

行政院所屬各機關因公出國人員出國報告書
(出國類別：研習)

研習「森林生態系經營理論及相關技術」報告

服務機關：行政院農業委員會林業試驗所
出國人 職稱：所長、副研究員兼主任、
副研究員兼主任、助理研究員
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一、緣起與目的

森林生態系的永續經營，已成為世界性的潮流，舉凡林業永續發展 C&I 的訂定、綠色消費市場 C&L 的建立、ITTO、CIFOR 熱帶森林永續發展 C&I 的編訂，乃至世界各國在歷次國際會議中，針對永續林業所作出的承諾及簽署的協定等，均顯示出此一潮流的強制性(楊政川 1999a、1999b、1999c)。為此，本所遂於民國八十七年起，以六龜試驗林為基地，開始進行一系列的先驅研究計畫，其第一期之研究成果，以於八十九年四月生態系經營研討會中發表，除此而外，為參酌生態系經營原創國的作法，亦積極就 OSU 及 USDA PNW 所發表之相關研究報告，進行引進及翻議的工作(劉一新 1999a、1999b、1999c、1999d、2000a、2000b)，目前有關計畫編訂、監測、評估的架構，已逐步成型。

農委會目前所推動的森林生態系經營計畫，已具初步成效，唯於效益監測 (effectiveness monitoring) 及棲蘭山檜木林經營部分仍有若干盲點有待釐清。近年來美國太平洋西北研究站(PNW research station)在森林生態系經營計畫及效益監測程序方面，已有大幅的修正，特別是西北森林計畫效益監測程序之編訂及執行，其內容較諸數年前進步甚多。本所雖已將其於 1999 年 1 月出版之「西北森林計畫效益監測程序之設計及策略」(The Strategy and Design of the Effectiveness Monitoring Program for the Northwest Forest Plan 【USDA 1999】)一文翻譯完竣，並應用於「六龜試驗林森林生態系經營計畫」及「棲蘭山國家森林生態系永續經營計畫草案」之編訂過程之中，唯這些觀念及作法，即使在美國亦屬新創，因此，本計畫之目的，即在造訪美國農業部太平洋西北研究站及其試驗地，以實地研習西北森林計畫及效益監測程序之編訂及執行實務，並吸取該計畫自 1992 年推動至今所得之經驗。

本次出國研習計畫由楊所長政川率團前往，並以「[An Overview of Taiwan's Forests and Their Management Perspectives in the 21st Century](#)」為題，於奧勒岡州立大學、美國內政部土地經營局，以及太平洋西北研究站等單位發表專題演講，隨行成員包括推廣系劉一新主任、經濟系吳俊賢主任及推廣系陳燕章助研員，研習考察時間自九十年八月三十日至九月十七日共計十九日，計參訪奧勒岡州立大學及其 McDonald Dunn 試驗林、美國聯邦林務署所屬林業科技實驗站、太平洋西北研究站、Mt. Hood 國有林、美國內政部土地經營局、地質調查所森林及原野生態系科學中心、世界林業中心等單位，並參加三個場次的研討會，除就我方與美方所發表的論文及研究報告進行充分的討論外，並就進一步的合作研究關係進行洽商，以建立雙邊合作研究之機制。

二、行程與任務

日期	星期	行程	任務
八月卅日	四	臺北 Portland	行程
八月卅一日	五	Portland 一帶	參觀考察 Mt. Hood 國有林
九月一日	六	Portland 一帶	參觀 Columbia River Gorge National Scenic Area
九月二日	日	Portland Corvallis	參觀 World Forestry Center Museum
九月三日	一	Corvallis	拜訪 Dr. C.Y. Li
九月四日	二	Corvallis	會見 OSU 校長及森林學院副院長，楊所長並發表專題演講
九月五日	三	Corvallis Portland	會見 OSU 主管國際合作計畫相關人員，洽談合作事宜 參觀 McDonald Dunn Experimental Forest
九月六日	四	Portland	列席旁聽 US Forest Service 會議，拜訪 Team Oregon 相關單位
九月七日	五	Portland	會見土地經營局及太平洋西北研究站人員，並由楊所長發表二場專題演講
九月八日	六	Portland 華盛頓州 Mortan	楊所長赴加拿大出席「中加林產工業永續發展交流研討會」其餘人員前往 Mt. St. Helen 繼續考察行程
九月九日	日	Mortan Paradise Tacoma Ocean Shore	參訪 Mt. Rainier 國家公園
九月十日	一	Ocean Shore Forks	參訪 Olympic 自然資源中心
九月十一日	二	Forks	會見 ONRC 主任及相關人員並洽談簽訂合作備忘錄事宜 參觀 PORTAC 木業公司
九月十二日 十六日	三 日	Fork Portland	因 911 攻擊事件班機延誤滯留於當地四日
九月十七日	一	Portland Seattle 臺北	返程

三、成果與心得

(一) 集水區及森林遊樂區之經營

九十年八月卅一日(星期五)

參觀胡德山國有林總部(Mt. Hood

National Forest Headquarter), 與地景分析及設計專家 Nancy Diaz 及 Zigzag 林區管理員 Ms. Colleen Pelles Madrid 就

該國有林轄區範圍及經營內容進行討論。

Bull Run 集水區之經營為胡德山國有林的重要經營項目之一，該集水區與人煙稠密之鄉鎮接壤，而其經營目的即在維護民眾用水品質，其用意之良善實足供臺灣國有林事業區經營之借鏡。

胡德山為一休眠中的火山，由於積雪終年不化，且有冰河景觀，故為奧勒岡州之重要觀光遊憩據點，於胡德山麓建有一遊客中心 Timberline Lodge，除提供遊客解說服務與住宿之外，且為紀錄胡德山林區開發歷史之地標，其中各項設施多採用廢棄建材如集材鐵軌、鐵鍊等，加上設計巧思，集實用與藝術價值於一身，令人印象深刻，而經由解說員的詳盡介紹，也使遊客更進一步瞭解此一融合生態、歷史、人文、環保之經營理念。

濱水帶之經營已成為具體之工作項目，即使於森林遊樂區中也不例外，在 Wildwood 森林遊樂區中，遊客可循規畫良好的步道及自導式解說系統，進行深度的生態旅遊，並以太平洋銀鮭的迴游產卵生態為題，透過解說牌的設置，進行主題及現地展示。園區內也容許正常林業經營行為(疏伐撫育作業)之進行，並詳加解說而列為展示重點，此點將提供本所六龜試驗林扇平生態科學園經營之參據。

鮭魚的復育

九十年九月一日(星期六)

由 Dr. Peyton W. Owston 引導參觀哥倫比亞河風景特定區(Columbia River Gorge National Scenic Area)，在哥倫比亞河流域，其重要魚類資源包括太平洋銀鮭(Pacific Silver

Salmon)、帝王鮭(King Salmon)、虹鱒(Rainbow Trout)，以及鱈鯨(Sturgeon)，且均屬高經濟價值之釣遊及商業魚種，為此，對於這些魚種的保育及復育工作，美國可謂不遺餘力，除投資鉅額金錢興建人工復育場外，並在在自然河道中興建大規模的魚梯，以保障魚類資源之生生不息。事實上，溪流魚類的經營，本為森林生態系經營之重要工作項目，唯因臺灣林業界中，無論研究或現場經營人員，瞭解溪流魚類之分類、生態乃至利用方式者實寥寥可數，因此，在此一經營議題上，向來可謂停滯不前，

究其實，臺灣溪流之釣遊魚類資源相當豐富，投入於此項遊憩行為之人數亦十分可觀，如能配合森林生態系經營計畫之推動，將此一議題正式納入林業經營之範疇，無疑是有其正面價值的。

