

出國報告（出國類別：國際會議）

參加亞洲生產力組織(APO)舉辦之  
「Workshop on Climate Change-resilient  
Agriculture Systems(因應氣候變遷之農業體  
系研習會)」

服務機關：行政院農業委員會科技處及農業試驗所

姓名職稱：黃國欽技士、徐武煥助理研究員

派赴國家：巴基斯坦

出國期間：2015 年 11 月 30 日至 12 月 4 日

報告日期：2016 年 3 月 1 日

## 摘要

亞洲生產力組織(Asian Productivity Organization，簡稱 APO)於巴基斯坦舉辦「因應氣候變遷之農業體系」研習會，主要目的為因應氣候變遷對農業生產體系潛在影響、並由與會各國分享氣候變遷之下農業調適最佳範例，及制定緩解氣候變遷對農業生產體系影響之策略。並邀請專家講座進行講授與討論。透過本次研習會，除了瞭解到其他亞洲國家農業部門針對氣候變遷對農業生產體系影響與對策外，也請專家講座介紹趨勢策略、研究方法以及技術工具，將可作為我國為調適與減緩氣候變遷對農業生產體系影響，所制定相關重點策略與評估指標研訂之參考。

## 目次

壹、目的-----	4
貳、研習會過程-----	5
參、研習會內容-----	6
肆、心得與建議-----	12
伍、研習會議剪影-----	13
附件 1、與會代表名單-----	15
附件 2、會議議程-----	19
附件 3：我國國家報告書面資料 -----	24

## 壹、目的

本次亞洲生產力組織(APO)於巴基斯坦舉辦「因應氣候變遷之農業體系」研習會，主要目的為因應氣候變遷對農業生產體系潛在影響、分享氣候變遷之農業調適最佳範例，以及制定緩解氣候變遷對農業生產體系影響之策略。主題包括有：氣候變遷下彈性運用農業系統中種植制度；氣候變遷之畜牧業、漁業及水產養殖系統；氣候變遷之下之糧食安全；發展精緻農業因應氣候變遷之政策和推展等四大主軸，細分成 17 個子題邀請專家講座進行講授與討論。透過本次研習會，除了瞭解到其他亞洲國家農業部門針對氣候變遷對農業生產體系影響與對策外，也請專家講座介紹趨勢策略、研究方法以及技術工具，將可作為我國為調適與減緩氣候變遷對農業生產體系影響，所制定相關重點策略與評估指標研訂之參考。

## 貳、研習會過程

一、出國期間：2015 年 11 月 30 日至 12 月 4 日

二、出國地點：巴基斯坦費薩拉巴德農業大學

三、出席人員：

本次會議各國參加成員來自政府機關、研究單位以及學校等，參加人員計有中華民國(2 人)、巴基斯坦(2 人)、柬埔寨(1 人)、伊朗(1 人)、馬來西亞(1 人)、印尼(1 人)、尼泊爾(2 人)、巴基斯坦(3 人)、菲律賓(1 人)、斯里蘭卡(1 人)、泰國(2 人)、越南(1 人)及孟加拉 1 人)等，共計 12 會員國 19 人參加，我國由農委會推薦科技處黃技士國欽與農業試驗所徐助理研究員武煥代表參加(各國出席人員名單如附件 1)。

本次亞洲生產力組織(APO)規劃於巴基斯坦費薩拉巴德農業大學(University of Agriculture, Faisalabad，簡稱 UAF)舉辦為期五天「因應氣候變遷之農業體系」研習會(議程如附件 2)。

四、研習會議程

日期	時間	行程內容
11 月 30 日(一)	09:00-17:00	參加研習會議
12 月 1 日(二)	09:00-17:00	參加研習會議
12 月 2 日(三)	08:00-17:00	參訪行程
12 月 3 日(四)	09:00-17:00	參加研習會議
12 月 4 日(五)	09:00-17:30	參加研習會議

## 參、研習會內容：

### 一、第一日議程：

#### (一)研習內容：氣候變遷下彈性化運用農業系統種植制度

(Climate Change-Resilient Agriculture Systems with emphasis on Cropping Systems)

首先由土耳其 Selcuk University Dr. Kenan Peker 就「Climate Change – Resilient Agriculture and Agribusiness Systems」進行專題報告，Dr. Kenan Peker 提出：自然資源含蓋自然、氣候和生物動力；而農業生產效率提升主要取決於生態系統中的自然資源，也是促使持續農業發展主要因素。

現階段因應氣候變遷問題解決方式，為利用可再生資源，降低能源消耗、回收和再循環利用廢棄物等均無法達到預期效果，爰需制訂因應氣候變遷對農業影響之政策，而農業企業產業化的系統管理模式是農業適應氣候變遷良好做法。所以在減緩、適應和有彈性的因應氣候變遷策略，涵蓋應不僅是農業，而是整體企業產業化價值鏈。

土耳其為例選定中部 Anatolia Region 和東部 Anatolia Region 有 8 個省（市）和 3260 個村莊的區域，以作物生產模式及種植系統來因應氣候變遷。由於土耳其農業耕地長期缺乏水資源，對於未來農業發展重點將著重滴灌設施、精準農業生產技術及生產環境永續利用為主要發展重點。

接續由 Dr. Ashfaq Ahmad 就「Building Resilience for Adaptation to Climate Change in the Crop Sector」進行專題報告，Dr. Ashfaq Ahmad 提到溫室氣體的增加，

將導致氣候變化，並以不同方式影響作物生產區域，氣候的變遷特別是溫度的升高，正衝擊著亞洲各國的農業生產，上個世紀，在亞太地區的天然災害造成農業損失佔全球總損害的 49%，而在亞洲的低收入和中等收入國家因氣候暖化導致生產總值的 6% 的損失。

Dr. Ashfaq Ahmad 並指出造成巴基斯坦氣候變遷主要因素有人口密集、城市外移、森林砍伐、汽機車廢氣排放及對氣候環境的漠視。此外 2011 年世界小麥產量約為 700 萬公噸，而在氣候變遷影響之下 2012 年減少至 660 萬公噸；全球玉米產量亦較 2014 年減少 6%。另外在中低緯度國家溫度上升 1°C 之下可能造成減少水稻產量達 10%。

未來全球熱帶和高緯度地區因氣候極端變化趨勢可能會促使區域性降雨量增高，而乾旱中緯度半乾旱低緯度地區則可能會造成水源缺乏；以全球氣溫為例，經評估自 1990 年至 2100 年有可能將由 1.1°C 增高至 6.4°C，進而導致海平面上升 22-34 公分的範圍之間，且熱帶氣旋和颶風將更加激烈，連帶將會有強大的風速和降水量；為因應氣候變遷造成農業生產影響，因此未來各國應投入相關計畫研究經費，積極培育作物品種來適應全球氣候變化。

另 Chiang Mai University 的 Dr. Attachai Jintrawet 則提出，可運用地理資訊及相關信息技術和預測系統作為降低氣候變遷造成農業生產風險的工具，且研發方向應朝向具備預測和管理問題，需有系統性的方法。Dr. Attachai Jintrawet 也說明了就研發部分，可分為了解研究、預測研究及管理研究三大層面，而最終目標為有效利用資源、創造就業、永續性生產和消費系統。以泰國

