行政院及所屬各機關出國報告（出國類別：參加研討會）

農業技術移轉之最佳實踐
研討會

出國人員姓名/服務機關/單位/職稱/電話

張錦宜/行政院農業委員會水產試驗所/副研究員/02-24622101 轉 2808

陳翠妙/行政院農業委員會畜產試驗所/副研究員/06-5911211 轉 258

出國地區：斯里蘭卡

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行政院及所屬各機關出國報告提要

出國報告名稱：農業技術移轉之最佳實踐研討會

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出國計畫主辦機關

行政院農業委員會水產試驗所

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出國類別：□1 考察 □2 進修 □3 研究 □4 實習 ■5 其他，參加研討會

出國期間：96 年 11 月 4 日至 96 年 11 月 10 日

出國地區：斯里蘭卡

報告日期：96 年 12 月 06 日

經費來源：亞洲生產力中心（Asian Productivity Organization, APO）

分類號/目：農林漁牧/農業發展

關鍵詞：農業、技術移轉

摘要

本案係經行政院農業委員會推薦，亞洲生產力組織（Asian Productivity Organization, 以下簡稱 APO）資助，由所屬機關水產試驗所張錦宜博士與畜產試驗所陳翠妙小姐出席於 2007 年 11 月 5-9 日在斯里蘭卡首都可倫坡舉辦之『農業技術移轉之最佳實踐研討會』（seminar on Best Practices in Agricultural Technology Transfer and Commercialization），本次研討會由位於日本之亞洲生產力組織總部、於斯里蘭卡之亞洲生產力組織分部及斯里蘭卡國家農業部共同主辦，主要出資單位為亞洲生產力組織，此次計 16 個國家 22 位參加者並邀請美國、中華民國(台灣)、南韓及印度 4 位專家與會進行與農業技術移轉相關之科技管理、推廣制度、政策擬定、智財保護及商品化分析之專題演講，另安排一日行程實地至農業推廣研究站了解當地實施之「乾旱地區的農民生活補助及農業合作計畫」，參觀實行之相關措施包括灌溉溝渠建設、儲水設施、農民合作組織、共用農業機械、農產加工設施、共用穀倉、碾米廠等。本研討會主要目標為探討農業技術管理及推廣之目標及定位、農業技術移轉及商品化案例分享研習及討論不同國家之農業技術移轉有效策略，會中並進行小組討論及分組報告，總結推動農業技術移轉於政策面、制度面及執行面之可行建議。

目次 頁碼

壹、 目的

亞太地區許多國家的農業都面臨了貿易自由化及消費市場對農產品需求結構改變等種種競爭壓力而處於轉型階段，其中，不論在國內或國際市場，佔亞洲農業結構組成最大宗的中、小型農場及農公司所感受到的競爭壓力最大也最沉重。為了永續經營，他們必須結合高效率且對環境友善之先進農業技術，以改善製程、增加產量、開發新產品、擴展商機或開拓新市場，然而，傳統農業尋求轉型的瓶頸往往就是無效率的農業技術移轉及牛步的商品化進程。

在亞太地區的許多國家中，公部門的研發機構為農業從事人員、農業機械製造商、農企業及食品加工廠發展出許多創新的農業技術，雖然大部分的技術並未有效率地技術移轉及商品化，不過，近來部分亞洲先進國家已經掌握全球趨勢，率先有計畫地推動農業技術移轉及商品化，這些成功經驗非常值得彼此交流學習。有鑑於此，亞洲生產力組織（Asian Productivity Organization, 以下簡稱 APO）乃於 2007 年 11 月 5 日至 9 日，在斯里蘭卡舉辦「農業技術移轉及商品化之最佳實踐」研討會（seminar on Best Practices in Agricultural Technology Transfer and Commercialization），以引介最新發展趨勢，提供各會員國互相觀摩切磋的機會。

本研討會的主要目標為：

(1)、探討農業技術管理及推廣之目標及定位

(2)、「農業技術移轉及商品化之最佳實踐」案例研習

(3)、討論不同國家之農業技術移轉有效策略

貳、 過程

日期	活動項目	備註
11/4	啟程 抵斯里蘭卡可倫坡機場，入住 Trans Asia Hotel	
11/5 09:00~10:00 10:30~12:00 12:00~13:30 13:30~15:30 16:00~17:30 18:00~	開幕式 斯里蘭卡農業發展部部長 Hon Maithripala Sirisena 致歡迎詞 專題演講：亞太地區農業科技管理、技術轉移及商品化—總論 by Dr. Kalim Qamar, 午餐 專題演講：【主題一】農業技術管理、移轉及商品化之最佳實踐 【主題二】成功的農業技術移轉及商品化應搭配之政策及制度 by Dr. Moon-Hee Lee, Chungbuk National University 國情報告：亞太地區各國農業技術移轉現況* 孟加拉：糖業及食品工業公司 Mr. A. B. M. Burhan Uddin 台灣：【台灣的農業技術移轉：政策、現況、發展與實例介紹】農委會畜產試驗所 陳翠妙小姐 斐濟：農業部 Mr. Raju Govind 歡迎晚宴 斯里蘭卡農業發展部部長 Hon Maithripala Sirisena	U.S.A. Republic of Korea
11/6 09:00~10:30 11:00~12:30 12:30~14:00	專題演講：如何在亞洲的開發中國家營造一促進農業技術移轉及商品化的環境 by Prof. R. Rajapakshe, 農業研究政策委員會 專題演講：成功的農業技術移轉及商品推廣之創新思維 by Dr. 張錦宜, 農委會水產試驗所 午餐	Sri Lanka Taiwan, R.O.C.

14:00~15:30	專題演講：智慧財產權與農業技術移轉及商品化 by Dr. Harvinder Singh Chawla, G.B. Pant University of Agriculture and Technology	India
16:00~17:00	國情報告：亞太地區各國農業技術移轉現況* 印度：【貧窮地區的農業技術移轉】農業及農產製造組組長 Dr. Arabinda Kumar Padhee 印度：【印度農業技術移轉簡介】綜合機械工程研究所 Mr. Palash Kumar Maji & Krishna 農業生技公司產品經理 Mr. Marutha Subash	
11/7	**參觀行程**	
09:30	抵達 Kurunegala 地區研究站簡報「乾旱地區的農民生活補助及農業合作計畫」	
10:45	抵達 Maho, Mirihanpitigama 實地參訪「乾旱地區的農民生活補助及農業合作計畫」的相關措施，包括：灌溉溝渠建設、儲水設施、農民合作組織、共用農業機械、農產加工設施、共用穀倉、碾米廠等。 抵達 Kurunegala 地區研究站簡報「乾旱地區的農民生活補助及農業合作計畫」	
13:30	與 Mirihanpitigama 農民合作組織成員共進自助式午餐	
16:00	抵達 Yapahuwa 參訪斯里蘭卡古王朝宮殿遺址	
21:00	返抵住宿飯店	
11/8 09:00~10:30	國情報告：亞太地區各國農業技術移轉現況* 印尼：農業部 Ms. Ani Rahayuni Ratna Dewi 伊朗：Haraz 研發及推廣中心副主任 Mr. Gholamhassan Najafi 寮國：農林部 Mr. Phonephanh Luangaphay	