水資源短缺與分配不均的現象，也發生在美國，加州為一人口稠密的大州，其水源爭奪戰可上溯至 1900 年代(劉一新譯 1996 環境保育學 p278~280 國立編譯館出版)，目前哥倫比亞河上的一些水壩，如 Bonneville Dam，亦負責供應加州之部分用水，此點也引發現地人民的一些不滿情緒。目前臺灣中南部因用水所引發的環保爭議，例如美濃水庫之興建，也存在相同的隱憂，如何加以解套，正考驗著相關單位的政治智慧。

(二) 林業陳列館之規畫及設計

九十年九月二日(星期日)

本所推廣系陳燕章助研員於今年六月，於世界林業研究所(World Forestry Institute, WFI)進行為期六個月的合作研究計畫，目前已進入報告

撰寫的階段，故安排此一參觀行程，以瞭解執行現況與未來進一步之合作關係。

WFI 為 USDA Forest Service 之分支單位，專責與世界各國林業研究單位之交流與合作研究關係之拓展。WFI 並與各學員所屬單位共同提供相對經費，供學員旅美生活所需。其合作計畫之執行以一年為限，學員需與美方相關研究人員洽商適當研究主題並參與計畫執行，學員除可經由此一合作研究計畫，瞭解美方在林業經營上所做的努力之外，亦可進行彼此之間的交流，對於未來國際合作研究關係的拓展上，自有其助益。

世界林業中心博物館 (World Forestry Center Museum) 為 WFI 之附屬機構，其開放空間展示方式與主題區設計值得借鏡。有關此點目前推廣系正進行內部會商，並與森保處等相關單位聯絡，配合三機多媒體簡報系統之安裝，選擇「臺灣的檜木」、「森林與水」等主題，進行本所林業陳列館之更新規畫，並參考實物展示與等比例縮放示意模型的製作理念，作為林業陳列館未來展示設計之參據。

行程中並參觀位於 Portland 郊區的大理菊花圃，並於晚間抵達 Corvallis。

(九月三日為美國勞工節放假一日，停留於 Corvallis 整理資料)

(三) 國際合作關係的拓展

九十年九月四日(星期二)

早上八時，拜訪奧勒岡州立大學校長 Dr. Paul G. Risser，由於本所曾與該校簽訂合作協定，因此，會談主題集中於如何進一步加強彼此之間的合

作關係，會談在愉快的氣氛下於九時結束。其後，楊所長以「An overview of Taiwan's Forests and their management perspectives in the 21st Century」為題，在上午十時於 OSU Forest Sciences Laboratory 發表專題演講。與會人員包括 OSU 教授及 PNW 研究人員在內的廿餘位學者專家，楊所長以流利的英文、精闢的內容與條理分明的應答，獲得在場人士一致的肯定。其後，Dr. John Hayes, Edward Starkey, Robert Gresswell, George Lienkaemper 等人，亦就森林生態系永續經營議題，發表專題報告。其中，OSU 森林系副教授 Dr. John Hayes 所報告的內容，為自 1995 年開始，結合奧勒岡州立大學、土地經營局(BLM)、地質調查局生物資源系森林及原野生態系科學中心(FRESC)等單位，共同執行之森林生態系合作研究計畫 Cooperative Forest Ecosystem Research (CFER) Program 之執行現況。該計畫透過科學家與現地經營者的結合，已使森林生態系經營進入實質運作的階段，而為奧勒岡州立大學教授與聯邦 PNW 試驗站科學家組成的研究群，自 1987 年開始推動之「奧勒岡海岸山脈林地生產力提升」計畫(COPE Program)之後的另一項大型計畫。近十年來，本所與這兩個計畫之成員，已透過研究人員互訪及國際研討會的召開，建立起密切的聯繫關係，雙方在森林生態系經營之多元化育林體系、濱水帶經營、社會及經濟評估、土壤微生物與立地生產力等研究議題上，亦充分表達強烈的合作意願。為此，本所已於九十年十一月十五日，依據與美方研究人員之會談內容，以及農委會對中美合作科技

計畫提送要求，將進行四年之久的六龜試驗林森林生態系經營先驅計畫為基礎，研提中美科技合作研究計畫送審，並將 Dr. John Haye 及 Dr. Robert Gressel 在內的七位研究人員納入美方合作人員名單，期能吸取他人先進經驗並加速本所六龜試驗林森林生態系永續經營計畫之推動。此一中美合作計畫若能順利成型，將成為本所繼 1993 年 7 月 1 日至 1996 年 6 月 30 日，與 USDA PNW 合作執行之「國有人工林永續生態系經營的研究」之後的另一項針對森林生態系經營所進行之國際合作計畫。無論在國際合作關係的拓展與實質研究內容的提昇上，均將有所助益。

本日下午，會見 OSU 森林學院副院長 Dr. Bart A. Thielges，商討進一步拓展雙方合作關係之可能性，其後並由副院長引導，參觀森林學院的各項教學及研究設施後結束拜會行程。

(四) 人員互訪及進修機會

九十年九月五日(星期三)

會見 OSU 國際計畫處主任 Dr. John G. van de Water 及副教務長 Dr. William H. Smart，以及負責聯繫亞太地區學生事務之 Miss Mayer Natania 洽談合作機會，特別是補助費用部分。從他們口中得知，受到美元對臺幣昇值的影響，近年來前往 OSU 就讀的臺灣學生人數已大幅減少，相對的，中國大陸至該校就讀的學生人數則呈現遞增。Dr. Smart 為此曾來臺多次吸收臺灣學生至該校就讀，唯因學雜費用偏高（每學期 4,500 美元，一學年 13,500 美元），因此成效依然不彰。有關此一議題，目前推廣系劉一

新主任與 Miss Natania 間已建立聯繫管道。

本日下午參觀 OSU McDonald Dunn 實驗林，有關該實驗林之經營計畫，劉一新主任曾於民國八十八年予以摘譯並發表於臺灣林業第廿五卷第五期，在這次的參訪過程中，發現該試驗林在進行疏伐作業時，加強了有關闊葉樹種的標定與保存作業，以增加斑梟(spotted owl)及其它野生動物之可利用棲位，行程中並參觀保存良好的老齡林，並聽取現場工作人員的說明，以瞭解美方在土壤微生物及其對森林生態系運作功能之影響上所做的研究。其後自 Corvallis 驅車返回 Portland。

(五) 列席 USFS 內部會議

九十年九月六日(星期四)

USFS 於本日召開業務會議，列席旁聽發現，USFS 人員在進行腦力激盪的過程中，雖輒起激烈爭議，唯均能對事不對人，此點在臺灣是不易見到的。

稍後拜訪 Team Oregon 成員之一的 Mr. Mike Abbate，該員曾來臺數次，並透過奧勒岡州駐臺代表引見過楊所長。Mr. Abbate 曾服務於 USFS，目前則主管一家私人的地景諮詢顧問公司，該公司目前承辦案件之一為臺南市政府橋頭港溪整建工程之規畫。由於其內容與本次研習內容無太大的關聯，遂於聽取簡報後告辭。

(六) 洽談簽訂合作協議

九十年九月七日(星期五)

參訪美國土地經營局(Bureau of Land Management, BLM) 奧勒岡州辦公室，除由楊所長發表專題演講外，

並聽取該局人員 Dr. Liang-Yi Hsin, Dr. Bob Alverts, Dr. Eric L. Stone 針對該局經營計畫編訂及執行相關細節進行簡報。簡報中提及有關該局在計畫研提前的公告週知程序，該程序實可以做為臺灣土地及自然資源經管機關編訂經營計畫之參據。由於目前各機關在編訂經營計畫之前，均未有類似此一公告週知之動作，致引發民間團體相當多的責難及雜音，究其實，由於經管標的與人民權益與生活福祉息息相關，因此，自然資源經管單位在經營計畫尚未付諸實施之前，的確應該完成公告週知的程序，俾經由公共決策參與，修正經營計畫之內容，並避免計畫執行過程中的一些不必要的爭議。參考加拿大 CCFM 所制定之森林永續經營之準則與指標(C&I)架構，公平有效決策的制定為評估其經營是否符合永續要求的準則之一，而公告週知決策的制定，則為該準則中的重要指標，因此，此點也正是生態系經營行動中，考量社會層面的具體表現。