為例，以季節性水稻產量預測(DSS-SRy4cast)系統及精準農業為先導系統運用於水稻、龍眼及甜玉米，可實際運用於農業生產，增加產量。

(二)研習內容：氣候變遷下彈性運用畜牧業，漁業和水產養殖系統(Climatic Change-Resilient Livestock Farming, Fisheries and Aquaculture Systems)

Dr. Muhammad Afzal 就氣候變遷對漁業和水產養殖的影響進行專題報告，目前全球陸地地區含水佔 28.4%、淡水面積 0.6%、海水面積 71%，相關漁業發展型態有海洋、淡水、鹹水、湖泊及池塘漁業，水資源更是養殖之關鍵，水的物理性質會影響溫度變化，而水流動和分層的樣態一直在變化，進而大氣溫度的變化，亦會涉及自然環境水循環。然後其溫度的改變將影響到海洋的生物生產和淡水生態系統。

在大氣溫度變化之下，將改變了表面水的水量密度，並決定了天氣的地表水將停留在那裡產生分層或向下移動導致水混合。這種混合（翻轉）或保持地表水（分層）進一步直接或間接地調節整個生態系統。

為減緩氣候變遷對養殖用水影響，可運用相關措施因應，如天氣預警系統建立、提高船舶的穩定性/安全性、補償機制的影響、河流和海岸提供的硬體防禦（如海堤）基礎設施的提供及大壩建設等。

## 二、第二日議程：

研習內容：在氣候變遷下糧食安全（DLC-2）「Food Security in Changing Climate (DLC-2)」及精準農業的推廣和政策「Outreach and Policy for Precision Agriculture」



首先由 Dr. Bushra Sadia 以「Biotechnology and food security: emerging issues and possible solutions」專題報告，其說明 FAO 糧食安全定義：為只有當所有人在任何時候，都有足夠、安全和富有營養的食物來源，以滿足其健康生活膳食需求。

人們透過糧食系統及相關活動，可連帶反應社會經濟反饋(如生計及消費者權益保護)及環境反饋(如水質及溫室氣體排放)，進而影響社會經濟變化(人口、經濟、社會、政治、人文環境及科學與技術)和全球環境變化(如土地覆蓋及土壤、大氣、氣候及水資源)。

目前全球所面臨挑戰為約有八分之一人口長期營養不足，是因為長期地球資源的消耗，以及至 2050 年全球人口將來到 90 億、發展高經濟生活水平之下資源的消耗、科學家/決策者一味追求著糧食安全目標、農業生產種植和收穫頻繁、增加使用化學性農藥肥料及綠色革命所帶來的農業生產的增產，均會造成未來全球氣候變遷挑戰。

DR. Muhamma Jameel 就巴基斯坦的因應氣候變遷農業政策和體制環境說明，巴基斯坦人口為 1.9 億，GDP 增長率(過去 10 年)每年 3.8%，年均收入 1,512 美元；巴基斯坦農業耕地面積 22.8 百萬公頃、種植面積 22.73 百萬公頃、農業生產灌溉區為 19.08 百萬公頃、農業對 GDP 的貢獻達 20.9%。

氣候變遷直接威脅到巴基斯坦糧食、水和能源安全，因此巴基斯坦政府提出相關適應措施，如水電/可再生能源方面發揮更大作用(提高能源效率(機井的效率))，研發具有較低的甲烷排放量的水稻種植技術，減少農業土壤氧化亞氮的釋放，培育具生產效率牛品種，提高森林覆蓋率及補給地下水含水層。

### 三、第三日參訪行程：

12 月 2 日參訪巴基斯坦阿尤布農試所(Ayub Agricultural Research Institute, Faisalabad，以下簡稱 AARI)，AARI 位於費薩拉巴德，成立於 1962 年，佔地 500 公頃，其轄下計有 25 個研究單位，是巴基斯坦農業生產技術主要研究機構，也是經濟成長重要機構。

AARI 機構成立目標：

- 作物品種不同性狀的遺傳性質改良。
- 農作物生產技術的研發。
- 作物有害昆蟲的蟲害，病害和雜草的研究。
- 植物的土壤和水的關係研究。
- 水果和蔬菜的加工/保存和收穫後的加工技術研究。
- 監管的投入方面和知識傳播給農民

由於棉花、小麥、甘蔗和水稻為巴基斯坦最重要的種植作物。本次參訪 AARI 則參觀甘蔗田間試驗區及加工實驗室，因甘蔗是巴基斯坦的一個重要的經濟作物，主要生產糖，爰該機構著重於甘蔗品種改良。目前種植甘蔗品種 CPF 248 平均收益率 120（公噸/公頃），增產潛力 150（公噸/公頃）。

是日下午則至位於費薩拉巴德水源管理研究中心(Water Management Research Center)之研究站，由於巴基斯坦土壤表層水資源缺乏，爰仰賴抽取地下水進行農業灌溉，該中心亦與費薩拉巴德農業大學建立了研究與培訓中心。該中心負責項目涵蓋水資源管理，研發適應節水技術、水分生產率的研究由於受灌溉方式和管理方法。

#### 四、第四日議程：

是日分別由 Dr. M. Sohail Sajid、Dr. Shahid Majeed 及 Dr. Fahad Rasheed 三位專家學者主持，並由與會各國就氣候變遷造成農業系統之影響進行國家報告，我國則由農業試驗所徐武煥助理研究員就我國因應氣候變遷之策略，透過簡報與與會人員分享我國農業生產、氣候及我國因應氣候變遷的發展趨勢及策略。透過研習亦瞭解各國家因氣候變遷對農業生產衝擊及相對因應策略，最後則以「氣候變遷對農業系統造成影響及策略」進行分組討論。

#### 五、第五日議程：

12月4日為研習會最後一天，由 Dr. M. Sohail Sajid 就前(3)日分組討論結果，再次和與會各國出席人員及與專家學者討論，最後並由費薩拉巴德農業大學校長 Dr. Iqrar Ahmad Khan 進行結業演說，並頒發給與會各國人員研習證書。

## 肆、心得與建議

此次代表國家參加亞洲生產力組織(APO)舉辦之「因應氣候變遷之農業體系研習會」，除與參與之各國學員與講師互動交流增廣視野，提出下列幾項心得與建議：

1. 巴基斯坦國民之 GDP 很低(2014 年約 1515 美元)，基礎建設普遍不佳，大部分農業生產無法使用較高價之設備(施)，農業機械使用類似印度，使用最大約 75hp 小馬力之曳引機。該國舉辦此次 Workshop，其中邀請 3 位土耳其學者報告，土耳其為世界重要糧倉之一，顯現巴基斯坦對於此次因應氣候變遷之 Workshop，著重 Cropping system 如何做調整。
2. 經由本次參與研習會過程可知，目前氣候變遷對全球農業生產系統之影響愈趨重要，未來將積極透過學術及研究機構研發能量，進行農業科技創新研發技術，並導入農業企業的加入，以減緩對我國農業的影響及確保糧食安全。
3. 巴基斯坦之 UAF 發表之學術期刊報告很多，但是在新技術如何應用於氣候變遷，仍尚在起步階段，雖然該國因應氣候變遷之相關配套政策及其主政單位仍待制定或決定，惟建議可透過國際合作或研討會方式逐步建立兩方合作模式，有機會得以將我國農業技術推展該國。
4. 此次參與APO於巴基斯坦召開之研習會，雖與會各國農業生產技術層面多仍尚在基礎研發，惟因我國為APO創始國家之一，透過會議參與，可有助於我國在國際上關於氣候變遷調適議題與資源的連結。