11:00~12:30	國情報告：亞太地區各國農業技術移轉現況* 尼泊爾：農業及農企業部 Dr. Shyam Kishor Shah 菲律賓：Cavite State University Prof. Lorenzo C. Lapitan & University of Phillippines Ms. Mariel Celeste Alvero Cortez 斯里蘭卡：農業部 Mr. P. M. N. Dayaratne & Mr. D. D. S. Werakoon	
12:30~14:00	午餐	
14:00~15:00	國情報告：亞太地區各國農業技術移轉現況* 泰國：農業研發中心研究員 Mr. Nisit Boonpieng & 遺傳工程及生技中心商務分析師 Ms. Phisamai Anupongsanukul 越南：蔬果研究所副所長 Mr. Nguyen Trong Mai	
15:00~17:30	分組座談 【議題一】:研究部門、推廣部門及農企業（或農業從業人員）之間應如何建立適當的機制，以加速有發展潛力的農業技術之商品化？ 【議題二】:因為從中央到地方的層層分工，史的農業推廣事務變得龐大、分歧而無效率，應如何改善此一問題？ 【議題三】:如何在政策面上推動好的制度，並在公務部門及私人企業間建立適當的管道，以創造一個適合發展農業技術移轉及商品化的大環境？ 【議題四】:智慧財產權再農業技術移轉中的重要性為何？從本次研討會分享的成功案例取經。 【議題五】:應本次研討會主題：農業技術移轉及商品化的最佳實踐所提出的專題演講及國情報告中，有哪些經驗是特別值得借鏡或學習的？ 【議題六】:從本研討會可以衍生出哪些議題值亞洲生產力組織另行舉辦研討會進行最專門或更	

	深入的討論及交流？	
18:30~	閉幕晚宴 亞洲生產力組織農業部部長 Mr. Song Hyun Choi	
11/9 09:00~10:30 10:30~11:30 12:00~12:30 12:30~13:30 13:30~	 分組討論及報告撰寫 分組報告 結業式 斯里蘭卡農業發展部部長 Mr. Hon Maithripala Sirisena、主任秘書 Mrs. A.A. A. R. Rathnayake 及亞洲生產力組織農業部部長 Mr. Song Hyun Choi 代表頒發結業證書 學員致謝詞 午餐 自由活動	
11/10	返程 斯里蘭卡------台灣	

*國情報告若無另訂講題則為該國農業技術移轉現況報告

參、 心得

1. 此次會議名稱為『農業技術移轉之最佳實踐』，但由各國國情報告顯示，各國的技術移轉仍定位於政府以農業推廣方式將技術由研究及推廣機關移轉給農民，商業化的評估係以移轉給農民之後，提升當地農業多少產量及產值與創造之出口量來評斷；這與台灣農業目前推行視農業技術為智慧財產，以法規及政府政策將技術或產品，植物品種透過公開透明流程轉移至私人企業或法人，以達到農業技術商品化與產業化之現況大異奇趣。
2. 各國報告中，僅泰國提出與台灣相似的農業技術移轉商品化之模式，其他國家如孟加拉、菲濟、印度、印尼、伊朗、菲律賓、越南等均未提及，此次南韓亦有一位自韓國農業部退休，目前在大學兼課之教授參與，他也提及韓國的農業發展和技術移轉，多是著重於科技研發現況之報告，並未提到與農業技術移轉相關的農業政策與制度及授權金收入等問題，這與筆者 2006 年曾到韓國參訪農業技術移轉現況相符，南韓政府目前大力推動信保基金希望可提昇私人企業之競爭力，技術移轉在工業及商業上已有好的成效，農業技術移轉走得比台灣慢一些。值得注意的是，此次日本並未派員參加，因此無法由會議中了解日本農業技術發展現況，但筆者參考 2006 年行政院農業委員會派員赴日本考察農業技術移轉情形，日本目前也有修正通過研發成果下放之法令及政策，因此農業技術移轉、智慧財產權保護及創新育成已有明確政策與良好模式足供參考，APO 總部位於日本，此次未派員向各會員國分享日本經驗，殊為可惜。
3. 多數國家的農業技術移轉方式，亦可視為農業推廣方式係以研究機關研發技術，由推廣人員承接後，評估以那些方式例

如教育訓練、出版刊物或實際田間示範等，由推廣中心轉移給農民實施，這與台灣目前研究人員也身兼推廣人員之情形不同。

4. 寮國國情報告指出，現今農民已有不同的思維方式，過去農民被動的承接政府由上而下的推廣方式，依照政府的政策施行農業推廣，現今，政府則視農民為客戶，希望能將農業推廣導向以農民需求為中心，過去農民只期待可以擴大種植面積及產量，現今農業已轉向要求品質及市場消費需求，農民希望可以更加了解品種及栽種過程的肥料和農藥的安全使用，也不再盲目的只種植熟悉的單一作物，轉而朝向具有市場及消費潛力的品種，雖然面臨的挑戰更多，但國際市場的開放及多元化資金投入，已是農民與農業推廣中心不得不面對的新議題，因應時代的變遷，政府農業推廣及農業技轉人員觀念需與時俱進，本項報告獲得各國回響與討論，茲整理如下：

舊觀念	新觀念
農人是政府福利政策下的受惠者	農人是有潛力的客戶
農人擔心如何渡過今天的難關	農人思考的是如何在未來競爭中佔到有利位置
農業是賴以維生的工作	農業是可以致富的事業
農業的成長端賴新農地的開發	單位產量的提高級可促進農業成長
中央政府通盤規劃農業方向	農民組織、民間社團即有能力開發利基市場
靠天吃飯，地理環境決定農產種類	市場需求好惡決定農業型態
個人經濟	群體的、小規模的計畫經濟
農業產出可得到政府補助	政府或企業主投資優良農產品

5. 台灣國情報告的議題是政府技術移轉政策針對農企業、農民和研究人員的影響，因為內容提到授權金的分配，如何與公司談判，報告中並提出討論農業推廣與技術移轉是一體二面