於結束 BLM 行程後，於下午參訪 PNW 試驗站，會見試驗站副主任 Dr. Robert C. Szaro 並會商簽署本所與該試驗站合作協議之可能性。Dr. Szaro 除表示同意外，並當場指派所屬 Dr. Samuel Chan，儘速研擬協議書草案並送交試驗站主任 Dr. Tom Mills 核閱。雙方在愉快的氣氛下交換紀念品及書籍刊物後結束會談，本次出國研習之公務行程至此告一段落。

(七) 復舊造林

九十年九月八日(星期六)

楊所長於上午赴加拿大與本所化學系鄒哲宗主任、利用系周群研究員及黃清吟博士會合，參加「中加林產

工業永續發展交流研討會」，其餘人員則繼續進行後續參訪行程。

參訪聖海倫火山國家紀念物(Mt. St. Helens National Volcanic Monument)。聖海倫火山於 1980 年爆發，造成難以估計的損失，事後在爆發點週邊的地區，凡屬國有林部分，均被劃入自然紀念物，除必要的設施如公路及遊客中心外，其餘均保留現狀不進行任何的復舊，人員進出亦僅能在規定的道路及地區活動，若踐踏干擾禁區植被者，均將被處以 100 美元的罰款。火山爆發至今，已超過廿年，絕大多數的地區，其植被仍僅停留在演替初期，而僅出現一些草花及灌木類。相對的，同樣位於爆炸點內，唯屬 Weyerhaeuser 公司所有之林地，則於 1983 年選擇 Noble Fir 進行復舊造林，目前已蔚然成林，平均樹高均達 20 英尺以上，此一成果證明了適當的人為介入，確可加速森林之建造，也為「森林一定要經營」的理念做了最好的現場實証，更可做為臺灣九二一震災復舊造林之典範，相當值得借境。

(八) 國家公園之經營管理

九十年九月九日(星期日)

參訪雷尼爾火山國家公園(Mt. Rainier National Park)，雷尼爾火山積雪及冰河終年不化，冰蝕景觀極為豐富壯觀，可謂處處都是生態學的野外教室。循 Alta Vista Trail 步行，並至名符其實的 Reflection Lake，湖畔有一國家公園管理處的職員(並非雇工)正在植草，詢問結果，所植之草均為現地原生種並於苗圃育苗後至原生育地栽植者，由此可見其對保育原生植群及環境的用心。保育工作的推動，除落

實於相關配套措施、法令的訂定與執行外，仍有賴現場人員的親身參與。

(九) 奧林匹克自然資源中心

九十年九月十日(星期一)

車程至位於華盛頓州 Fork 的奧林匹克自然資源中心(Olympic Natural Resources Center, ONRC)，並會見該中心前副主任徐得祥博士。徐博士目前雖已退休，唯仍積極參與相關業務的推動，並與臺灣林業界保持密切聯繫，對於雙方合作協議事宜也表達高度的促成意願。

(十) 奧林匹克自然資源中心

九十年九月十一日(星期二)

早上與 ONRC 主任 Dr. John M. Calhoun 會面時，驚聞發生 911 攻擊事件，全美進入警戒狀態，所有機場關閉，原訂返臺行程勢將遭到延誤。

詢及有關合作機會時，Dr. Calhoun 建議直接與華盛頓大學聯繫洽商。拜會結束後，聽取華大自然資源系研究員 Dr. Scott Horton 的簡報，並參觀 PORTAC 公司位於 Fork 的兩家鋸木場，這兩家鋸木場主要在處理中小徑疏伐木，且自原木去皮、大剖(第一家)、切割、乾燥、分級、包裝(第二家)均為電腦全自動控制，據該公司經理 Mr. Warren Blakeslee 稱，其作業容量每天可處理 70 車的原木。此一投資，在 Fork 一地，製造了 150 個工作機會，除緩和了老齡林禁伐後的就業問題外，也為中小徑木疏伐材找到出路。

下午在徐博士的引導下參觀 Hoh Rain Forest，該處為 Olympic 國家公園的一部分，短暫停留後，轉往疏伐作

業現場，除觀看木材收穫機操作之外，並聽取現場監工對於疏伐強度如何進行現場即時監控的說明。

結束 ONRC 參訪行程後，於九月十二日返回 Portland，並因班機延誤，遂以個人休假方式，滯留於 Portland，並於九月十七日自西雅圖搭機返臺。返臺當日因颱風放假一日，故於次日起恢復正常上班。

四、檢討與建議

2000 年 9 月 20 日 27 日，本所透過農委會與國科會科技計畫補助，針對中

美森林生態系經營之現況及進展，邀請 OSU 及 PNW 的六位專家學者，共同舉辦了一場中美森林生態系經營研討會，除就雙方推動森林生態系經營之現況發表論文外，並安排二場實地考察。在這場研討會中，美方提及本所於 1993 年 7 月 1 日至 1996 年 6 月 30 日，與 USDA PNW 合作執行之「國有人工林永續生態系經營的研究」計畫，並要求評估恢復此一中美合作計畫的必要性與可能性，並邀請本所赴美參訪。

為此，楊所長乃率領相關研究人員，透過不同計畫的支援，配合個人休假，於 2001 年 8 月 31 日至 9 月 8 日，親自拜訪 WFI、OSU、PNW、BLM、USGS 等單位進行會商。行程中除實地參訪各相關試驗地外，楊所長並就我國林業現況，發表三場專題演說，並與各相關單位就進一步發展合作關係進行研商。由於演說內容具體，合作訴求明確，美方研究人員對於雙方的實質合作關係均表樂觀。據此，於回國後即透過中美科技合作計畫途徑，於 11 月 15 日研提中美森林生態系經營合作研究計畫送農委會國合處彙整送審在案，此一第二階段的中美合作研究計畫，除將針對多元化育林體系、濱水帶復舊經營、社會經濟評估、土壤生產力及微生物等議題，進行合作研究外，並將安排人員之互訪與現地觀摩，使雙方的實質合作關係能夠獲得進一步的加強。

本次出國研習，對於國有林集水區及森林遊樂區的經營、濱水帶及溪流魚類經營、重大天災復舊造林、原生植群及環境保育，乃至中小徑木伐採利用等課題，均親赴現場實地考察並搜集相關資料，俾便針對各項議題發表更深入的報告供研究及經營人員之參據。

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(附件) 楊所長專題演講內容

The Forest Sector of Taiwan, ROC

ABSTRACT

Taiwan, the Republic of China, has a total land area of 36,179 square kilometers and a population of 22,350,363 people by July 2001. The year 2000 per capita GNP is US\$14,216. The total exports and imports are 148,321 and 140,011 millions of US dollars, respectively, in year 2000. The Taiwan Island is located in subtropical and tropical humid region of the Asian Pacific and characterized by the complicated topography at high mountainous areas. Such a broad range of environments nourishes the island of 36,000 km² to be full of high biodiversity in forest ecosystems. The forests of Taiwan cover more than 2 million ha and account for 58% of land area and hence are very important natural resources for the country. Among them, the natural forests occupy 72.7% of forest coverage and contain roughly 5 forest types, with the cypress forests being the most valuable one. In addition, man-made forests of 422,600 ha (20.1%) and bamboo plantations of 152,300 ha (7.2%) have been established at the elevations below 2,000 m. The total estimated forest stock volume is 358 million cubic meters, which includes 310.5 million for natural forests and 47.6 million for man-made plantations. Though the stock volumes of young man-made plantations are lower than those of natural forests, the productivity however can be enhanced through silvicultural treatments like thinning and pruning. The land coverage of national forests is more than 70%. But most bamboo plantations (78.6%) are owned and managed by local private groups. Taiwan forestry developed vigorously and was largely for timber production during the 1950s and 1960s. However forestry policy has gradually sifted from timber production toward resources conservation since 1970s. Wood industry, like plywood and furniture industry were export-oriented and very prosperously developed during 1960s and 1970s. Nevertheless, plywood trade became an imported item since 1980 while furniture industry gradually lost its ground due to higher costs since 1990.