## 伍、研習會議剪影



圖一、研習會議情形。



圖二、參訪巴基斯坦阿尤布農試所(Ayub Agricultural Research Institute)。



15-AG-16-GE-WSP-B Workshop on Climate Change-resilient Agriculture Systems

( 30 November–4 December 2015, Faisalabad, Pakistan )

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*Total number of Participants = 19*  
*(\*)Participants from Profit-Making Organization = 0*  
*(\*\*)Colombo Plan Sponsored Participants = 0*  
*(\*\*\*)APO Sponsored Participants = 0*

As of 26 November, 2015

**Workshop on  
CLIMATE CHANGE-RESILIENT AGRICULTURE SYSTEMS  
30 November–4 December 2015  
Faisalabad, Pakistan**

**PROGRAM OF ACTIVITIES  
(Provisional)**

<i>Time</i>	<i>Activity</i>	<i>Moderators/Presenters/ Remarks</i>
<b>Day 0: Sunday, 29 November 2015 (Sunday)</b> Arrival of Delegates in Faisalabad		
<b>Accommodations:</b> 1. Serena Hotel, Club Road, Faisalabad, Pakistan Tel: +92- 412600428; Fax: +92- 412629235; Homepage: <a href="http://www.serenahotels.com/serenafaisalabad/default-en.html">http://www.serenahotels.com/serenafaisalabad/default-en.html</a> 2. Foreign Faculty Hostel, University of Agriculture, Faisalabad. Tel: +92- 419200161-69 3. University Rest House, University of Agriculture, Faisalabad. Tel: +92- 419200161-69		
<b>Day 1: Monday, November 30, 2015</b>		
08:30 – 09:00	Registration	Administration Block Lobby
<b>Opening Session</b>		
09:00 – 10:15	<b>Inaugural Session; Old Senate Hall, UAF</b> (Details given below)	
9:00 – 9:05	Recitation from Holy Quran	Dr. M. Sohail Sajid, Secretary, Organizing Committee
9:05 – 9:15	Welcome remarks	Representative of NPO, Pakistan
9:15 - 9:25	Welcome Message from APO	APO Secretary-General Mari Amano (through video link); and Dr. Muhammad Saeed , Senior Program Officer, APO
9:25 – 9:35	Address of the COP	Prof. Dr. Bashir Ahmad, Chief of Party, USPCAS-AFS
9:35 – 9:45	Address of the Vice Chancellor	Prof. Dr. Iqbal Ahmad Khan, Vice Chancellor, UAF
9:45 – 10:00	Address of the Chief Guest	Guest of Honor
10:00 - 10:05	Vote of thanks	Prof. Dr. Ashfaq Ahmad Chatta, USPCAS-AFS, Pakistan
10:05 -10:15	Group Photo	Outside the Administration Block
10:15 – 10:40	Inaugural Tea	Rear Lawns of Faculty of Agriculture, UAF

<b>Technical Session 1: Climate Change-Resilient Agriculture Systems with emphasis on Cropping Systems (DLC-2, UAF)</b>		
10:40 – 11:00	APO and APO Activities, and Program Review	Dr. Muhammad Saeed, APO, Japan
11:00 – 11:40	<b>Presentation 1:</b> Climate change- resilient agriculture and agribusiness systems	Dr. Kenan Peker, Turkey
11:40 – 12:20	<b>Presentation 2:</b> Building resilience for adaptation to climate change in the crop sector	Dr. Ashfaq Ahmad Chattha, USPCAS-AFS Pakistan
12:20 – 13:00	<b>Presentation 3:</b> Seasonal rice-yield forecast in Asia and the Pacific to handle climate variability	Dr. Attachai Jintrawet, Thailand
13:00 – 13:40	<b>Presentation 4:</b> Climate change risk assessment - some challenges and opportunities for agricultural production in Minnesota, USA	Dr. Garcia Axel y Garcia, USA
13:40 – 15:00	<i>Lunch break</i>	STC Hall, UAF
<b>Technical Session 2: Climate Change-Resilient Livestock Farming, Fisheries and Aquaculture Systems</b>		
15:00 – 15:40	<b>Presentation 5:</b> Building resilience to climate change in the livestock and poultry sectors	Prof. Dr. M. Sajjad Khan, UAF, Pakistan
15:40 – 16:00	<i>Coffee break</i>	Arranged near DLC-2
16:00 – 16:40	<b>Presentation 6:</b> Climate change impact on fisheries and aquaculture	Prof. Dr. Muhamamd Afzal UAF, Pakistan
16:40 – 17:30	<b>Panel discussion 1:</b> Building climate change resilience in agriculture, livestock, fisheries, and aquaculture- way forward	<b>Moderator</b> Dr. Attachai Jintrawet, Thailand <b>Rapporteurs:</b> Dr. M. Sohail Sajid, Dr. Shahid Majeed
20:00– 22:00	<i>Welcome dinner to be hosted by the APO</i>	Dynasty, Faisalabad

Day 2, Tuesday, 1 December 2015		
08:30 – 08:40	Registration	DLC-2
<b>Technical Session 3: Food Security in Changing Climate (DLC-2)</b> <b>Stage Secretary: Dr. M. Sohail Sajid</b>		
08:40 – 09:20	<b>Presentation 1:</b> Climate change impacts on agricultural productivity and food security	Dr. Muhammad Saeed, APO, Japan
09:20 – 10:00	<b>Presentation 2:</b> Introduction to US. Pakistan Centre for Advanced Studies in Agriculture and Food Security: Challenges, Issues, and Opportunities	Dr. James Hill, USA
10:00 – 10:40	<b>Presentation 3:</b> A solution for global food security in changing climate: International Winter Wheat Improvement Program (IWWIP) Approach	Dr. Fatih Ozdemir, Turkey,
10:40 – 11:00	Coffee break	Arranged near DLC-2
11:00 – 11:40	<b>Presentation 4:</b> Climate change, drought and agriculture in Turkey	Dr. Mustafa Kan Turkey
11:40 – 12:20	<b>Presentation 5:</b> Biotechnology and food security: emerging issues and possible solutions	Dr. Bushra Sadia, USPCAS-AFS, Pakistan
12:20 – 13:00	<b>Presentation 6:</b> Food Safety in the Changing Climate	Prof. Dr. Tahir Zahoor, UAF, Pakistan
13:00 – 14:00	Lunch Break	STC Hall, UAF
<b>Technical Session 4: Outreach and Policy for Precision Agriculture</b> <b>Stage Secretary: Dr. Shahid Majeed</b>		
14:00 – 14:40	<b>Presentation 5:</b> Ag-weather network and crop improvement	Dr. Axel Garcia y Garcia, USA
14:40 – 15:05	<b>Presentation 6:</b> Role of precision agriculture under changing climate	Dr. Jahanzeb Cheema, USPCAS-AFS, Pakistan
15:05 – 15:30	<b>Presentation 7:</b> An application of probit model to determine the influence of various factors on the adaption of rice residue burning decisions	Dr. Tanvir Ahmad, Lahore, Pakistan
15:30 – 15:55	<b>Presentation 8:</b> Outreach and extension in the realm of climate change: challenges, issues and opportunities	Dr. Babar Shahbaz, USPCAS-AFS, Pakistan
15:55 – 16:20	<b>Presentation 9:</b> Policy and institutional settings for the development of climate-smart agriculture	Dr. Jamil Ahmad Khan, USPCAS-CAS, Pakistan
16:20 – 16:40	Coffee break	Arranged near DLC-2
16:40 – 17:40	<b>Panel discussion 2:</b> Promoting technologies, policies, and institutional settings for the development of climate-resilient agriculture: challenges and possible solutions	<b>Moderator</b> Dr. Axel Garcia y Garcia, USA <b>Rapporteurs:</b> Dr. Shahid Majeed Dr. Tasneem Khaliq
17:40 – 17:50	Briefing on field visits	Prof. Dr. Ashfaq Chatta
20:00– 22:00	<b>Dinner to be hosted by the USPCAS-AFS</b>	Lawns of NIFSAT, UAF