或是互相衝擊，由傳統免費的農業推廣演進到現今的有償技術授權，其界限應如何區分，研究人員推廣人員的心理應如何調整，本討論中越南提出研究人員已經領政府薪水再分配授權金是否合理，由美國來的專題報告學者指出，農業技術商品化在西方已在進行，台灣目前與美國相較雖然授權金不高但已實際朝向商品化的目標前進。印度的智財專家則指出，由政府出資的研究成果固然珍貴，但研究人員扮演發明創作角色，是否也可以共同列為專利所有權人，泰國則問及台灣如何進行農業技術評價，多數的問題均非簡單的答覆可以涵蓋，但由各國熱烈發言提問之情形可知大家對台灣農業技術商品化的過程及評估方式有極大興趣。

6. 由各國的國情報告來看，大部分國家係由政府主導農業推廣，但由上而下的推廣工作面臨許多政策面、制度面及執行面的問題，斯里蘭卡指出政府部門分項太多，時間多花在政策制度訂定，組織間聯繫及多頭馬車的問題，反而到了農民身上所分配到的時間和經費就大打折扣了，資源也被稀釋

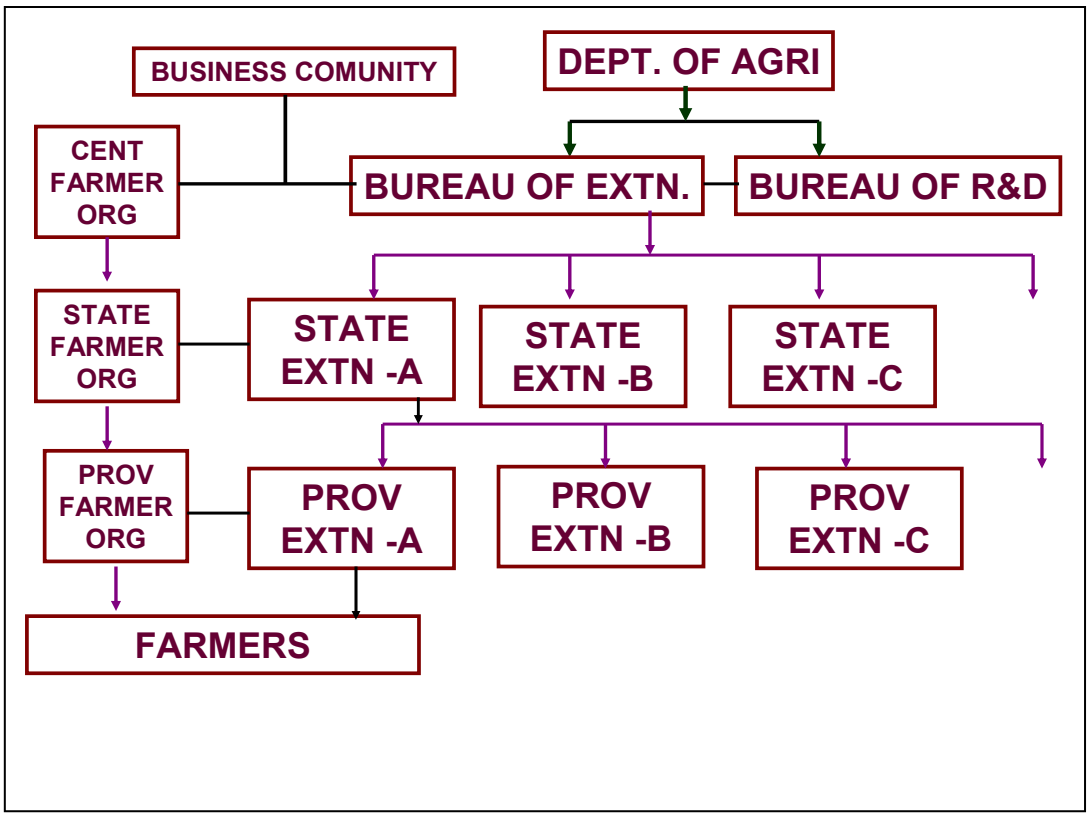
7. 台灣張錦宜博士和美國專家 Dr. Kalim Qamar,均指出研究人員應該參與技術商品化與產業化的課程，才能使研究與產業更接近，避免技術與應用落差太大，也可加速技術商品化的時程。

8. 來自印度的智財保護專家 Dr. Harvinder Singh Chawla 觀點與台灣較為接近，他認為應將傳統的農業推廣眼光放大放遠，不要只強調產量，更要強化市場機制及商品化的概念，並將農業研究導向注意農業生產之安全，健康的飲食習慣以及產品追蹤等具競爭力的方向，這與目前台灣推行安全農業與產銷履歷制度相同。

9. 本次會議最後分三組，分別討論由 APO 觀察員指定討論幾天

來的會議的重要議題，再由小組派員報告 30 分鐘，視為正式的報告，做為未來農業技術移轉推廣的發展參考，這是 5 天會議最重要且精彩的部分，因為各國國情報告均是各說各的，除了提問，少有交集，APO 安排此項分組討論，可達到各國交換意見，討論面臨的問題及嚐試找出解決之道，再整理出有系統及共識的報告為很重要的討論。

10. 本次研討會分組座談中討論到「如何在研究部門、推廣部門及農企業（或農業從業人員）之間建立適當的機制，以加速有發展潛力的農業技術之商品化？」。其中一小組提出相當簡潔、一目瞭然的示意圖（如下圖），可作為我國農業推廣與技術部門橫向聯繫的參考。



11. 知識經濟時代，各國應該依與智慧財產權相關的貿易協定(Trips) 鼓勵農業智慧財產權的發展，界定應以智財及不需以智財保護之技術及政策，並投入智財教育訓練，使研究人員，推廣人員及農民農企業均有智財保護之關念。
12. 創造智財保護的環境，由擁有資源的政府機構，如行政機關、政策法規的部門研究單位、私人企業，提供研究資金的公營或民營機關及提供服務的律師事務所，農民等均需要以智財管理，文件分析等建立良好且有效的智財保護的環境。
13. 對於發展農業智財保護及農業技術商品化之私人企業，政府應給予協助，例如稅賦優惠，租金優惠和研究發展的支出費用，以扶植農企業成長，長期減少政府農業推廣的預算支出，並且提供農民就業機會，長期可形成私人企業與政府聯手使農業走向國際化之導向，促進台灣經濟發展。

