-CB-01

CAPaBLE Course B workshop "The study of impacts of climate change on rain-fed rice production"

- 23 Feb.-1 Mar. 2004
- Ubonrachathani University, Thailand

Workshop agenda:

Topics for Training and Workshop	Timeframe
Training session in climate risk in rain-fed rice production Data Preparation for **Mekong River Basin Rice shell** – 4 days • Administrative boundary input – 1 day • Weather data – input simulated date from CCAM – 1 day • Soil map + soil attribute data – 1 day • Landuse map- rice – define and verify rice paddy area – 1 day Data Integration into **Mekong River Basin Rice shell** – 1 day • Rice cultural practice file – ½ day • Simulation of rice production option – ½ day	35 hours (5 days)
2-day workshop on simulation of rain-fed rice production • Practice simulation of rice production under different climate scenario o Analyze how and why the yield of rice production may change under the future climate scenarios. • Simulate alternate crop management scenarios as adaptation strategies to impact of climate change	14 hours (2 days)

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Appendix 3

APN2003-CB-01

CAPaBLE CB-01 Synthesis Workshop "The Study of Future Climate Changes Impact on Water Resource and Rain-fed Agriculture Production"

- Vientiane, Lao PDR
- 29-30 July 2004

Workshop agenda:

29-Jul-04	
Opening Session	
0900 - 0910	Background of CAPaBLE CB-01 Implementation *Mr.Suppakorn Chinvanno, CAPaBLE CB-01 Program coordinator*
0910 - 0920	Welcome and Opening Address *Mr. Noulin Sinbandith* *Vice-Chair of Science Technology Environment Agency, Lao PDR*
0920 - 0945	Group photo session & coffee break
	Technical Session (Parallel Session)
0945 - 0955	Objective, program and expected outcome of the workshop *Mr.Suppakorn Chinvanno, CAPaBLE CB-01 Program coordinator*
0955 - 1010	Scenario based approach for for the assessment of climate change impacts, vulnerability and adatation *Dr.Anond Snidvongs, Chulalonglorn University*
Session A: Modelling of Potential Impact of Climate Change on Water Resource (Facilitator: Dr.Anond Snidvongs)	
1010 - 1200	Model results verification and finalizing impact output
	Lunch
1300 - 1630	Summary & Discussion: Potential impact of climate change on major river basins in Lao PDR and Thailand
Session B: Modelling of Potential impact of Climate Change on Rain-fed Agriculture (Facilitator: Dr.Attachai Jintrawet)	
1010 - 1200	Model results verification and finalizing impact output
	Lunch
1300 - 1630	Summary & Discussion: Potential impact of climate change on rain-fed agriculture in Lao PDR and Thailand
30-Jul-04	
Presentation Session (Joint Session)	
	Theme 1: Future Climate Scenarios Used in CAPaBLE CB-01 Project
0830 - 0850	Future Climate Scenario in Thailand *Mr.Wirote Laongmanee, SEA START RC, Thailand*
0850 - 0910	Future Climate Scenario in Lao PDR *Mr.Oulaphone Ongkeo, Department of Irrigation, Ministry of Agriculture and Forestry, Lao PDR*
	Theme 2: Potential Impacts of Climate Change on Hydrological Condition
0910 - 0930	Potential Impact of Climate Change on Hydrological Condition in Mun River Basin - Thailand *Dr.Boontium Lertsupavitnapa, Ubonratchathani University, Thailand*