Day 3, Wednesday, 2 December 2015		
06:45– 07:00	Registration	Serena Hotel Lobby
07:00 – 18:00	<b>Technical session 5: Field visits</b> to observe the impact of climate change on agriculture, agrifood supply chain, and/or best practices of the development of climate resilience in agriculture and adaptation of agriculture to climate change	<b>Chief Coordinator:</b> Prof. Dr. Ashfaq Chatta
08:00 – 11:00	Visit Ayub Agricultural Research Institute (AARI), Faisalabad	<b>Coordinator:</b> Dr. Fahad Rasheed
11:00 – 11:30	<i>Coffee break</i>	AARI, Faisalabad
11:30 – 12:30	Visit Water Management Research Center, Post Graduate Agricultural Research Station, UAF	<b>Coordinator:</b> Dr. Fahad Rasheed
12:30 – 13:30	<i>Lunch break</i>	At SB Farms
13:30 – 16:30	Visit SB farms (Mr. Basharatullah)	<b>Coordinator:</b> Dr. Fahad Rasheed
16:30 – 16:50	<i>Coffee break</i>	At SB Farms
16:50 – 17:50	Briefing on sharing country experiences and group exercise (in bus when travelling back to the UAF campus/hotel)	Lawns of NIFSAT, UAF
20:00– 22:00	<i>Dinner to be hosted by the USPCAS-AFS</i>	Lawns of NIFSAT, UAF



Day 4, Thursday, 3 December 2015		
08:30 – 08:40	Registration	DLC-2
08:40– 10:15	<b>Technical Session 6: Sharing country experiences</b>	<b>Moderator:</b> Dr. M. Sohail Sajid
10:15 -10:30	Coffee break	Arranged near DLC-2
10:30 -13:00	<b>Sharing country experiences</b>	<b>Moderator:</b> Dr. Shahid Majeed
13:00 – 14:00	Lunch break	STC, UAF
14:00 – 15:00	<b>Sharing country experiences</b>	<b>Moderator:</b> Dr. Fahad Rasheed
15:00 – 15:30	Coffee break	Arranged near DLC-2
15:30 – 18:30	<b>Technical Session 7: Group exercise</b> <ul style="list-style-type: none"> <li>➤ Group discussions will be based on the outcome of the Day 1 – 4 workshop proceedings such as presentations by resource persons and participants, resource papers and country papers, learning from field visits, and discussions and exchange of views among the participants/resource persons on the subject.</li> <li>➤ Participants facilitated by resource persons will discuss the issues and challenges relating to the building of resilience to climate change in the agriculture sector, and formulate strategic action plans to address them.</li> <li>➤ A framework for group discussions will be provided separately later.</li> </ul> <b>Chief Facilitator: Prof. Dr. Ashfaq Ahmad Chatta</b> <b>Rapporteur: Dr. Farah Riaz</b>	
20:00 –22:00	<b>Farewell dinner to be hosted by the UAF</b>	Namwah, Faisalabad
Day 5, Friday, 4 December 2015		
08:30 – 08:45	Registration	
08:45 – 10:15	<b>Technical Session 8:</b> Presentation of summary of group discussion output by each group in a plenary session	<b>Facilitator:</b> Dr. M. Sohail Sajid
10:15 –10:30	Coffee break	Arranged near DLC-2
10:30 –11:30	Formulation of the recommendations of workshop	Participants & Resource Persons
11:30–12:00	Formulation of follow-up action plans to be undertaken by individual participants	UAF, NPO, & APO Secretariat
12:00 –12:30	Program evaluation by participants, resource persons, and implementing organization	
12:30 – 13:30	Lunch break	STC Hall, UAF
13:30 –14:30	<b>Closing Session</b> (Details to be provided later)	UAF & NPO organizers
14:30– Onward	Appreciate local culture and people	
Day 6, Saturday, 5 December 2015		
Departure of Delegates to their countries		

## 附件 3：我國國家報告書面資料

### **Current Coping Strategies Adaptation to and Mitigation of Climate Change in Taiwan**

Taiwan Agricultural Research Institute  
Agricultural Engineering Division  
Wu-Huan Hsu,  
Council of Agriculture  
Department of Science and Technology  
Kuo-Chin Huang

#### **Introduction**

In the near decades, the climate change has becoming a concerning issue due to its vast influences on the food security in most of the countries. Agricultural system has to being resilient and meets the climate variation, which temperature and carbon dioxide concentration are gradually increasing in the environment. In Taiwan, the temperature has been increased about 1.4 °C since 1911. In the recently years, the government annually subside much money to the farmers whose crops or facilities damaged by disasters (such as typhoon). Many phenomena (season variation etc.) mentioned us to focus on this severe problem. And the strategies of adaptation and mitigation for coping with climate change should have been made by our government. Therefore, there was two integrated projects with four years period, one entitled “Afforestation and Carbon Reduction Technology Development” since 2012 and the other “Agricultural Innovation Studies for Coping with Climate Change and Food Security” has been proposed separately in Taiwan since 2010 and 2012. In the last program, including six strategies/themes and many technologies have been carrying out.

#### **The Trend of Climate Change in Taiwan**

The air temperature in Taiwan has been vast influenced by climate change for past 100 years. From 1911 to 2009, the annual mean temperature in the flatland has increased by 1.4 °C (Fig.1)(Hsu et al., 2011). The similar trend of temperature increasing has often been found in most of the countries.

The precipitation in Taiwan also been variated by climate change, rainfall days shorten annually (Fig.2) and the change in recently decades become more dramatically (Fig.3). The extreme events such as drought happened in 1863, 1980, 1993 and 2002, separately, cause water resource was insufficiently supplied for crop cultivation. And the average number of typhoon hit Taiwan slightly increased for past 50 years(Fig.4).