肆、 建議事項

1. 亞洲生產力中心（APO)經常性於亞洲各國辦理各項農業、經濟、社會議題之研討會,由其網站 http://www.apo-tokyo.org/ 可見其組織相當龐大且辦理之活動、研討會很多，筆者此次參與深感收獲豐碩，也認識不少來自不同國家的農業技術與推廣專家，建議國人應多多把握參與國際研討會之機會，以學習知識、增廣見聞、拓展國際視野。
2. 此次會議由亞洲生產力中心（APO）主辦，APO 總部在日本，由於中國大陸不是會員國，台灣係以中華民國身份參加，這是我們少數能以正式國名參加的國際組織，有幸參加此次會議實為難得機會，也格外珍惜此次可以向亞洲國家介紹台灣農業技術發展、技術移轉現況、經濟實力及其地理位置，和中國之分別的機會。
3. 台灣與斯里蘭卡並無邦交，使用落地簽證入境，出發前斯里蘭卡農業部與外交部曾要求參加者以國際快捷寄送申請落地簽文件，我們也都照做了，但到了可倫坡似乎沒有發揮效用，反而是台灣旅行社寄送機票時所附上的落地簽空白申請表及要回國的出關申請表在入境和出境時發揮了功能，因此若國人有機會赴當地參加會議或觀光，需要向旅行社提醒要落地簽空白表及準備一張照片(大小沒有要求)，入境前在可倫坡機場申請落地簽，只要文件齊備，申請手續及過程均很簡單，免費用。
4. 機場的安全檢查關卡重重，一關接一關，但基本上還蠻尊重外國人，沒有刁難，各國國際線的檢查是以感測棒掃瞄，不會直接碰觸旅客身體，可能經費不足，可倫坡機場則是以人力方式，戴手套，全身上下檢查。在此提醒，兌換當地盧比最好在機場，台幣不能直接換盧比，要先準備美金，1 元美金

約 108 元盧比，1 元台幣約相當 3 元盧比，飯店只提供外幣換盧比服務，不提供盧比換美金服務，離開前最好在出關 chink in 機位及行李前就先換回美元，因為一進入候機室，換匯率的銀行只有一家，很簡陋，沒有收據，手續費又高，有受騙的感覺。

5. 此次會議地點在首都可倫坡 COLOMBO, TRANS ASIA HOTEL，為 5 星級飯店，在抵達可倫坡的前幾天，當地一位反對黨領袖被暗殺，由於可能引發叛軍政變，因此街上有很多軍人和警察荷槍實彈在各路口盤查臨檢，會議均在飯店內，飯店外是另一個世界，由於出國前並無國際新聞提及斯里蘭卡政治情形，因此國人如有機會走訪其他國家最好就近打聽當地治安情形，多問幾個人，包括飯店經理，接送司機及當地人民，了解情況前不要四處亂逛，以免麻煩。

6. 英文是斯里蘭卡官方語言，多數人都會講英文，只是口音很重需要適應一下，當地人交談時多是使用當地語言，與外國人交談才會使用英文，也因為如此，就發生一些溝通上的問題，出發前 APO 表示此次出國費用含機票、機場接送、住宿及早午餐係由 APO 負責，但又有部分費用係由斯里蘭卡 APO 分部及農業部負責，因此權責不清，我們由機場到飯店係 3 人共同搭一部由飯店提供之車輛，會議結束離開前要先結清幾天來的需自付的消費，檢查帳單時每人均被要求一筆機場接機費，而且是全額，非分攤費用，本團來自外蒙古的參加者，更是被要求加倍的機場接送費用，在多次溝通及爭取後才免於付費，因此，雖是國際級飯店，結帳時也應該要詳細檢查，確認需要付費才付，不要予取予求。

7. 斯里蘭卡當地生活與台灣相較仍是落後，飯店內的飲食基本上沒有問題，衛生安全可以相信，但外出用餐就要小心，因

為有些地區沒有自來水，而且沿襲印度傳統，當地人也會用手抓飯吃，所以可帶一些習慣藥品以備不時之需。

8. 本次會議要求需在出國前 1 星期上網繳交欲報告之全文內容、摘要及簡報檔，否則需自行影印 35 份帶到會場，為免麻煩且節省行李重量，我們均在期限內將檔案上傳到指定的 APO 網站，但會議開始時，工作人員又表示沒有收到我們的檔案，而且是大部分的國家都沒有，臨時才又收集檔案複印，浪費不少時間；且大會結束時給各參加者一片含各國報告及記錄會議過程之光碟片，但卻是空白片，全無內容，幸好及時發現可以再複製，否則各自回國就無法再補救。

9. 現今科技已十分發達，此次各會員國參加者均人手一部數位相機，隨身碟也很普遍，因此照片及檔案的交換很普遍，但是檔案內可能含的病毒也是來自世界各國，因此建議如果要帶隨身碟出國，帶一個空白的，不幸中毒也不會連累到其他檔案，如果要帶筆記型電腦出國，一定要有防毒程式，嚴格執行掃毒工作，以免中毒回台灣，後患無窮。

10. 台灣是 APO 會員國，也有多次機會承辦 APO 會議，建議承辦單位要多加留意以上細節，把握會議過程及參訪節奏，各個會員國參加人員在結束時填寫意見表，亦以此評估承辦單位及評量國家的進步程度，台灣已是先進國家，辦理國際會議非難事，只要事先多準備多用些心，成效會更好，也可給各國參加者及日本總部來的觀察者留下良好印象。

11. 有關農業技術移轉及商品化等領域，建議 APO 還可以再舉辦相關的研討會議題如下：

議題	參加對象	理由
農業技術移轉政策	農業政策制定者	部分政策已不合時宜
農業金融	農業推廣人員	貧農無適當貸款管道
農業推廣人力資源	農業推廣人員	缺乏有效率的人力資源運用
智慧財產權	研發人員	研發成果需被保護
創新農業技術	農業從業人員	農民不易接受新技術
市場導向的研發策略	研發人員	農業技術研發應落實於產業應用
農場規劃	農業推廣人員、農業從業人員	更有效率地運用土地、人力；提高產值

伍、 附錄

1. Innovative approaches for the effective agriculture technology commercialization for company and dissemination for small farmers--Experiences of Taiwan

   成功的農業技術移轉及商品推廣之創新思維， 張錦宜博士，行政院農業委員會水產試驗所

2. The overlook of Agricultural Technology Transfer in Taiwan

   台灣的農業技術移轉：政策、現況、發展與實例介紹，陳翠妙小姐，行政院農業委員會畜產試驗所

3. 研討會活動及相關照片

Innovative approaches for the effective agriculture technology commercialization for company and dissemination for small farmers--Experiences of Taiwan, ROC

Chin-I Chang

Fisheries Research Institute, COA, Taiwan

ABSTRACT

The researches of agriculture technology in Taiwan are mostly carried out by the official institutes belonging to the Council of Agriculture, Executive Yuan (COA). For a long time, these institutes have harvested plentiful achievements. However, most of them were considered as the free supplying public wealth and ignored by farmers and companies until the implementation of "The Fundamental Science and Technology Law" in 1999. This law pushes people to face the protection of intellectual property and to pay for the commercially potential result of research even if it was derived from official research institute. Recently, COA was constructing different channels to assist researchers in commercializing their innovative products and to accelerate technology transferring to companies or disseminating over the farmers. Therefore, two administrative orders, named "Rules for Ownership and Application of Government-subsidized R&D Outcomes" and "Rules for the Industrial Technology Cooperative Research" were implemented in 2000 and 2001, respectively, to complete the legal institutions of agriculture technology licensing.