0930 – 0950	Potential Impact of Climate Change on Hydrological Condition in Nam Ngum River Basin - Lao PDR: Impact on inflow to Nam Ngum Reservoir
	Ms.Keophusone Phonhalath, National University of Laos, Lao PDR
0950 – 1010	Potential Impact of Climate Change on Hydrological Condition in Nam Thuene Watershed - Lao PDR
	Mr.Vivarath Sihabouj, National University of Laos, Lao PDR
	Theme 3: Potential Impacts of Climate Change on Rain-fed Agriculture
1010 – 1030	Climate Scenario Verification and Potential Impact on Rain-fed Rice Production in Thailand
	Mr. Chitnucha Buddhaboon, Ministry of Agriculture, Thailand
1030 – 1050	**Coffee Break**
1050 – 1110	Potential Impact of Climate Change on Rice Production in Tung Kula Field, Thailand
	Dr. Vichien Kerdsuk, Khon Kaen University, Thailand
1110 – 1130	Potential Impact of Climate Change on Maize, Sugarcane and Cassava Production in N.E. Thailand
	Mr. Sahaschai Kongton, Mr. Vinai Sarawat and Mr. Sukit Ratanasriwong, Ministry of Agriculture, Thailand
1130 – 1150	Potential Impact of Climate Change on Rice Production in Sawannaket Province - Lao PDR
	Mr.Thavone Inthavong, National Agricultre and Forestry Research Institute, Lao PDR
1150 – 1215	General discussion
1215 – 1330	**Lunch**
1300 – 1400	Registration for Partcipants and Guests of the Project Conclusion Event
CAPaBLE CB-01 Phase 1 Conclusion Event	
1400 – 1420	Introduction to Asia Pacific Network for Global Change Research and background of CAPaBLE capacity building program
	Dr.Anond Snidvongs, APN Liaison Officer for Southeast Asia
1420 – 1430	Special Address - APN Lao PDR
	Mr.Chanthanet Boulapha, APN SPG - Lao PDR
1430 – 1440	Special Address - APN Thailand
	Dr.Asdaporn Krairapanond, Ministry of Natural Resource and Environment, Thailand
	For APN Focal Point - Thailand
1440 – 1500	Keynote Speech: Obligation of UNFCCC Non-Annex 1 Countries in the Study of Impact of Climate Change
	Dr.Asdaporn Krairapanond, Ministry of Natural Resource and Environment, Thailand
1500 – 1520	Framework and Direction in Study of Impact of Climate Change and Achievement of CAPaBLE CB-01 Capacity Building Program
	Mr.Suppakorn Chinvanno, CAPaBLE CB-01 Program coordinator
1520 – 1540	Summary of Potential Impact of Climate Change on Hydrological Condition in Lao PDR and Thailand
	Dr.Anond Snidvongs, Chulalonglorn University
1540 – 1600	Summary of Potential Impact of Climate Change on Rain-fed Agriculture in Lao PDR and Thailand
	Dr.Attachai Jintrawet, Chiang Mai University

1600 - 1610	Closing Remark *Mr.Chanthanet Boulapha, APN SPG - Lao PDR*
1610 - 1630	Group Photo Session
1630 - 1800	**High Tea & Cocktail Reception**
1800 - 2000	**Farewell Dinner**

List of Participants

	Research Participants		
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1	Mr.Vivarath Sihabouj	Faculty of Engineering	National U. of Laos
2	Ms.Keophusone Phonhalath	Faculty of Engineering	National U. of Laos
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4	Ms.Chithdavone Southammavong	Meteodology and Hydrology Dept.	Ministry of Agriculture and Forestry
5	Mr.Soulideth Souvannalath	Water Resources Coordination Committee Secretarial	Prime Minister's Office
6	Mr.Thavone Inthavong	National Agriculture and Forestry Research Institute	Ministry of Agriculture and Forestry
	Thailand		
7	Dr.Boontium Lersupavithnapa	Faculty of Agriculture	Ubonratchathani University
8	Dr. Vichien Kerdsuk	Researcher, Research and Development Institute	Khon Kaen University
9	Mr. Sukit Ratanasriwong	Roi Et Agricultural Resources Service Center	Ministry of Agriculture
10	Mr. Vinai Sarawat	Khon Kaen Field Crop Research Center	Ministry of Agriculture
11	Mr. Sahaschai Kongton	Land Development Dept.	Ministry of Agriculture
12	Mr. Chitnucha Buddhaboon	Prachinburi Rice Research Center	Ministry of Agriculture
	Resource Person		
13	Mr.Wirote Laongmanee	SEA START RC	Chulalongkorn University
14	Mr.Suppakorn Chinvanno	SEA START RC	Chulalongkorn University
15	Dr.Anond Snidvongs	SEA START RC	Chulalongkorn University
16	Dr. Attachai Jintrawet	Multiple Cropping Center	Chiang Mai University
	Local Participants - Observer		
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17	Mrs.Bouangeun Oudomchit	Meteodology and Hydrology Dept.	Ministry of Agriculture and Forestry
18	Mr.Manolat Soukhanuvong	Meteodology and Hydrology Dept.	Ministry of Agriculture and Forestry