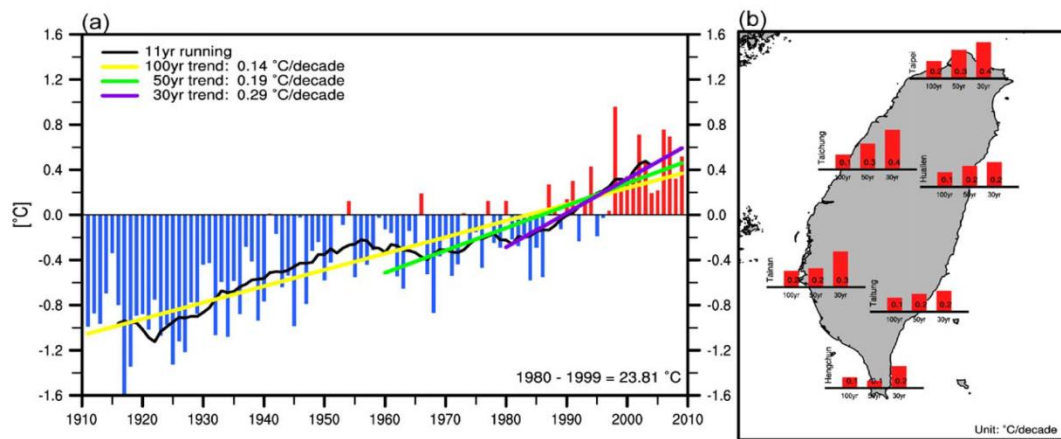


Fig.1 Average Air Temperature variation in Taiwan for past 100 years (Hsu et al., 2011)

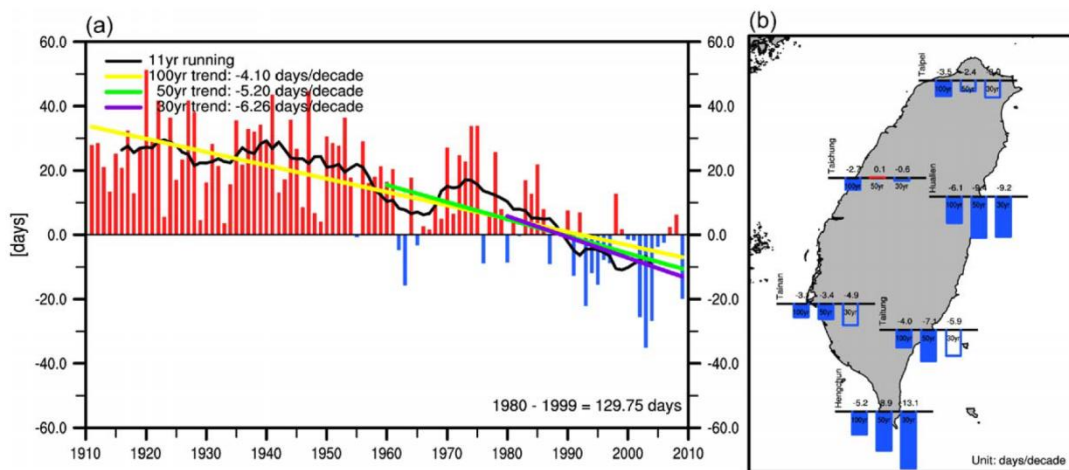


Fig.2 Rainfall variation in Taiwan for past 100 years (Chang & Wu, 2011)

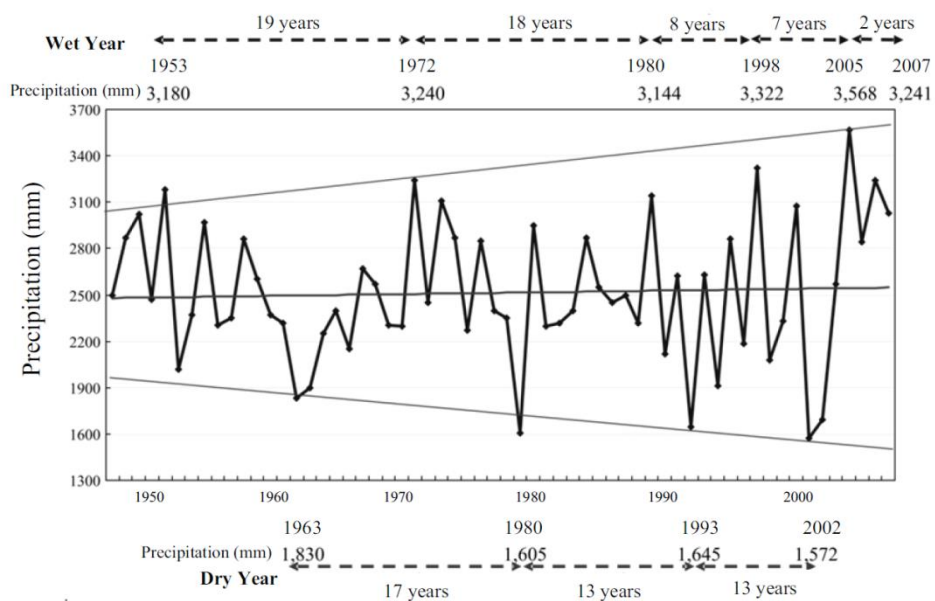


Fig.3 Trend of precipitation in Taiwan (Chang & Wu, 2011)

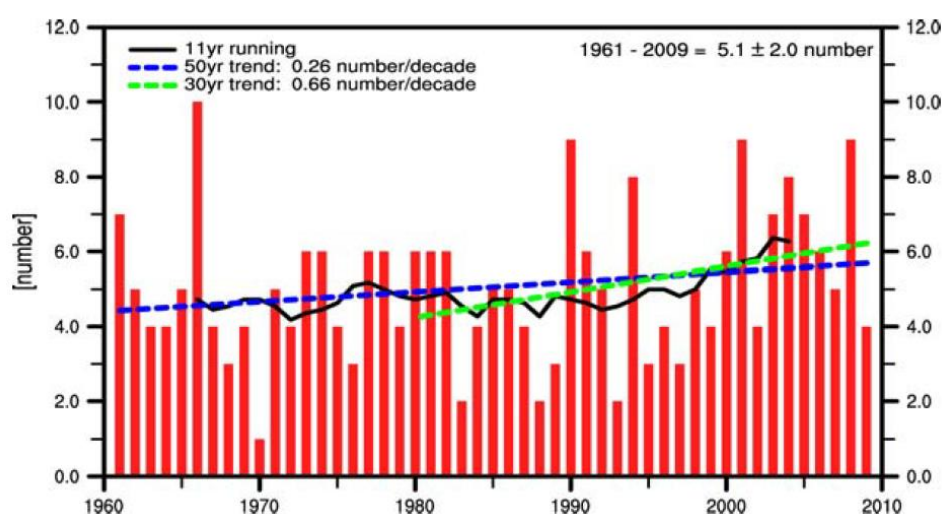


Fig.4 Average number of typhoon hit Taiwan from 1960 to 2010 (Hsu et al., 2011)

### Current coping strategies adaptation to and mitigation of climate change

According to the Scientific Report 2011 (Hsu et al., 2011),

After 2010, the implementation plan for the National Adaptation Policy Framework and Adaptation Programmes of Action for Climate Change had been proposed, the Council for Economic Planning and Development (CEPD) in Taiwan developed a national adaptation strategy framework (Fig.5) and implemented a substantial action plan a very important role accounts for aspects of climate change such as natural disasters, water resources, coasts, agricultural production and biodiversity, health, infrastructure, energy supply and industrial economics, and land-use planning and management. Among these, agricultural production and biodiversity are the duties of Council of Agriculture (COA) and has been originally defined as below.

Agricultural production:

1. Constructed food security/safety system in accordance with the degree of risk.
2. Integration of science and technology to enhance the ability of the industry anti-adversity.
3. The establishment of multi-objective and sustainable forestry management quality adjustment mode and promote afforestation.
4. Establish monitoring and evaluation systems in agricultural meteorology and domestic / international markets.