Two successful cases of the transfer of agriculture technology were discussed in the seminar. The "Completely using of fish scales" was sold to a big enterprise with a record-breaking royalty in the technology transfer of agriculture in Taiwan. The derived products included healthy food, cosmetic and medical materials. To specifically apply the technology, the licensee enterprise even created a subsidiary company with a brand-new factory. In difference with the business successful case of the first one, the second case named "*E - kit* for the detection of Edwardsiellosis in eel farming" introduce another concept of agriculture technology transfer. For the purpose of fast dissemination and helping farmers in reducing the mortality of rearing eels, *E - kit* should be easy, cheap and individual availability.

Although there are some problems of the agriculture technology transfer in Taiwan, such as the environment of technology transfer in agriculture is not very mature, the concept of user-payment is unpopular among official researchers, companies and farmers, the experience of agricultural technology evaluation is

deficient, domestic market is too small to engage big investment of enterprises, to accelerate agriculture technology transfer is still the already decided policy in Taiwan. The research of agriculture technology can't be limited to increase the amount of production, but also should promote agriculture head into the "knowledge economy" situation. When the agriculture transforms into the knowledge type industry, the research capacity of official agriculture institute can be encouraged, the technological level of agricultural enterprises can be upgraded, and the new green revolution of agriculture can be fired up.

INTRODUCTION

The green revolution of agriculture has made a significant contribution to supply food to human being. However, with the increase of population, the stress on global food supply is heavier day by day. During the previous century, of the 6 billion people in the world today, 800 million are still in the state of malnutrition. Moreover, predictions forecast that by the year 2050, the world's population will have increased to over 10 billion people and the available farming land is going to decline minutely. The best way to resolve this problem is to rely on technology to enhance the production of agriculture, to improve the methods of breeding, testing, farming, disease prevention, and to cultivate or rear new varieties so that plants and animals which originally could not be grown or difficult to raise in certain areas can now be done. As such, the importance of applying technology in agriculture is steadily growing.

There are two current trends of agricultural technology research. On one hand it is being widely applied with traditional breeding, testing, farming, disease prevention, fertilizers and pesticides. The efforts have significantly improved the quality and quantity of agriculture products. On the other hand, the application of new biotechnology has allowed agriculture to collaborate with medicine, food and environmental protection industries. By means of the cooperation, agricultural activities can expand into different areas and create brand-new industries in the process. The economic value created by these new technology and applications is growing rapidly and with unlimited potential.

DEVELOPMENT POLICY OF TAIWAN'S AGRICULTURAL TECHNOLOGY RESEARCH

The job of promoting Taiwan's agricultural technology industry is based on the "Enforce Biotechnology Industry Promotion Program" issued by the Executive Yuan.

Planning and execution is conducted by the Council of Agriculture. As many research projects, regulations, and industry promotions involves collaboration with the National Science Council, Department of Health, Ministry of Economic Affairs, and the Ministry of Finance, the Executive Yuan has thereby set up a “Biotechnology Industry Guidance Committee” The Team is made up of science political committee members in addition to the Minister and Deputy Minister of each Ministry and Department. The Team helps coordinate cross-departmental issues. In order to integrate upstream, mid-stream, and downstream resources as well as allow full coordination between the research projects and industry development, the Council of Agriculture has collaborated with Academia Sinica and the National Science Council in implementing the “National Program for Bio-Agricultural Technology”.

In recent years, the Council of Agriculture has been organized major fields of technology research in agriculture, invested resources to encourage related research and set the future direction of Taiwan’s agricultural technology industry. Based on Taiwan’s rich material resources and global competition analysis the focus topics will include (1) plant sprouts, (2) aquaculture farming, (3) animal use antibiotics, (4) animal & poultry ranching, (5) biotech food, (6) biotech fertilizer, and (7) biotech pesticides. It will try to break traditional methods by fully utilizing the strengths of the industry, the government, academia, and research fields. Initial results such as the planning and construction of fundamental facilities; amendment and discussion of regulations, common agreement on the research direction, etc. have all been completed.

CURRENT STATUS OF TAIWAN’S AGRICULTURAL TECHNOLOGY INDUSTRY

According to COA’s "Investigation report of 2004 Agriculture biotechnology manufacturer and industry value", Taiwan had more than 200 companies related to agricultural technology and the estimated output was 700 million US dollars in 2004.

Unite: $ USD

Division	No. of company	2003		2004	
		Output	%	Output	%
Plant sprouts	25	110	24.73	101	14.57
Aquaculture farming	11	30	6.74	37	5.34
Animal use	11	19	4.27	23	3.32

antibiotics					
Animal & poultry ranching	10	22	4.94	29	4.18
Biotech food	110	213	47.88	360	51.96
Biotech fertilizer	15	1	0.22	14	2.02
Biotech pesticides	7	4	0.90	3	0.43
Others	25	46	10.34	126	18.18
Total	214	445	100.00	693	100.00

SWOT analysis of Taiwan's agriculture technology industry

Strength

- Taiwan has already established the broad-based research in agriculture.
- Excellent scientific teams in agriculture research.
- Advantage in environment & climate.
- Occupying the key location, quickly response to the Asia-Pacific market (China, Japan, and Southeast Asia) dynamics.
- Invest / reward ratio of agriculture biotechnology is relatively high.
- Some kinds of agriculture, such as vegetable, orchid, subtropical flower & fruit, Chinese herbal medicine and aquaculture are very competitively.

Opportunity

- The problem of international grain shortage will be more and more serious.
- Domestic traditional industries face the pressure of transformation.
- The government drew up various kinds of investment rewards and subsidies to encourage the development of biotechnology industry.
- The government established agriculture biotechnology parks.
- The concept of sustainable management of agriculture is friendly to the environment.

Weakness

- The domestic markets are too small to the developments of biotechnology enterprises.
- The international commercial network hasn't set up yet. The international competitiveness is insufficient.

- The laws & regulations for the research, production and management of agriculture technology have not perfectly finished yet.
- Most of the farmers are not able to directly transfer the research results of agriculture biotechnology.
- Business talents of agricultural enterprises are insufficient.
- Within the limitation of market, most of peasants or small agri-companies in Taiwan are not able to expand the scales.
- In comparison with the biomedical research, the manpower and funds of agriculture biotech research are both on the low side.
- The foundation of this industry is too weak to support and take the risk of long-term R & D.

Threat

- WTO effect onto the domestic market for farm products.
- The relative high cost of labour and management impelled the industry to move outside.
- The low production cost of the developing countries.
- The draining of brain & technology may become competitors
- Scientific advanced countries have already tried to patent many developing agriculture biotechnology.
- Regulations to biotechnological products are becoming stricter day by day.