19	Mr.Chansamoud Keosoutha	Head, Dept. of Irrigation	National U. of Laos
20	Mr.Bounhome Silimanotham	Lecturer, Dept. of Irrigation	National U. of Laos
21	Mr.Bounngeun Paseuthkoun	Lecturer, Dept. of Irrigation	National U. of Laos
22	Mr.Loekham Thammalat	Lecturer, Dept. of Irrigation	National U. of Laos
23	Mr.Somphone	Lecturer, Dept. of Irrigation	National U. of Laos
24	Mr.Souvanh talavong	National Agriculture and Forestry Research Institute	Ministry of Agriculture and Forestry
25	Mr.Phetdavone	Water Resource Coordinating Committee	Office of Prime Minister
26	Mr.Chanthalangsy	Water Resource Coordinating Committee	Office of Prime Minister
27	Ms.Pailin Boukaew	Water Resource Coordinating Committee	Office of Prime Minister
28	Mr.Phonepaseuth Phoulipan	Technical Officer	Lao National Mekong Committee
29	Mr.Khampraseuth Keomany	Student, Dept. of Civil Engineering	National U. of Laos
30	Mr.Khamvanh	Student, Dept. of Civil Engineering	National U. of Laos
	Invited Guest		
	Lao PDR		
31	Mr.Chanthanet Boualapha	APN SPG - Lao PDR	
32	Ms.Rutchanee Uerpairojkit	Embassy of Thailand	
33	Mrs.Latsamay Sylavong	IUCN - Lao PDR	
34	Representative	Vientiane Time Newspaper	
35	Representative	Pathetlao Newspaper	
36	Representative	People News Newspaper	
37	Representative	National Radio of Lao	
	Thailand		
38	Dr.Asdaporn Krairapanond	Ministry of Natural Resource and Environment. Also represent APN Focal Point - Thailand	
39	Dr.Kansri Boonprakob	Ramkhamhang University (also represent IPCC)	
40	Dr.Jariya Boonjawat	APN SPG - Thailand	
41	Mr.Kamol	Nations Newspaper	


Synthesis Workshop
The Study of Future Climate Change Impact on Water Resources and
Rain-fed Rice Production

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The Nation

FRIDAY, August 13, 2004
56 PAGES, 3 SECTIONS, VOLUME 29, NO 30515

Thai summers 'will get longer and even hotter'

■ *Kamol Sukin*
THE NATION

THE WEATHER in Thailand might seem unbearably hot already, but the latest climate projections predict temperatures will rise further and the summer season will be longer, scientists said.

The changes will occur nationwide, particularly in the Central provinces and Bangkok, Japan-based Asia-Pacific Network for Global Change Research CAPaBLE Programme CB-10 researchers said, based on recent simulations.

The rising carbon dioxide content in the air, part of the global-warming phenomenon, is causing the increases, they said.

"Average temperatures in Thailand will increase, except during the rainy season," team member and scientist Wirote Laongmanee said.

"The number of 'hottest days' [those above 33 degrees Celsius] will increase in most of the study areas," he said.

In some northern provinces, and in some years, Wirote said, the hottest days would increase to as much as two months (around 63 days).

The team led by Chulalongkorn University scientist Dr Anond Snidwongs conducted the projections using the Conformal-Cubic Atmospheric Model (C-CAM), and based on Thai climate data between the years 1980 and 1989.

The study is scheduled to finish officially by the end of this year, Wirote said.

Two other notable facts drawn from the study concern changes in the "day-night" temperature gap and seasonal changes, Anond said.

"Night-time temperatures will increase by around five degrees Celsius on average by about 2040, when carbon dioxide has risen to 1.5 times the current level. At that time, the daytime temperature will increase by about 2-3 degrees Celsius," he said. "The mean gap between night-time and daytime temperatures will be narrow, which will significantly affect people's lives.

"We all might need air-conditioned bedrooms to sleep well at night," Anond said, adding, "or some insect species might spread out and cause trouble. This is just one of the possible consequences."

A longer summer period would automatically cause a shorter winter, Anond said.

"Winter currently begins around November and ends around February. It will shift to start around December and end in January. In some years, the total winter could remain for only a month or so," he said. "That's bad news for people who spend holidays in the northern provinces," he said.