Biodiversity:

1. Strengthening links with the management of protected areas
2. Mitigate anthropogenic disturbance caused to the speed of biodiversity loss
3. Strengthen the conservation and rational utilization of genetic diversity
4. Strengthen biodiversity monitoring, data collection, analysis and application to assess the vulnerability of biodiversity and risk

Food security/safety got a higher priority due to climate change and its vast influences on the issues of agricultural production and biodiversity. The impacts of

climate change on crop productivity and food security and their responsive studies, rice plays a very important role in Taiwan. According to the prediction, climate change will cause the rice production drop about 13-14% in Taiwan if temperature was decreased over 2°C in the end of this century (ref 8).

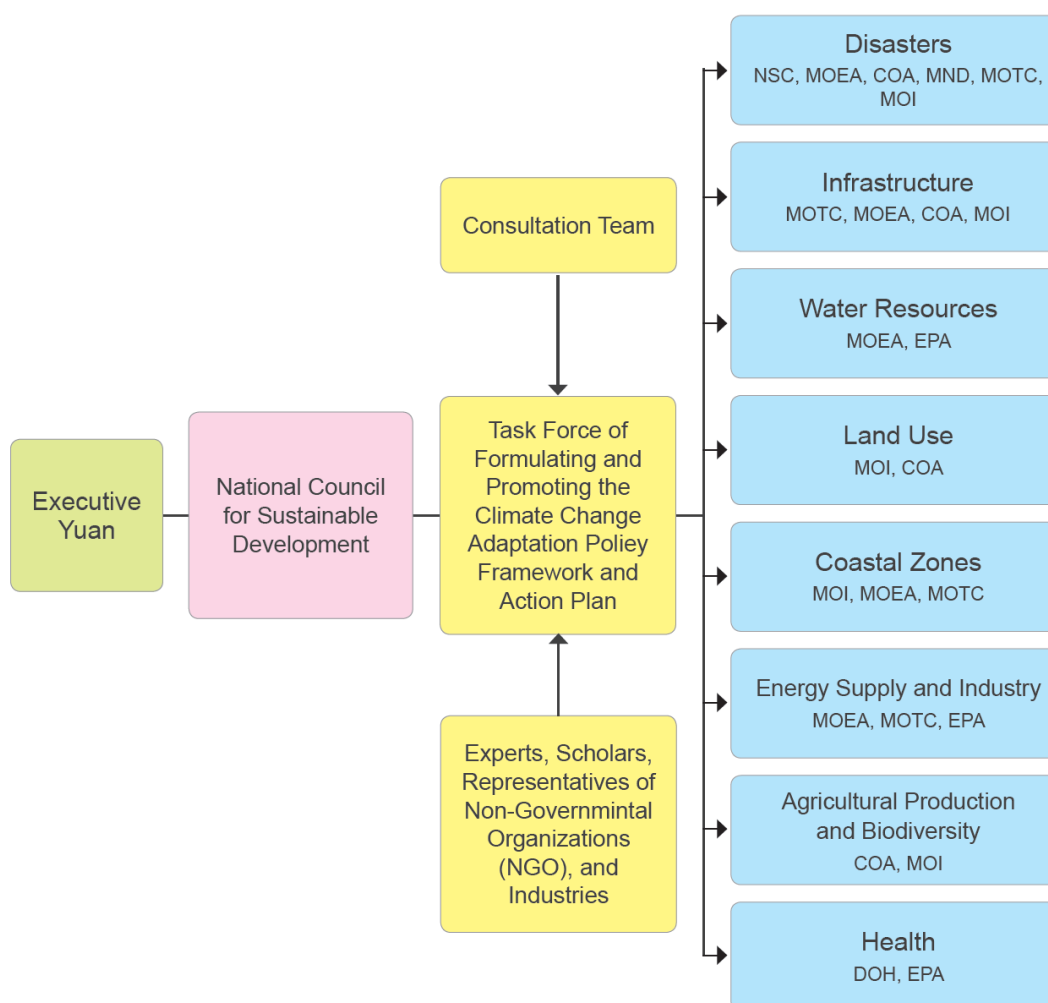


Fig.5 The national adaptation policy framework for climate change

Except for an integrated project entitled “Afforestation and Carbon Reduction Technology Development” (2010-2013) which’s main purpose for carbon reduction, an integrated agricultural thematic research project (2012-2015) implemented in Taiwan have been proposed to cope with climate change and food security. Several directions of projects have been focused in integrated project are

1. Basic study
  - (1) Construction of a food security system
  - (2) Integrated adaption strategies
  - (3) International food security mechanisms
  - (4) Weather data collection and statistics
  - (5) Geographic information for disaster prevention
2. Risks control
  - (1) Risk reception and coping strategies
  - (2) Agriculture insurance
3. Potential impact

- (1) Agricultural ecology
- (2) Distribution of pest
- (3) Bee's honey-collection ability
- (4) Population dynamics of wildlife indicators
- (5) Agricultural economics
4. Stress / tolerance
  - (1) Rice germplasm for heat tolerance
  - (2) Selection of rice varieties for heat tolerance
  - (3) Climate-resistant rice varieties breeding
  - (4) Rice varieties with resistance to diseases (Bacterial blight)
  - (5) Seeding cold tolerance
  - (6) Breeding of soybean varieties for chilling tolerance
  - (7) Breeding of potato varieties for cold and wet resistance
  - (8) Maize germplasm for waterlogging tolerance
  - (9) Restoration and windproof technologies for crops cultivation in flooding area and windy area
  - (10) Diseases caused by heavy rain
  - (11) Nutritional analysis vs. stress tolerance
5. Yield Potential
  - (1) Selection and breeding of forage rice with high yield
  - (2) Breeding of field corn with high yield
6. Feedstock
  - (1) Development of new nutritional resources and formula
  - (2) Development of diverse feedstuff resources and diets for livestock
  - (3) Breeding of sweet potato varieties for animal feedstock
  - (4) Feedstock substitution (eg. dietary corn → sweet potato)
7. Storage technologies
  - (1) Development of controlled atmosphere storage technologies
  - (2) Long term storage system
8. Change of cropping methods
  - (1) Environment-friendly (Environment compatible) crop rotation system and models
  - (2) Crops calendar adjustment
  - (3) Modification of tillage methods, cultivation techniques
  - (4) Adapted cropping models and strategies
9. Energy conservation and carbon reduction
  - (1) Energy conservation technologies
  - (2) Agricultural wastes (biomass) application
  - (3) Agricultural carbon footprint label system
  - (4) New rice lines for saving water

The research directions mentioned above are correspond to coping strategies adaptation to and mitigation of climate change as below

1. Establishing food security system with risk sensitive approach
  - (1) In addition to food security stock, planned food production and supply mechanisms are needed for food security.
  - (2) A system for food security alert and a regional cooperative mechanism for emergency food needs are also needed.
2. Integrating science and technology to enhance agriculture's capability of coping

with stress

- (1) Strengthening research and development on the breeding of drought-tolerant, flood-tolerant, heat-tolerant, salt-tolerant, and pests-resistant and other resistant varieties capable of coping with adversities.
- (2) Utilizing meteorological, information communication and other cross-disciplinary technologies in agricultural management, and safeguard biodiversity.
3. Developing the ecological and flood-retention functions of marginal land
  - (1) Planning to turn flood-prone areas into wetlands or buffers zones against flooding.
  - (2) Formulating protection of property rights affected by Climate Change and providing necessary assistance and compensation.
4. Promoting low-carbon agriculture
  - (1) Highlighting the advantage of local production, encourage local consumption.
  - (2) Developing low-carbon agricultural products.
  - (3) Setting up the agricultural carbon emission inventory system
5. Creating low energy-consuming, low carbon-emitting new business opportunities
  - (1) Developing low energy consuming, low carbon emission as well as healthful and environmental-friendly new green agricultural business models
6. Strengthening farm villages' own disaster-prevention system
  - (2) Connecting national disaster-prevention systems by integrating information and communication technologies.
  - (3) Establishing farm village risk management system to enhance farm villages' own disaster-prevention capability.
7. Establishing risk management strategy to preserve biodiversity
  - (1) Expanding ecological and marine protection areas,
  - (2) Constructing multiple mechanisms for genetic resources conservation.
  - (3) Setting up a biodiversity information center, tracking species changes and safeguarding biodiversity.