LEGAL INSTITUTIONS OF AGRICULTURE TECHNOLOGY LICENSING IN TAIWAN

(1). The Fundamental Science and Technology Law (1999)

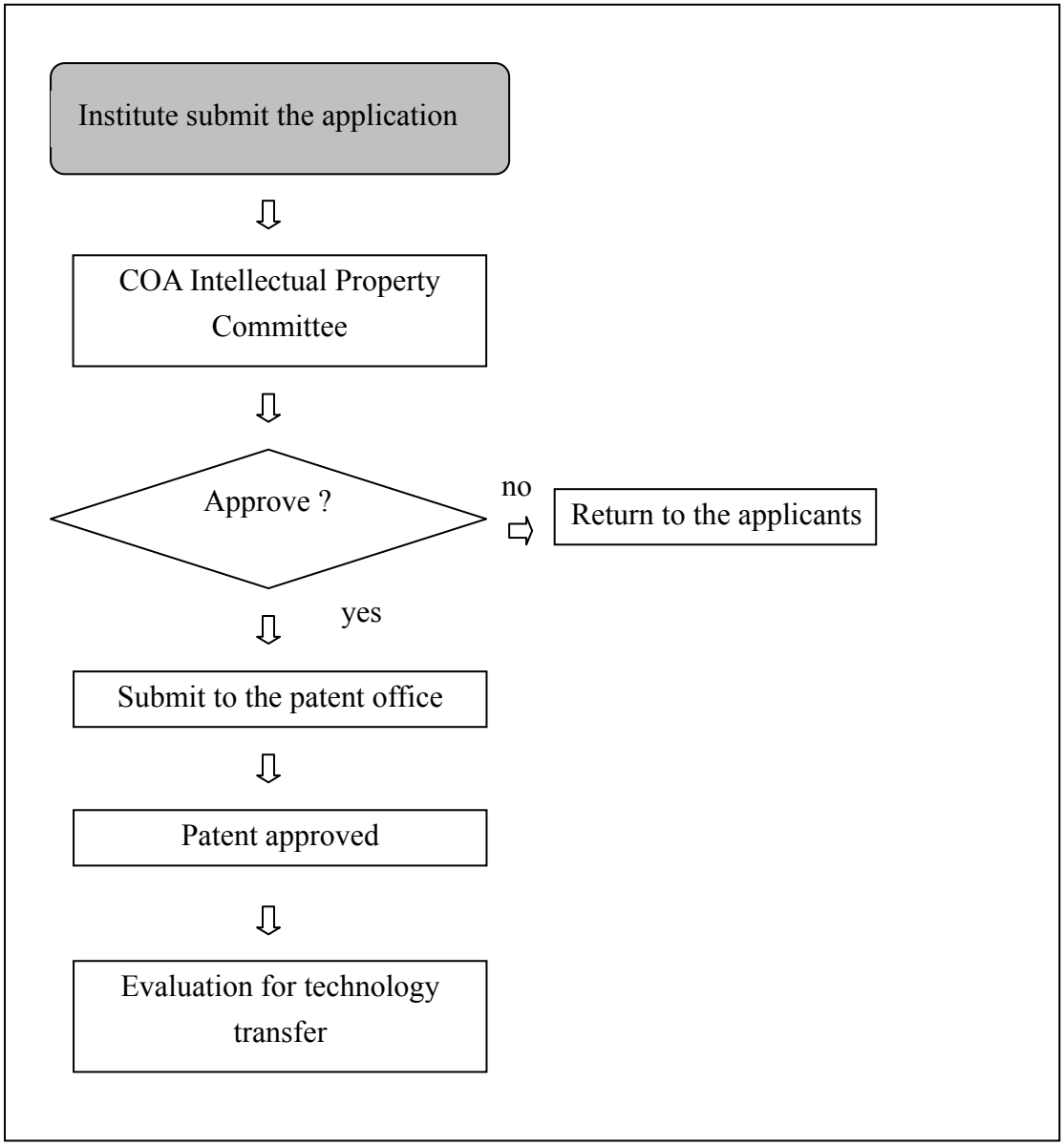
The establishment of a legal environment for the implementation of R&D results. This law simplified the administrative procedures of technology transfer and encouraged the efficient employment of R&D achievements.

(2). Rules for Ownership and Application of Government-subsidized R&D Outcomes (2000)

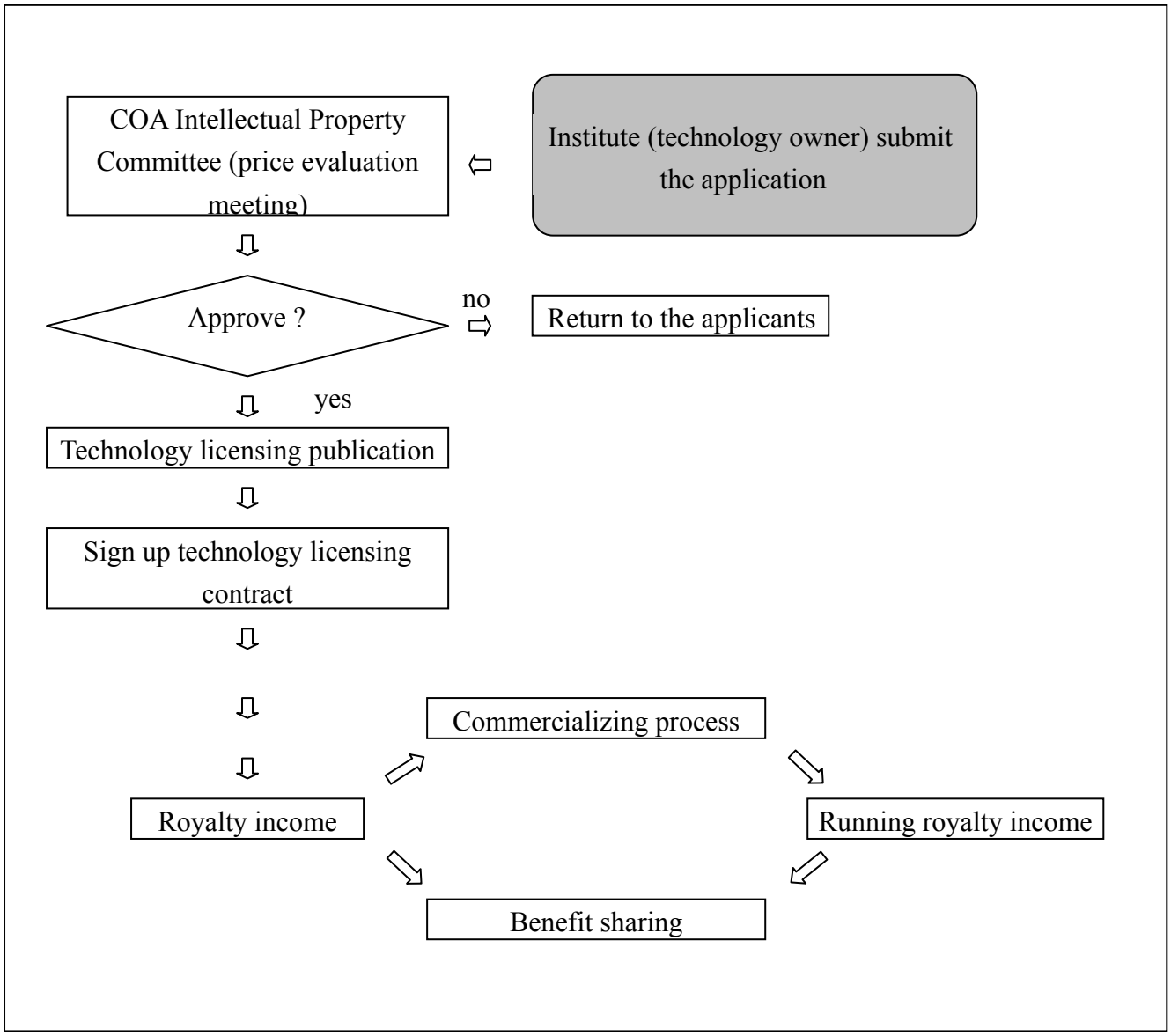
R&D achievements and intellectual property rights of official institutes can be rewardfully transferred to industry to advance the level of industrial technology and stimulate overall development of industrial R&D capabilities. According to the rules, 60% of the royalty should be returned to the government but the other 40% can be