The team has not simulated Bangkok in particular, but current simulations show a trend towards higher mean temperatures both day and night, as with other provinces studied in the region.

It is possible the capital will be hit by higher rainfall and a stronger and more frequent monsoon, Anond said.

Bangkok will suffer seriously from sea intrusion, the scientist said.

The study is the first of its kind based on real statistics, but further studies are required to confirm projections for the sake of better accuracy said Suppakorn Chinvanno, CAPaBLE coordinator.

"The outcome results from simulation of one of the sampling years in the 2040's [2040-2049] and [the decade] from 2066 [2066-2075]. However, the trend is reliable at certain CO2 levels," he said.

World scientists forecast the carbon content in the air will double in 70 years at current greenhouse-gas emission levels. The current carbon dioxide content in the atmosphere is about 360 parts per million (ppm) and is increasing by 23 ppm per year, he said.

The Nation

FRIDAY, *August 13, 2004*
56 PAGES, 3 SECTIONS, VOLUME 29, NO 50515

CLIMATE-CHANGE STUDY

Jasmine rice yields at risk

Global warming likely to cut output of staple crops, research indicates

■ *Kamol Sukin*
The Nation
VIENTIANE

GLOBAL WARMING may significantly dampen the production of jasmine rice, one of Thailand's best-loved crops, according to a recent scientific study.

"The higher the concentration of carbon dioxide in the atmosphere, the lower the yield of jasmine rice," stated the study.

The conclusion was drawn from research conducted by Thai and Lao scientists over the past year to predict the most likely impact of climatic changes on the two countries' water resources and food production.

The study comes under the Asia-Pacific Network for Global Change Research's (APN) CAPaBLE Programme CB-01, which uses hydrological records and other data relating to Thailand and Laos over the past decade to forecast future climatic trends and their impact on the two neighbouring nations.

It is the first study to show how such changes could affect Thailand at the micro level.

The simulation revealed that the decreasing trend in Thailand's rice yield would continue irrespective of the amount of rainfall and that the country would face serious repercussions from any climatic fluctuations.

In terms of annual rainfall, the Kingdom is likely to see levels drop considerably in the next 40 years if the carbon-dioxide content in the air rises as anticipated to 1.5 times that of the referential baseline years (1980-1989).

The trend is expected to reverse after 26 years when twice as much carbon dioxide will fill the air along with significantly more rainfall (assuming current figures follow the same pattern as the baseline years). Many parts of the Kingdom may then experience serious flooding, the study said.

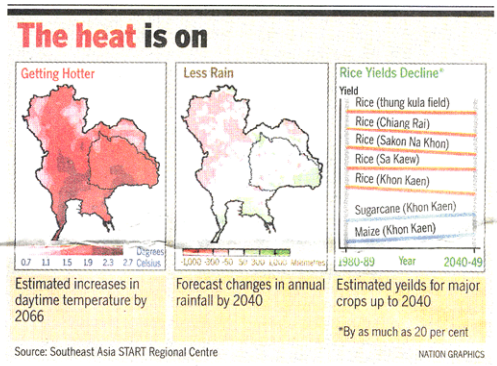
"The projected figures show a drop in the rice yield for both scenarios [drought and flood]," stressed Attachai Jintrawet, a member of the study team and a scientist at Chiang Mai University.

"The yield drop could reach as much as 20 per cent," he added.

"Even though the exact magnitude of the decrease would require

See Concerns **[4A]**

Thai summers 'will get hotter' ■ 3A



Climatic concerns

■ From 1A

a more detailed study, the general trend has been confirmed," said the study team.

Thailand currently produces 22 million tonnes of rice per year, which accounts for about 4 per cent of the world's total production. Of the 59 million rai nationwide devoted to growing rice, around 40 million rai are located in heavily rain-fed areas.

Attachai said samples taken from specific areas revealed that the yield in Sakon Nakhon would drop from 2,635 to 2,355 kilograms per hectare in the wettest years of the decade.

The findings were based on a simulation using a mathematical model called the Conformal-Cubic Atmospheric Model, or CCAM. Scientists then verified the trend by cross-checking it with their own observations at experimental sites in northern areas such as Thung Kula Ronghai, Sakon Nakhon, Sa Kaew, Chiang Rai and the Lao province of Savannakhet.