### **Some Examples of Adaptation to and Mitigation of Climate Change**

There three researches and vegetables/fruits/flowers industry in Taiwan are being presented as the examples for adapting climate change in the article .

1. Developing a Decision Supporting System on Agricultural Production for Coping with Climate Change

Extreme events such as weather often result in losses of agricultural products and seriously threatening to food security. Therefore, the soil, climate and environmental space information and other database have been integrated in the inquiring system and applied to master modern food, main vegetable production areas, and the system been used for meteorological observation and data simulation. The project combined Oryza with CLIMEX models to assess possible risk of harm under climate change.

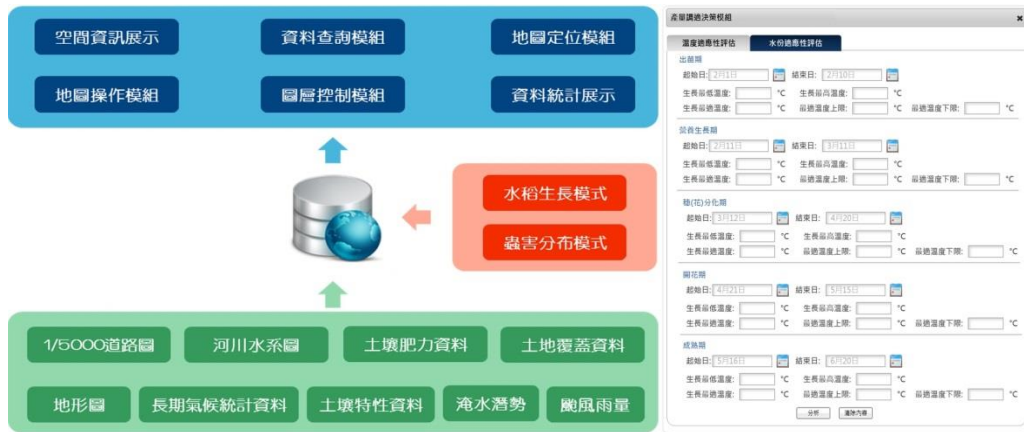


Fig.6 Common Gateway Interface (CGI) of the inquiring system

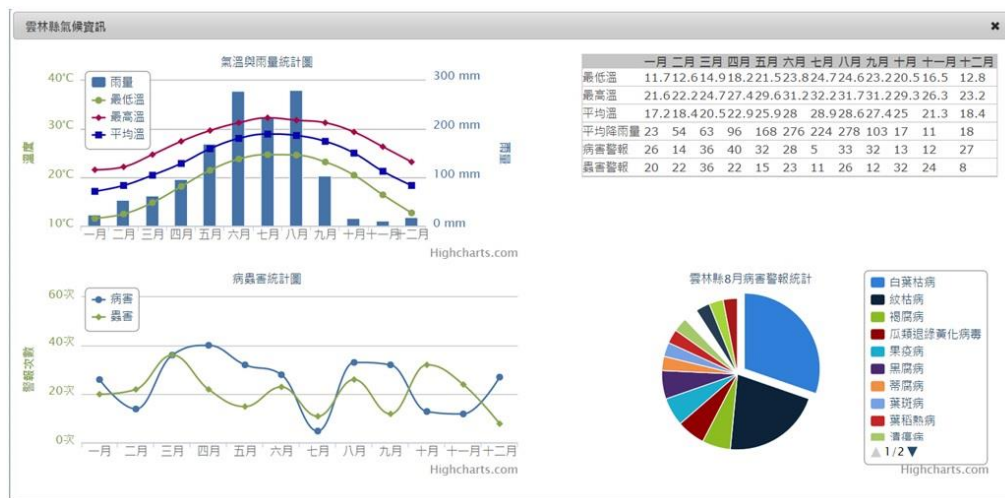


Fig.7 Statistical analysis of climate and pests

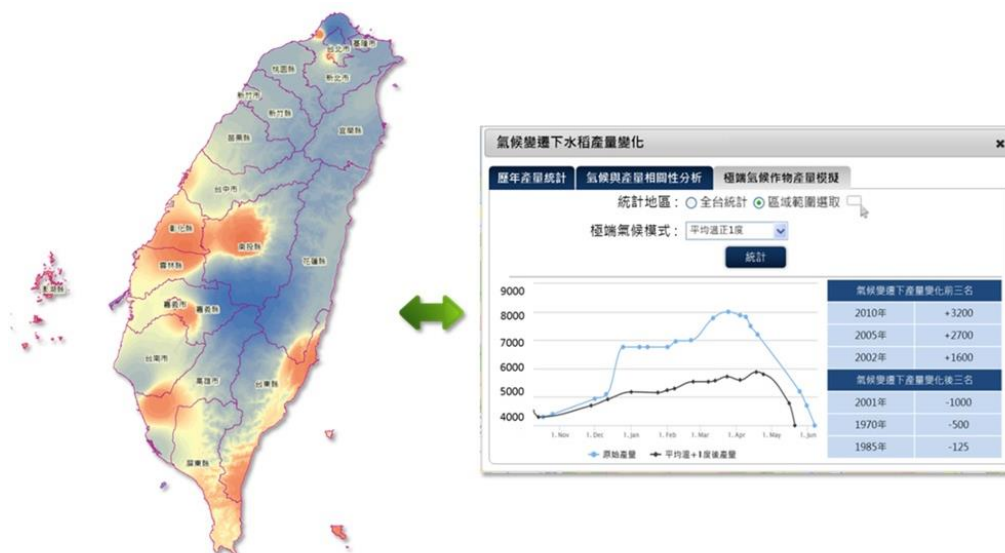


Fig.8 Crop production simulation under extreme climate condition

- Establishing the management and restoration techniques for flooding papaya and pomelo



In order to classify the damage levels of flood damage and to establish the cultivation techniques on the papaya and pomelo trees. Cultivation techniques including defoliation treatment and using of different medium being applied to prevent serious damage, to reduce the losses and to increase restore growth rate of plants after flooding have been developed.