shared by the inventors and their institute to encourage the application and promotion of the academic's IP and R&D achievements.

COA Patent Application Flow Chart



COA Technology Transfer Flow Chart



Current situation of COA's technology transfer and intellectual property related licensing.

Year No. of items	2002	2003	2004	2005	2006	Total
Patent	18	35	38	48	38	177
Trademark	2	1	0	8	11	22
Cultivated variety licensing	7	3	8	15	17	56
Technology transfer	3	15	26	41	79	164
Total of incomes (USD)	39,367	169,067	327,800	501,600	1,125,833	2,163,667

(3). Rules for the Industrial Technology Cooperative Research (2001)

Manufacturers designate topics and then carry out joint research with R&D institutions. They can also send R&D personnel to work in open laboratories, so as to take full advantage of all the R&D institution's research resources and close interaction to improve R&D quality and research. The private company involved in the cooperative project gets the priority to transfer the technology.

Current situation of COA's industry & agriculture technology cooperative research.

Year	Project No.	Grant from		Total
		COA	Company	
1999	45	987567	--	987567
2000	23	1889267	--	1889267
2001	62	3281833	496167	3778000
2002	144	6874700	1166900	8041600
2003	157	7217700	1166067	8383767
2004	143	5828500	834467	6662967
2005	108	4317733	683633	5001366
2006	113	3862200	588967	4451167

INNOVATIVE APPROACHES FOR THE AGRICULTURE TECHNOLOGY COMMERCIALIZATION FOR COMPANY – SUCCESSFUL CASE STUDY

Completely using of fish scales

(1). Status

The technology, named completely using of fish scales, has successfully transferred to a company in 2006. The royalty of single transfer is one million USD for ten years. The running royalty is 2.5% of the income of related products. The licensee company invested more millions to establish a factory for specifically applying the technology. This technology not only can earn money for the company, but also resolve environmental problem from the waste fish scales, and furthermore, increase the income of fish farmers.

(2). Business direction research

- Mature and large market
- Cheap material
- Abundant source of material
- To reduce the production costs
- Waste to gold

(3). Reference searching & patent maping

- Fish scales are rich in collagen
- The major sources of cosmetic collagen suffered from bovine spongiform encephalopathy , foot-and-mouth disease of livestock and avian flu
- The cost of traditional procedures of extraction collagen from fish is very expensive

(4). SWOT analysis

(5). Research design

(6). Quality, biosafety and validation test

(7). Strategy of technology transfer

- Intellectual property protection
- Specific or nonspecfic authorization
- Bidding for the license
- Documents for raising the royalty

INNOVATIVE APPROACHES FOR THE AGRICULTURE TECHNOLOGY DISSEMINATION FOR SMALL FARMERS – SUCCESSFUL CASE STUDY

E - kit for the detection of Edwardsiellosis in eel farming

(1). Status

The technology, named E-kit, was developed for assisting eel farmers to detect the major pathogen, *Edwardsiells tarda,* of rearing eels. By means of the easy-design kit, without any help of technicians or instruments, an individual farmer can inspect the pathogens inside the eel, estimate the number of bacteria in the pond, evaluate the risk of disease outbreak and even know the effective medicine to treat with different strains of pathogens.

This discovery has successfully transferred to a company in 2006. Since the cost of materials is very low (only about one cent USD for each test), the price of the commercialized product can be as low as one USD. Therefore the promotion is not very difficult. More than twenty-thousand kits have been sold in last year. The dissemination of this kit all over Taiwan for the eel farmers not only can reduce the mortality of rearing eels, cut down the cost of eel production, but also can avoid remains of medicine and raise the quality & price of rearing eels.

(2). Customer direction research

- Easy
- Cheap
- Valuable

(3). Dissemination channel

- Union of eel & shrimp breeders corporation
- Network of production and marketing groups
- Business exhibition
- Internet

(4). 4-E promotion strategy

- *E - kit* is **E**asy to use.
- *E - kit* is for **E**el farmers.
- *E - kit* specifically detects ***E****dwardsiella tarda.*
- *E - kit* is an **E**-generation product.

DISADVANTAGES FOR AGRICULTURE TECHNOLOGY TRANSFER IN TAIWAN

- The environment of technology transfer in agriculture is not very mature.
- The concept of user-payment is not popular among official researchers, companies and farmers.
- The experiences of agricultural technology evaluation are insufficient.
- Big enterprises are not interesting involve in agriculture.
- Domestic market is too small.

CONCLUSION

In twenty-one century, agriculture is in the face of new era. The research of agriculture technology can't be only confined to seek the amount of production increases, but also should promote agriculture head into the "knowledge economy" situation. Located in the subtropical region, Taiwan is rich in biological resources and has abundant experiences in agriculture technology. According to the analysis of current status of the industry, the existing foundation, and global competition, the development strategy of Taiwan's agriculture technology will be:

(1). The plant sprouts, aquaculture, animal antibiotics, functional food polypeptide, biotech fertilizer, and biotech pesticides will be chosen as the primary focus of development.

(2). Two objectives should be worked along both lines. One is to accelerate the transforming of traditional farming. The other one is to accumulate technical know how and talent in the field of new applications.