"Rainfall is one factor, but the reduction of the yield is also caused by other factors like flooding, soil erosion and more leaching of soil nutrients, which are related to climatic change," he added.

Apart from jasmine rice, the study also simulated the impact on other crops in Khon Kaen. The team found that higher levels of carbon dioxide would cause yields of cassava to fall, but have the opposite effect on sugarcane and maize.

"These are just the initial findings of our broader study," said the coordinator of the programme.

Launched last January, the programme aims to answer three central questions: Which computer model can most accurately forecast the climate in parts of Thailand and Laos along the Mekong River; what impact will changes have on water resources; and how will they affect food production.

Despite the "impressive" results, further fine-tuning of the current models is needed in order to increase the accuracy of both the model and the simulated impact, said Anond Snidvongs, APN's liaison officer for Southeast Asia.

"The forecast is a sign that we should do something now to prepare for the coming changes, such as plan for better land use or better select the crops we produce," said Anond.

"We hope our findings will cause policymakers to cooperate more closely with the scientific community in order to develop our country and the region," he added.

Appendix 4

APN2004-CB-02

Workshop on Method and Preparation for the Assessment of Community Vulnerability and Adaptation to Impact of Climate Change / Variability

- Thursday 28 April - Saturday 30 April 2005
- Khon Kaen University, Thailand

Workshop agenda:

Thursday 28 April 2005	
0900 - 1200	**Background briefing** • Study of climate change / impact / vulnerability / adaptation in Southeast Asia - AIACC project / APN CAPaBLE program • What is climate change? • Reason for concerns • Climate change in Southeast Asia region - future climate scenarios • Impact of climate change and climate variability on rain-fed rice production in Lao PDR and Thailand • Vulnerability of rain-fed farmer to climate impact - what and how to measure • Past activities - research / framework / method / finding (preliminary) • Research gap o Analysis on past responses of farmer to climate impact and effectiveness to cope with future impact o Analysis on vulnerability from multi-year impact and threshold
1300 - 1600	**Planning Exercise** - Field assessment scoping • Location & coverage - criteria in selection study site(s) • Sampling size • Proxy of climate impact for the assessment • Climate impact scenarios • Field assessment timeframe • Assessment plan
Friday 29 April 2005	
0900 - 1030	**Exercise and Brainstorm Session** • Vulnerability assessment framework review • Vulnerability assessment method review • Multi-criteria analysis - define criteria and indicators • Stakeholders engagement - participatory method - who/when/how
1030 - 1600	**Planning Exercise** - Questionnaire design (base on vulnerability criteria and indicators) • Brainstorm on questionnaire design for the use in the field interview
Saturday 30 April 2005	
0900 - 1200	**Wrap-up questionnaire** Finalize 1st version field questionnaire
1200 - 1500	**Conclusion:** • Assessment method and questionnaire • Interview technique and focus group activity • Assessment scope, plan, budgeting and timeframe • Analysis and wrap-up plan • Plan for final synthesis workshop - finding discussion
1800	**Farewell dinner**

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Appendix 5

APN2004-CB-02

Synthesis workshop on field assessment analysis – vulnerability to impact of climate change in study sites in Lao PDR and Thailand

- Environmental Research Institute, Lao PDR
- 6-7 September 2005

Details of workshop:

The workshop is a roundtable meeting of the team who had conducted field assessment on the impact of climate variability and change to the livelihood of the rain-fed farmer in Vientiane plain, Lao PDR and Kula Field, Thailand. The discussion in the workshop was on the preliminary finding and analysis result review.

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Appendix 6

APN2004-CB-02

Local focus group meeting – stakeholder's participation on adaptation to climate impact – Lao PDR

- Vientiane, Lao PDR
- 4 November 2005

Workshop details:

This focus group meeting was a roundtable meeting among researchers and selected local stakeholders from the surveyed area to discuss the adaptation options to climate impact.

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Appendix 7

APN2004-CB-02

Local focus group meeting – stakeholder's participation on adaptation to climate impact - Thailand

- Land Development Office, Roi-et, Thailand
- 7 December 2005

Workshop details:

This focus group meeting was a roundtable meeting among researchers and selected local stakeholders from the surveyed area to discuss the adaptation options to climate impact.

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