Fig.8 Papaya plant damage indicators caused by wither

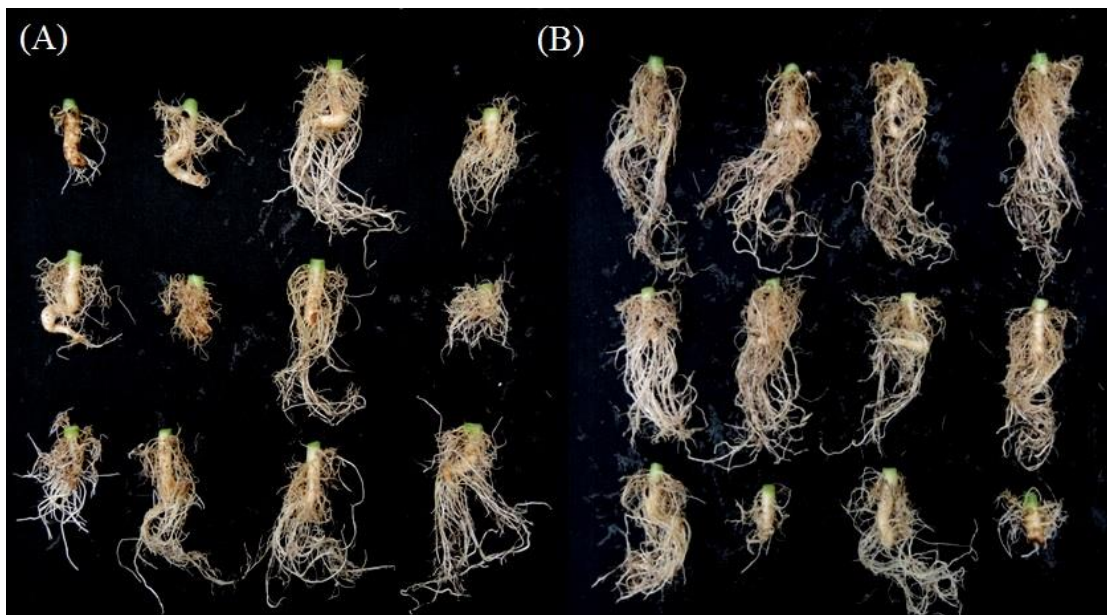


Fig.8 Papaya's new root growth condition in 21th day after flooding, (A)control, (B) defoliation treatment



Fig.9 Damage indicators of Pomelo's leaf caused by wither (left) and the roots growth condition using different medium after flooding (right)

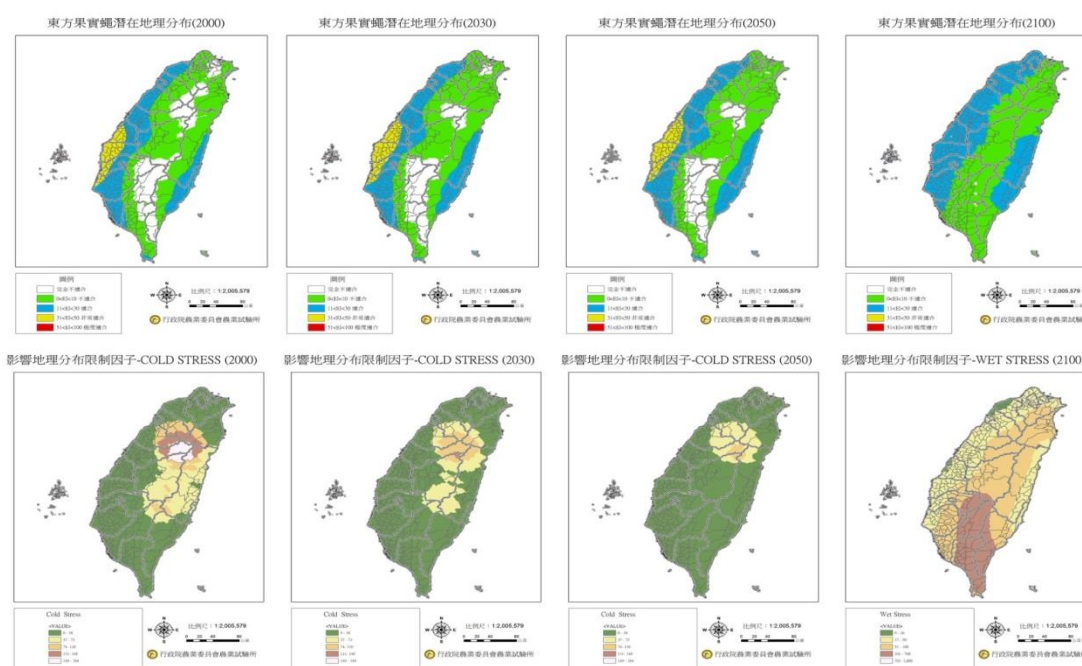
### 3. Study on climate change impact on the potential geographic distributions of the agricultural pests

Pest potential distributions prediction was becoming one of very important topics under climate change. The result of the project can be used for forecasting the probability of diffusion of pests. A real-time warning and control measuring system have been made according to probability of occurrence of pest. It is useful for farmers to manage their crop cultivation. Based on the pest's species potential geographical distribution data, pest control in field could be conducted more clearly.

### 4. Vegetables/fruits/flowers industry to meet climate change in Taiwan

Vegetables/fruits/flowers industry is gradually increased in frustrated in Taiwan. The greenhouses (simple and high-tech) and net house have been mainly used in the production of flowers, vegetables and fruits are the strategies of agricultural industries for coping with adaptation to climate change. Originally, construction of greenhouses has to invest much money, so normally it has to consider the profits of the products. Through intelligent technologies and materials of automatic control of environment, sensing system, integrated pest management (IPM), artificial light (such LED), ICT etc. application in agricultural facility, the appropriate coping strategies adaptation to and mitigation of climate change could be done more conveniently and easily.





Study on climate change impact on the potential geographic distributions of the agricultural pests

## Closing Remarks

1. To cope with the challenge of climate change, we have to change our thinking to create niches, establish rolling strategy of adjustment and expand citizen participation.
2. Input of resources for response to climate change must be recognized and selected without regrets, and formulate short-, medium- and long-term action plans after considering the requirements of overall development and the most appropriate use of funds, and put them into practice.
3. Taiwan's government will keep in upholding agricultural policy guidelines of "healthfulness, efficient and sustainable operations," continuously innovate and pursue balance, and develop low risk, low carbon emission and emerging green agriculture to ensure food security and sustainable development of Taiwan's agriculture.
4. The greenhouses (simple and high-tech) and net house mainly used in the production of flowers, vegetables and fruits are the strategies of agricultural industries in Taiwan for coping with adaptation to climate change.

## References

1. Ag. Statistics yearbook 2014 (<http://eng.coa.gov.tw/>)
2. Chang, C. C. and R. S. Wu. 2011. Climate change adaptation strategies for agricultural water management in Taiwan. ICID 21st International Congress on Irrigation and Drainage, 19-29.
3. Chang, W. C. & S. H. Huang. 2015. Establishing the management and restoration techniques for flooding papaya and pomelo.
4. Council for Economic Planning and Development (CEPD). 2012. Adaptation strategy to climate change in Taiwan, p11.
5. Huang, Y. B., F. C. Lin & S. H. Huang. 2015. Study on climate change impact on the potential geographic distributions of the agricultural pests.

6. Hsu, H. H., C. Chou, Y. C. Wu, M. M. Lu, C. T. Chen & Y. M. Chen, 2011: Climate Change in Taiwan: Scientific Report 2011 (Summary). National Science Council, Taipei, Taiwan, ROC, 67pp.
7. Liu, T. S. 2015. Developing a decision supporting system on agricultural production for coping with climate change.
8. Strive for Safety Food Production and Maintain Food Security for Domestic Requirement (<http://eng.coa.gov.tw/suggest.php?issue=22018&id=22021>)
9. Yu, G. H., W. T. Lin & C. R. Wu. 2011. Study on irrigation management strategies for drought in Taiwan. ICID 21st International Congress on Irrigation and Drainage, 199-208.