Timber production has decreased dramatically since 1990s because harvesting natural forests has been totally banned from 1991, as a result of highly developed economy and pressures from the general public and environmentalists. Annual timber consumption is about 4.5 million cubic meters and more than 99% of that is imported. Canada and Malaysia were the countries exporting softwood and hardwood, respectively, to Taiwan in year 2000. In order to support a prosperous forest industry, Taiwan needs not only to diversify its timber purchasing but also to maintain its domestic sustainable supply by intensively managing the plantations. Management of both man-made and natural forests is integrated into an ecosystem-based approach that is environmentally sound, socially beneficial and economically viable. Sixteen forest recreation areas are currently open to the public and have very high revenues. Three more recreation areas are under planning. Totally, 5 million peoples are anticipated to enjoy these eco-tour opportunities. Both *in situ* and *ex situ* conservations are operating in Taiwan. Nineteen nature reserves, 9 protected natural areas, 6 national parks, 13 wildlife refuges, and 28 important wildlife habitats have been established since 1965. Their total area is 700,970 hectares and accounts for 19.5% of the total land area of Taiwan. Three botanical gardens and an arboretum are also managed to preserve plants' gene pools. Land-use change and biodiversity loss are current crucial forest issues in Taiwan and, therefore, foresters should be involved in the efforts of implementing nature conservation and environmental education so that people can become more aware of how important their forests are being managed to be sustainable.

INTRODUCTION

Taiwan, the Republic of China, consists of islands of Taiwan, Penghu, Kimen, Matsu, and some other small islets. She has a total land

area of 36,179 square kilometers and her population is 22,350,363 by July 2001. The year 2000 per capita GNP of this country is US\$14,216. The total exports and imports are 148,321 and 140,011 millions of US dollars, respectively, in year 2000. The island of Taiwan is located in subtropical and tropical transition zone of the Asian Pacific (21° 45' to 25° 38' N; 119° 81' to 122° 61' E) and accompanied by abundant rainfall and high humidity. The mean annual temperature is over 20 degrees Celsius. The average temperature of July and February are about 28 and 14 degrees Celsius, respectively. The mean annual relative humidity is 81%. The average annual precipitation is about 2,500 mm, ranging from 1,100 to 4,980 mm. The Central Mountain Ridge makes the backbone of Taiwan and is characterized by the complicated topography and high elevations with more than 200 peaks over 3,000 meters. Three major forest soils are found, including red-yellow soils, brown forest soils, and podzolic soils, which distribute at the elevation below 500 m, 500 to 1,800 m, and above 1,800 m, respectively. Such a broad range of environments nourishes the island of 36,000 Km² to be full of high biodiversity in forest ecosystems. There are over 4,000 vascular plant species, more than 400 species of birds (about 40% resident), 90 species of reptiles, 30 species of amphibians, 140 species of fresh water fish, and an estimated 50,000 insect species, including more than 400 species of butterfly. The forests of Taiwan cover 58% of the island area and hence are very important natural resources for the country. Timber production had been the major income of Taiwan economy since 1950s and 1960s. Plywood and furniture industry were export-oriented and very prosperous during 1960s and 1970s. Forest policy had gradually sifted from timber production to resources conservation since 1970s. Furthermore, harvesting from natural forests, which occupy 72.7% of the total forested land, has been totally banned since 1991. These natural forests are being managed for the purposes of water supply, soil protection, recreation, and conservations. Man-made plantations, occupying 20.1% of the total forested lands, are still at a relatively young stage and hence have low stock volumes. In addition to increasing wood imports, these plantations have to be

intensively managed to meet Taiwan's annual timber demands, averaged around 4.5 million cubic meters. Sixteen forest recreation areas are currently open to the public and make very high market revenues. Both in situ and ex situ conservations are implemented to preserve animal and plant gene pools throughout the national forests. Environmental education has been carried out to make the public become more aware of how important their forests are being managed to be sustainable.

TAIWAN'S FOREST TYPES

Taiwan is a small island with a high range of mountains and hence exhibits vertically diversified habitats and climates (from the tropics to the subalpine) from low to high altitudes. Therefore, a spectrum of five natural forest types exists on the island, which occupies 1,527,500 ha and an estimated 72.7% of Taiwan forest coverage.

1. Spruce-fir-hemlock mixed forests

This type of coniferous mixed forests distributes at elevations of 1,700 to 3,000 m. The fir trees (*Abies kawakamii*) generally grow at higher altitudes almost near 3,000 m, and sometimes are found to aggregate as a small pure stands. Most of spruce (*Picea morrisonicola*) and hemlock (*Tsuga formosana*) grow at lower portion of distribution range. The land area of spruce-fir-hemlock mixed forests is 79,700 ha and accounts for approximately 3.8% of forested land.

2. Cypress forests

An estimate of 48,500 ha of cypress forests accounts for only 2.3% of the forested land mass. However, due to its fine wood properties for construction and furniture, this is considered the most valuable timber tree species in Taiwan. This type of forests extends its distribution from 1,500 m to 2,800 m in elevations and often forms productive stands. Two species grow

together and constitute cypress forest type. Yet, most trees of *Chamaecyparis obtusa* var. *formosana* grow at higher distribution range. Fewer trees are often found to mix with *Chamaecyparis formosensis* at lower sites.

3. Pines and other coniferous forests

This is another type of coniferous forests mixed mainly by *Pinus taiwanensis*, *P. massoniana*, *P. armandi*, *P. morrisonicola*, *Cunninghamia konishii*, *Calocedrus formosana* and *Taiwania cryptomerioides*. The distribution extends from 1,000 m to 2,800 m in elevations and covers 91,900 ha which is 4.4% of the forest area.

4. Conifers-hardwoods mixed forests

Aside from the coniferous species mentioned above, the hardwoods components of this forest type are mainly the members of the families of *Fagaceae* and *Lauraceae*. The land mass is approximately 331,600 ha (15.8%) and distributes from 1,000 m to 2,000 m in elevations.

5. Hardwoods

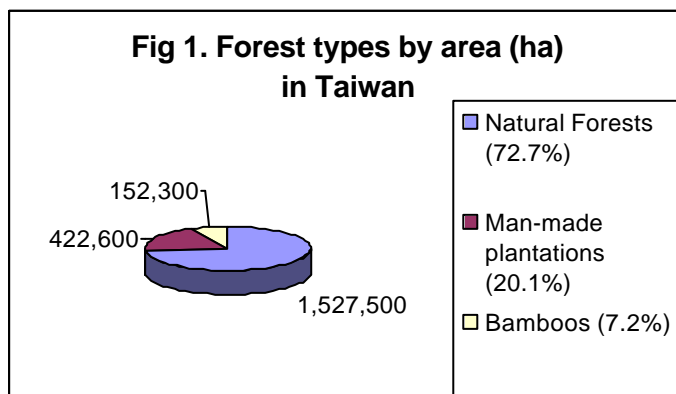
Trees of *Lauraceae* and *Fagaceae* constitute the most of hardwood forest type, which covers 975,800 ha and accounts for 46.4% of the forested land. This type of hardwood forests are widely distributed from 100 m to 2,000 m altitudes.

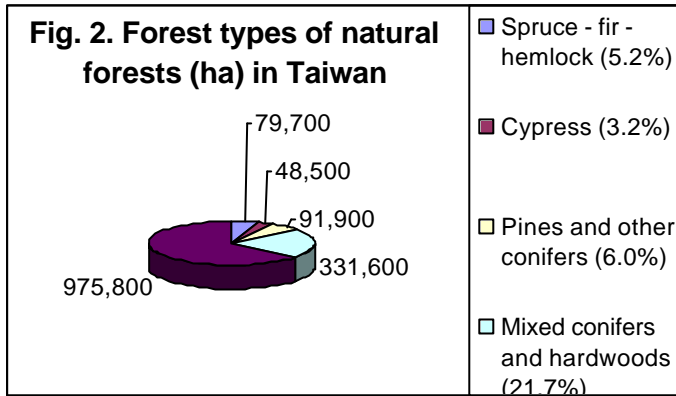
In addition to these natural forests, man-made forests of 422,600 ha (20.1%) have been established in the past 40 years at the elevations below 2,000 m. They include coniferous stands (218,400 ha, 10.4%), hardwoods stands (144,600 ha, 6.9%), and mixed stands (59,600 ha, 2.8%). Bamboo plantations can be considered as another type of man-made forest with 7.2% (152,300 ha) of forested land in Taiwan. The area and altitude distribution for various forest types are summarized at Table 1 and shown

in Fig. 1 and Fig. 2.

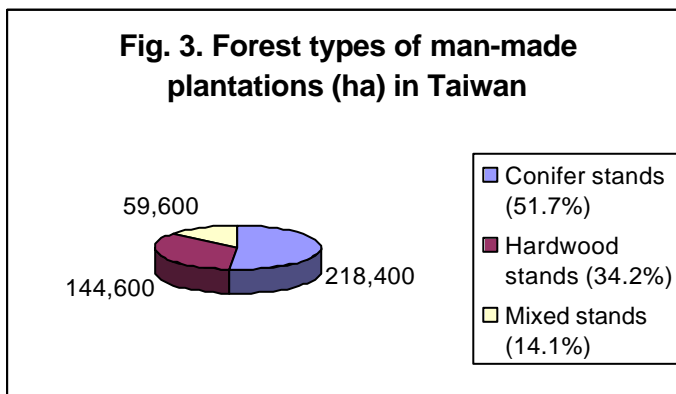
Table1: The area and altitude distribution for various forest types

Forest type	Area		Altitude(m)
	hectare	%	
Natural Forests	1,527,500	72.7	
Spruce-fir-hemlock	79,700	3.8	1,700-3,000
Cypress	48,500	2.3	1,500-2,800
Pines & other conifers	91,900	4.4	1,000-2,800
Mixed conifers-hardwoods	331,600	15.8	1,000-2,000
Hardwoods	975,800	46.4	100-2,000
Man-made Forests	422,600	20.1	
Conifer stands	218,400	10.4	1,000-2,000
Hardwoods stands	144,600	6.9	300-1,200
Conifers-hardwoods mixed stands	59,600	2.8	750-1,500
Bamboo plantations	152,300	7.2	500-1,200
Grand total	2,102,400	100.0	





The coniferous species grown in man-made forests are *Pinus taiwanensis*, *Cryptomeria japonica*, *Chamaecyparis formosensis*, *Cunninghamia lanceolata*, *Taiwania cryptomerioides* and others. Among them, *Cryptomeria japonica* and *Cunninghamia lanceolata* are acclimated exotic species but are vulnerable to the Taiwan red-belly squirrel. On the other hand, the indigenous *Taiwania* trees exhibit high resistance and growth potential. The hardwoods species used for man-made plantations include *Acacia confusa*, *Fraxinus formosana*, *Zelkova serrata*, *Cinnamomum camphora*, *Liquidambar formosana* and others. All of them are indigenous tree species of Taiwan. The areas of different plantations are shown as Fig. 3.



The average age of man-made forests are around 22 years old and need tending treatments such as pruning, thinning or even understory planting where the survival rates were low because of drought, pest or other damage. We intend to establish multi-layered and species- mixed stands for maintaining biodiversity in the woods and sustaining productivity at

the same time. The coverage and uses of main species used for plantation plantings are summarized in Table 2. It is interesting to note that although hardwoods occupy a much higher percent of natural forestland, we establish coniferous plantations of larger areas because of the high initial survival rate of conifer seedlings. In addition to tree species, the major bamboo species for plantations include *Dendrocalamas latiflorus*, *Phyllostachys makino*, and *Phyllostachys pubescens*.

Table 2. The coverage and uses of main tree species used for plantation plantings

Speices	Uses	Area	
		hectare	%
<i>Pinus taiwanensis</i>	Paper making	52,100	23.9
<i>Cryptomeria japonica</i>	Construction, utility poles	47,000	21.5
<i>Chamaecyparis formosensis</i>	Construction, furniture	26,300	12.0
<i>Cunninghamia lanceolata</i>	Construction, utility poles	21,300	9.8
<i>Taiwania cryptomerioides</i>	Construction, furniture	6,100	2.8
Other mixed conifers		65,600	30.0
Conifers total		218,400	100.0
<i>Acacia confusa</i>	Flooring, charcoal	21,200	14.7
<i>Fraxinus formosana</i>	Furniture	9,900	6.9
<i>Zelkova serrata</i>	Construction, furniture	5,500	3.8
<i>Cinnamomum camphora</i>	Construction, furniture	5,000	3.5
<i>Liquidambar formosana</i>	Furniture, mushroom raising	3,100	2.1
Other mixed hardwoods		99,900	69.0
Hardwoods total		144,600	100.0

FOREST STOCK VOLUME

The total estimated forest stock volume is 358 million cubic meters, which includes 310.5 million for natural forests and 47.6 million for man-made plantations (Fig. 4).

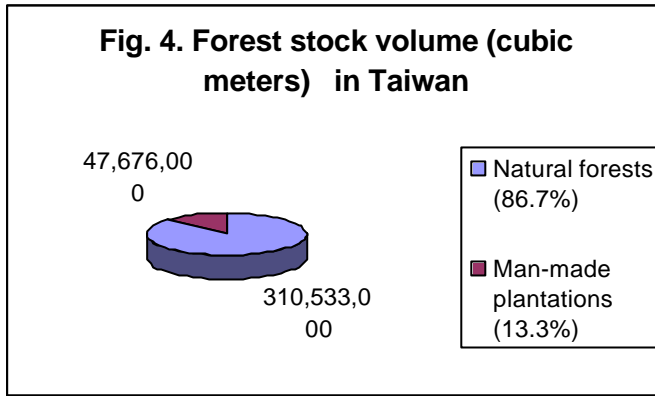


Table 3 illustrates the stock volume of various forest types with the highest stock volume per hectare being the hemlock and cypress forests. Hemlock wood has been mostly used for making school-desks. The most valuable cypress timber (Hinoki, as the Japanese called) had long been harvested and exported to Japan during the period from the beginning to the interim of 20 century. However the stock volumes of man-made plantations are much lower than those of natural forests. This is because man-made plantations are still at a relatively young stage and productivity can be enhanced through silvicultural treatments since the site conditions for them now are very high productive lands, once occupied by natural forests. For instance, a *Taiwania* plantation of 29 years old at Liu-Kuei Experimental Forest of Taiwan Forestry Research Institute now shows growth potential of 500 m³/ha which is comparable to those of hemlock (599 m³/ha) and cypress (598 m³/ha) natural forests with age of more than one hundred years. We have been practicing tending operations, like pruning and thinning, on that plantation. It is also obvious that volume growth of hardwoods is much lower than that of conifer species. This may be due to branching habit, low growth rate or inferior site conditions for most broad-leaved tree species.

Table 3. Forest stock volume of various forest types

Forest type	Stock volume		m ³ /ha
	1,000m ³	%	
Natural Forests	310,533	86.7	203
Spruce-fir	10,564	3.4	391
Hemlock	31,490	10.1	599
Cypress	29,045	9.4	598
Pines & other conifers	20,671	6.7	218
Mixed conifer-hardwoods	94,608	30.4	285
Hardwoods	124,155	40.0	127
Man-made Plantations	47,676	13.3	113
Conifer stands	34,065	71.5	156
Hardwoods stands	8,818	18.5	61
Conifer-hardwoods mixed stands	4,793	10.0	80
Bamboo plantations	358,429,617 ^{*1}		2,353 ^{*2}

*1 The unit for growing stock of bamboo plantations is “culm”.

*2 The average unit is “culm/ha”.

FOREST LAND OWNERSHIP

According to the Constitution, most forests on Taiwan are owned by the central government (Table 4). Therefore, central government agencies, such as the Taiwan Forestry Bureau of the Council of Agriculture, are responsible for managing most forest land, including 74.1% of natural forests, 69.9% of man-made forests as well as 19.4% of bamboo plantations. Designated by related laws and based on forest plans, these forests are being managed as national parks, natural reserves, protected natural areas, wildlife refuges, protection forests, forest recreational areas, and some timber production forests. The managing agency, Taiwan Forestry Bureau has to propose forest management plans to the Council of Agriculture for reviewing and monitoring purposes. Only small portions of national forests are owned and managed by the Taiwan Forestry Research Institute and the Experimental Forest Administration of

some universities. Forest science researches are implemented in these areas. Their findings serve as references for the Taiwan Forestry Bureau to manage national forests accordingly. County governments, aboriginal groups, private cooperatives and individuals manage communal & private forests, including 24.4% of natural forests, 27.1% of man-made forests and 78.6% of bamboo plantations. Most of these forests are managed for timber production while the minor rest are for aboriginal reserves and protection forests. However, some of these forests have been illegally converted into orchards, tea and vegetable farms due to high economic revenues. The bamboo plantations are mostly managed for production of bamboo shoots that are consumed as a healthy vegetable with high fiber content and low calories. Small portion of bamboo culms are used as raw material for the craftworks industry. Besides, a bamboo charcoal industry with promising potential has recently developed.

Table 4. The forestland ownership and managing agencies

Ownership & managing agencies	Natural forests		Man-made forests		Bamboos	
	hectare	%	hectare	%	hectare	%
National Forests	1,154,900	75.6	308,000	72.9	32,700	21.4
Taiwan Forestry Bureau	1,131,800	74.1	295,500	69.9	29,600	19.4
Other agencies *	23,100	1.5	12,500	3.0	3,100	2.0
Communal & Private Forests	372,600	24.4	114,600	27.1	119,600	78.6
Grand total	1,527,500	72.7	422,600	20.1	152,300	7.2

* Other agencies include the Taiwan Forestry Research Institute and the Experimental Forest Administration of some universities.

FORESTRY POLICY, TIMBER INDUSTRY, AND

FOREST MANAGEMENT STRATEGIES

Taiwan forestry developed vigorously during the 1950s and 1960s. Large-scale of forest exploitations were carried out largely for producing timbers, which made up more than 90% of total forestry output values. Starting from the 1970s, forestry policy has gradually shifted from timber production toward resources conservation. This was due to Taiwan had become more industrialized and developed and people had more income than before. Hi-tech industry was also developing prosperously in 1990s. Therefore the public has gradually begun to emphasize the importance of living quality, environmental protection, and natural resources conservation. In 1975, the government approved the Taiwan Forestry Management Reformation Act. Based on the Forest Law, the major objective of forest management in Taiwan is long-term profit of national land protection. Timber cutting is no longer the major income of forest management. According to Taiwan Forest Management and Administration Act, which was sanctioned in 1990 and revised in 1991, the conservation of natural resources and ecosystems are the principal objectives of forest management. Therefore, demanded by the general public and pushed by environmentalists, no cuttings were allowed for natural cypress stands within national forests since 1990. From 1991, all the harvesting was prohibited in natural forests. Table 5 and Fig. 5 & 6 illustrate that the timber production and cutting area in Taiwan had been decreased from 490,215 and 5,546 in 1987 down to 35,179 cubic meters and 632 hectares in 2000, respectively.

Table 5 Timber production and cutting area
in Taiwan in 1987 – 2000

Year	Cubic meters	Hectares
1987	490,215	5,546
1988	310,371	5,208
1989	191,215	2,493
1990	139,796	1,917
1991	126,058	1,046
1992	118,323	1,036
1993	71,735	575
1994	56,128	439
1995	63,176	625
1996	56,362	500
1997	52,173	448
1998	49,529	458
1999	42,945	393
2000	35,179	632

Fig. 5. Timber production in Taiwan in 1987 - 2000

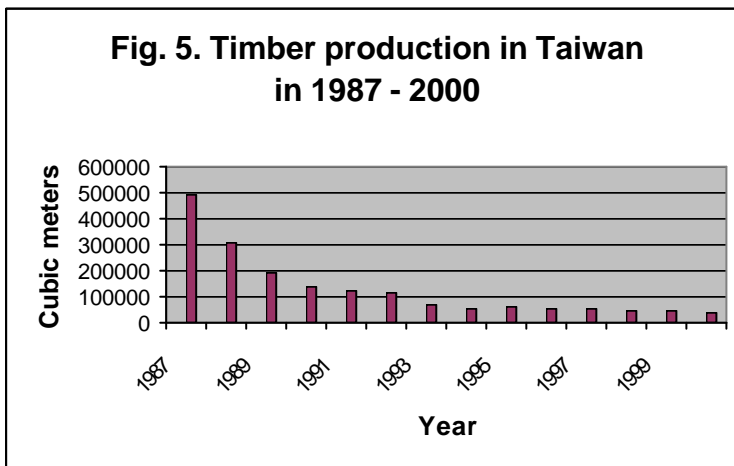
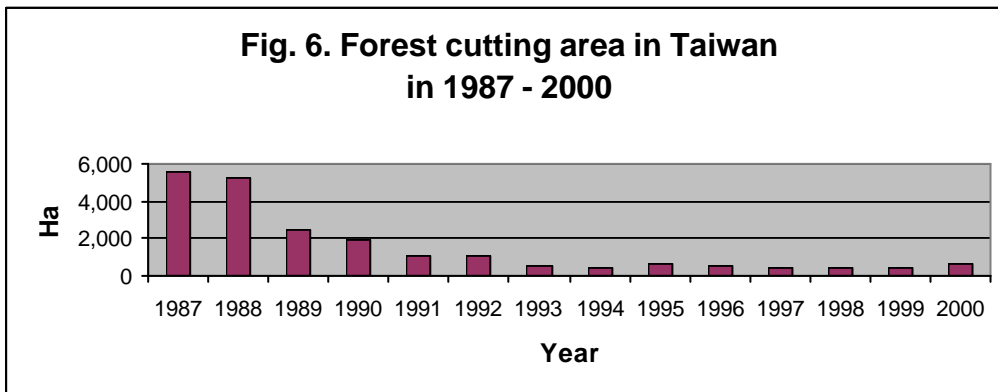


Fig. 6. Forest cutting area in Taiwan in 1987 - 2000



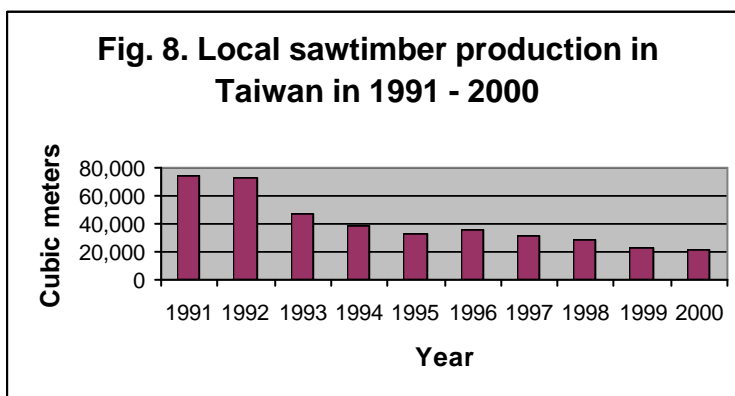
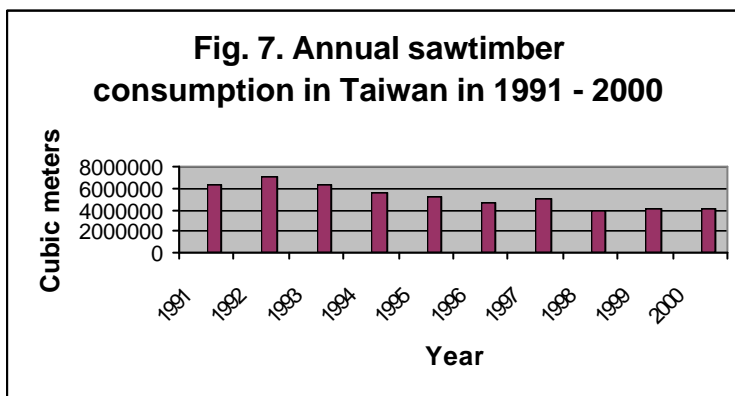
For decades timber production has played an important role in supporting Taiwan's economical development. However, in 1999, agricultural production only comprised 2.61% of the Gross Domestic Product, and forest product value just accounted for 0.2% of the agriculture product value. In recent years, although the economic value ratio of forestry is very low, its non-market values of ensuring the safety of the economic infrastructure, protecting residents' lives and properties, and conserving soil and water resources are very high. Therefore current forestry policy emphasizes nature conservation, sustainable management, multiple-use management, and ecosystem management.

In 1960s and 1970s, plywood industry had been a locomotive and export-oriented product industry with an annual export more than one million cubic meters. However plywood trade had turned from a mainstay of export to an import item since 1980 due to huge domestic demand. Furniture industry development was also export-oriented and fast growing in early 1960s and 1970s. During 1980s, automation of production techniques further facilitated the expansion of furniture export to the peak of US\$1,073 million in 1987. However, due to increasing costs of raw materials and labors and the recession of global economy, the furniture industry gradually lost its ground year by year since 1990. From 1960 to 1970, timber used to support wood industry was roughly equal from both local production and imports. After 1970, timber consumed relied more and more upon imports. Since 1990s, Taiwan's timber industry has been largely depending on imported timbers. More than 99% of timber supply (Table 6) comes from foreign countries. Figures 7, 8, and 9 illustrate the annual sawtimber consumption, local and imported sawtimber, respectively, in Taiwan in 1991 – 2000. In year 2000, Canada and Malaysia were the biggest countries exporting softwood and hardwood, respectively, to Taiwan (Table 7).

Table 6. Saw timber consumption (cubic meters) in Taiwan in 1991-2000.

Year	Total	Local production	Imported products	Share of
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				imports
1991	6,314,285	74,188	6,240,097	98.8%
1992	7,101,492	72,909	7,028,583	99.0%
1993	6,240,192	46,844	6,193,348	99.2%
1994	5,626,501	38,616	5,587,435	99.3%
1995	5,234,245	32,311	5,201,934	99.4%
1996	4,669,077	35,453	4,633,624	99.3%
1997	5,061,607	32,056	5,029,551	99.4%
1998	3,983,753	29,069	3,954,684	99.3%
1999	4,040,001	23,333	4,016,668	99.4%
2000	4,034,793	21,133	4,013,660	99.5%



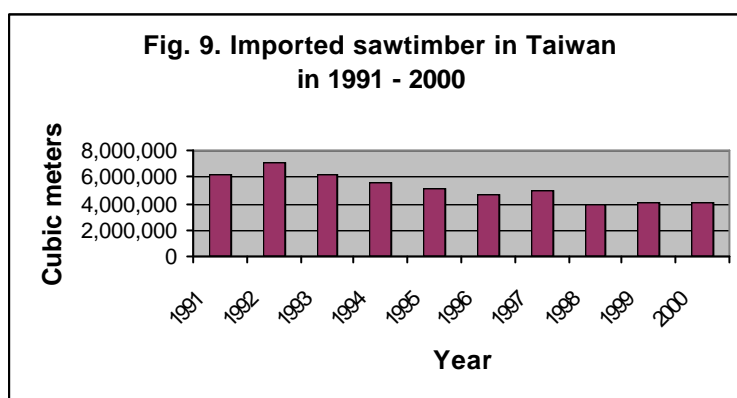


Table 7. The first five countries exporting timbers
(cubic meters) to Taiwan in year 2000.

Softwood lumber	Canada	New Zealand	Chile	Austria	United States
	144,877	89,457	49,991	11,586	8,219
Softwood log	New Zealand	Canada	United States	Vietnam	Malaysia
	53,166	12,571	3,249	1,059	989
Hardwood lumber	Malaysia	Indonesia	United States	Canada	Burma
	257,234	167,099	52,756	22,207	17,399
Hardwood log	Malaysia	Gabon	Papua	United States	German
	749,714	45,122	37,017	33,805	11,375

For the purpose of supporting a prosperous forest industry, Taiwan needs not only to diversify its timber purchasing but also to maintain its own sustainable supply. Besides, it is predicted that wood demand worldwide will increasingly rely upon timber production from man-made forests. This trend will continue and may alleviate pressures on the natural forests. Halting natural forest logging has been announced by the administration in Taiwan since 1991. Hence, how to enhance productivity and maintain sustainability in plantation forests becomes an important issue. Small forestland parcels, complex topography varying in elevations,

consideration of soil and water conservation, and lack of accessibility have created a new perspective for man-made forests. Setting priority for timber production from man-made plantations, coupled with development of appropriate forest industries in Taiwan, has been a crucial decision to be made. Recent studies suggest that among various alternatives, the best choice is a series of measures: adopting uneven-age management, prolonging rotation age and producing high grade wood for the furniture industry and house construction. To meet that end, we have developed practicable methods of pruning, thinning, underplanting, and even tending of naturally regenerated valuable seedlings and saplings, in addition to retaining parts of snags and dead wood on the forest floor. Thus we have aimed at to create an uneven-aged and multi-layered forest condition at the originally young, even-aged stands. Such management strategies not only may provide suitable wildlife habitats, but also will yield significant timber harvest over the long run. Both forest scientists and environmentalists believe that we can produce more wood and at the same time conserve biodiversity by adopting sustainable management of forest ecosystems. How long for rotation age will depend upon different timber species. Nevertheless timber in national forests would not be harvested until the trees are at least over 40 years of age. For the most valuable *Chamaecyparis formosensis*, we even set the rotation age up to 100 years.

Though logging operations in natural forests have been banned since 1991, some proper measures of conservation management are still needed. This is because ecosystem structures and functions of natural forests are often subjected to either eugenic or dysgenic changes over time, especially in response to natural and human-caused disturbances. Typhoon and land-use conversion exhibit significant impact on forest ecosystems in Taiwan almost every year. Under the circumstances, Taiwan Long-term Ecological Research Network (TERN) has been established since 1992. TERN is one of the branches of The International Long Term Ecological Research Network (ILTER). Five studying and monitoring sites have been set up in natural forests from the north to the

south of Taiwan. Periodical investigation and monitoring on succession mechanism for ecosystem structure and function can provide database for subsequent series of silvicultural manipulations to promote natural regeneration. The goal is to restore forestland productivity, maintain optimal biodiversity and ecological integrity as a whole. In short, management of both man-made and natural forests is integrated into an ecosystem-based approach that is environmentally sound, socially beneficial and economically viable.

FOREST RECREATION AND ECO-TOURISM

Following the admirable economic growth attained especially during the past two decades, people in Taiwan have improved their living standard and lifestyle to a new height. Naturally, leisure and recreational programs have become a regular part of their lives. Since 1965, the Taiwan Forestry Bureau has planned and developed forest recreation areas to meet the increasing needs for eco-tourism. Currently, there are 16 forest recreation areas open to the public, including 4 in northern, 5 in central, 4 in southern, and 3 in eastern part of Taiwan. Each year, there are about 3.5 million people participated in the eco-tourism activities in these areas. Market revenues are very high for eco-tourism (Table 8). The Ali-Shan High Mountain Train in Ali-Shan Forest Recreation Area alone made more than NT\$82,680,000 (US\$2,334,000) dollars in 1998. The decrease in 2000 was due to some recreation areas were damaged by the big earthquake occurred on September 21, 1999. However restoration has being progressively carried out since then. In addition, three more forest recreation areas are under planning. Five million people in one year are expected to enjoy the eco-tour opportunity that these forest recreation areas will supply in the very near future.

Table 8. Revenues from Forest Recreation Areas

Year	Revenues	Number of	Visitors
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	(NT\$)	Visitors	Accommodated
1993	382,869,940	3,278,902	367,775
1994	348,339,756	3,167,442	322,366
1995	405,617,718	3,859,552	341,480
1996	319,367,031	3,129,250	266,711
1997	412,148,493	3,397,946	288,289
1998	508,691,029	3,723,498	298,674
1999	536,802,663	2,803,351	314,756
2000	410,106,622	2,281,956	294,233

In order to accelerate the development of forest recreation areas and increase their management efficiency, five candidate areas of rich resources are identified and selected for private investment. According to the rules of the “Encouraging Private Sector Participating in the Traffic Construction Regulation”, the investors can manage hotels and restaurants and install self-provided facilities. The other forest recreation areas will be managed by a cooperation system with the assistance of private sectors. They will invest in lodgings and restaurants to provide any comfortable leisure environment.

NETWORKS OF NATURE CONSERVATION

Like other countries in the world, Taiwan’s industrialization and economic prosperity in the past four decades can not at all compensate for forest over-exploitation and ecological degradation. Therefore recent national policy has placed emphasis on maintaining the ecological values and sustainability of ecosystems. Besides the innovative ecosystem-based approaches to forest management mentioned-above, other actions we have been taking is the establishment of networks of nature conservation.

In-situ conservation. The program for *in-situ* conservation was mainly the designation of protected natural areas in forestland. First, according to the Cultural Heritage Preservation Law, the government has

established 19 nature reserves covering a total area of over 64,477 hectares throughout the island of Taiwan. They range from a 4.9 ha volcanic mud landforms at the lowlands to the 47,000 ha forest reserve at the mountainous area. Protecting individual species and entire ecosystems, these reserves provide a solid base for organized protection. Secondly, the government has also set aside 9 protected natural areas that are national forest lands recognized as having unique natural characteristics such as wildlife, landscape and fossil. A third designation is 6 national parks. These parks range from 3,780 ha (Kinmen, an off-shore island) to 105,490 ha (Yushan in central Taiwan). The entire ecosystem of the ecological protection area within the parks is strictly preserved. At the same time the parks also provide opportunities for eco-tourism development. Furthermore, in order to compliment the whole conservation network, Taiwan has established 13 wildlife refuges and 28 important wildlife habitats. These refuges and habitats serve to protect wildlife throughout the whole island, like Formosan landlocked salmon, green sea turtle, waterfowl, and so on. At present, there are 19 nature reserves, 9 protected natural areas, 6 national parks, 13 wildlife refuges, and 28 important wildlife habitats, with a total area of 700,970 hectares and account for 19.5% of the total area of Taiwan (Table 9).

Table 9. Coverage of designated areas for natural conservation in Taiwan.

Category	Nature reserve	Protected Natural area	National park	Wildlife refuge	Important wildlife habitat	Total
Numbers	19	9	6	13	28	75
Coverage (ha)	64,477	21,739	322,845	23,200	296,572	700,970
% of Taiwan	1.8%	0.6%	9.0%	0.6%	8.3%	19.5%

Ex-situ conservation. Botanical gardens play an important role in *ex-*

situ conservation and also serve as educational and recreational areas. The Taiwan Forestry Research Institute (TFRI) is in charge of managing 3 botanical gardens and 1 arboretum in Taiwan, which are dispersed through the north, the middle-south and the south-tip of the island. They occupy a total area of 892 ha and contain 2,818 plant species in 479 families. In addition, planning for an alpine botanical garden (30 ha) and a coastal one (12 ha) is now underway. Other specific biological conservation measures have also been explored to maintain biodiversity, such as establishment of provenance plantations for 10 species and clonal banks for 9 species of forest trees. Assessments continue to yield information on genetic variation and will be used to develop a gene conservation strategy.

ENVIRONMENTAL EDUCATION IN NATIONAL FOREST SYSTEM

Forests can provide an amazing range of goods and services. However, forest issues such as land-use change and biodiversity loss are increasingly reflected in national and international policies. This has resulted in a series of initiatives to improve forest conservation, promote sustainable management and recognize the rights and need of local forest-dependent communities. Taiwan has also confronted by the same issues. Forestlands of 300-1,500 m were cleared and converted to monoculture plantations, which induce biodiversity losses, and farms to produce tea, Areca nuts, fruits, and vegetables, which cause soil erosion problems. Mud and rock flows often follow heavy rainfall at watershed areas in central Taiwan, particularly after the 1999 earthquake. In these circumstances, the new administration started paying more attention to implementation of ecologically appropriate, socially beneficial and economically viable forest restoration and management programs. However, it is critical that the accurate policy- decision and effective program implementation on forest ecosystem management and nature

conservation depend upon the public perception and support. Similar to some situations in North America, the Taiwanese public is woefully under-informed, or misinformed, about the state of their forests. The forest sector did not do an appropriate job of conveying to Taiwanese how important the forest ecosystems are in terms of supplying goods and services to human society, and how carefully the forests are being managed. In order to let people in Taiwan receive complete, accurate and unbiased information about their forests, the forestry agencies recently started taking a series of actions to promote environmental education and nature interpretation programs. This was done through (1) setting up visitor centers, science park for forest ecology and interpretative trails in forested land and botanical gardens, (2) sponsoring workshops or eco-camps for school teachers and students on conservation of biodiversity, water and soil resources, and (3) holding activities in accordance with special themes for general citizens as well as local communities. Some program examples are “Observing Migratory Birds”, “Viewing Esthetic Forest Landscapes”, “Wildlife Protection and Hunting Culture Renovation”, “Technical Assistance on Development of Eco-tourism” and “Promotion and Extension of Green Construction”. In summary, through sustainable management of forest ecosystems, education of the general public, enforcement of environmental laws and protection of key natural forest areas, Taiwan is striving to reach a goal—“Sustainable Development for The Green Silicon Island”.

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- Council of Agriculture: <http://www.coa.gov.tw>
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Taiwan Endemic Species Research Institute: <http://www.tesri.gov.tw>

Taiwan Forestry Bureau: <http://www.forest.gov.tw>

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