(3). A trading platform of agriculture information & technology should be set up as soon as possible.

(4). Improve the level of technology, assist the transition of traditional farming, reduce production costs, and increase product's value to achieve the objective of helping farmers.

(5). Expand the application scope of agricultural activities, promote to high value added fields such as medicine, food, and environmental protection to increase productivity of agricultural activities.

(6). Promote organic, fine production, create sustainable agriculture, reduce environmental pollution, protect the ecology, and enhance the benefits of society.

In the future, besides the I.P. protection to new product, new technology and new cultivated varieties, the transfer of agriculture technology and introducing enterprises into agriculture are also the prior topics in Taiwan. Only while the agriculture

transforms into the knowledge type industry, the research capacity of official agriculture institute can be encouraged, the technological level of agricultural enterprises can be upgraded, and the new green revolution of agriculture can be created.

The overlook of Agricultural Technology Transfer in Taiwan

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Current status of Agricultural Technology Transfer in Taiwan

The major organization for agriculture research in Taiwan, R.O.C. is the Council of Agriculture (COA). The COA is in charge of research and development in agronomy, horticulture, forestry, fishery, animal husbandry and food affair areas. A total of 16 research institutions are administrated by the COA. For advancing the science and technology in agriculture, Taiwan government passed “Science and Technology Basic Law” in 1999 which was similar to the Bayh-Dole Act in the U.S.A. Based on the law, the regulation of “Achievement Management on Science and Technology Research and its ownership and Utilization” has been implemented by the COA for managing all agricultural research and extension starting from 2001. Based on the policy, all the researchers must disclosure their inventions at regular basis, and turn the project results into intellectual property rights such as patents, trademarks, copyrights, trade secret and plant variety right for technology transfers.

A total of 283 cases of technology transfer which account for over 100 millions NT dollars royalty (equivalent to 3 million US dollars) have been reported for the past 5 years in COA. The outcome of approved intellectual property is fruitful, and keeps growing.

Two successful examples of the commercialization of agricultural technologies

In Vitro Animal Embryos Production Technique-The Taiwan livestock research institute (TLRI) is engaged in research and development of the dairy cattle industry. The TLRI is the major research Institute in Taiwan to preserve all livestock germplasms for future genetic improvement. The National Dairy Herd Improvement Program has been funded since 1977, and it includes 315 members of dairy herds with 36,524 cattle. The development of a robotic system for dairy farming is underway. Power crowd gates, automatic detaching milking units and automatic washing system for udders and teats were tested with good performance and can be installed at prices half or even two third lower than those of imported ones. The Institute also studies the genetic defects in dairy cattle through numerous detecting and screening tests. For example, screening for dairy congenital diarrhea caused by lethal genes has been established by using blood, frozen semen and milk samples.

The TLRI also studies the reproductive physiology and biotechnology in cattle. The embryos transfer technology has been commercialized. The *in vitro* animal embryos production (IVP) comprises three steps: oocyte maturation, fertilization, and embryos cultivation. The ovaries were collected from animals in the slaughterhouses, and the cumulus-oocyte complexes (COCs) were aspirated out immediately. After *in vitro* maturation and fertilization, the zygotes were co-cultured with cumulus cells to develop into the blastocyst stage. The IVP blastocysts can be either frozen in liquid nitrogen for storage or transferred to the uterus of a recipient for cattle development. The IVP system has set up an important

model for embryo production and transferring in cattle industry. The IVP technology is not only essential for the development of artificial reproductive technology, but also used for large amount of materials for the transgenic animal and nuclear transfer researches.

Industrial Processing of Meat Products-Curing meats, traditionally with an excessive quantity of common salt, is to preserve the meat from spoiling. In recent medical studies, high content of common salt is considered to be one of the factors associated with cardiovascular disease and hypertension. For catering to consumers' taste, the TLRI placed a strong emphasis on modifying the traditional processing ways with new technology. In this project, dry-cured ham with low salt content was developed. It showed that 2.6% of salt in dry-cured loin ham under different curing conditions could shorten the ripening period to two weeks with good taste qualities. Also, the TLRI has developed a new industrial automatic manufacture procedure which produces the stewed pork and packs it in the vacuum bag through pasteurization. It appeared that the pork tastes equally good to the stewed pork made with traditional methods, and can be stored for 3 months at 3 C. Moreover, the pork production yields from this industrialized procedure was 20% more than the traditional ones, that lower the production cost significantly. This pork manufacture procedure has been transferred to food industry to produce the tasty stewed pork for export in Taiwan.

In order to strengthen our native poultry industry in Taiwan for competition with other countries, the Yun-lin County Poultry Production Association in central Taiwan has cooperated with the TLRI to develop a

new chicken processing technology for commercial production. So far 9 chicken dishes have been commercialized.

Salient issues and restrictions in the technology transfer

Until 2006, the COA has owned ca. 200 agricultural patents, many of which are resulted from the researches conducted at 16 research Institutes. However, only a small percentage of agricultural patents have ever been commercialized. The possible reason is either the cost of production is too high to be profitable or the technology is not suitable to industrial application. The other reason is the agro-industry generally lacks the knowledge of the importance of intellectual property rights. Most of farmers think agriculture technologies developed by public supported research institutions shall be provided free, and the government has the responsibility to support modern farming and advanced agro-industry. It is also very common that once the technology is transferred, the licensee has financial problem and reluctantly to use the technology. Restrictions in technology transfer include either the researchers or the technology transfer managers are unable and not willing to bargain hard a business with commercial companies. Other factor affecting the technology transfer is the licensors lack of the experience to seek appropriate licensee, and have no intellectual properties rights concept.

What government shall do for the commercialization of technology transfer

In 1999, the Science and Technology Law accelerated technology

transfers from the government institutes and universities to the private sectors. Technology transfers in the early year 2000s have gained tremendous attentions from university and government researches. Since then, a government invention policy is established to permit research institutes and universities to retain invention titles developed through the government research funds. The policy also encourages researchers to collaborate with industry in promoting the commercialization of inventions. To speed up the transfer of project results, private sectors such as agro-industry, farmer association and small farms may join the research project in a cooperative way. Currently, a minimum of 10% of total research funds is required to pay the research institutes by the potential technology transfer recipients. The potential technology recipient may pay at least 8% of total research fund to transfer new technology for certain length of period. For encouragement, the researcher and/or inventor may share 40% of technology transfer income from the royalty. This kind of cooperative research links tightly between agro-industry and public research institute, and is proved to be effective in technology transfer.

Recently, the COA corresponds and supports many technology exhibitions to give the opportunities for the licensors and potential licensees to meet. In 2007, the Taipei International Invention Show and Techno Mart attracted thousands of technology suppliers and buyers during the exhibition. The intellectual property service providers were interested in identifying business partners and commercializing the latest innovations in the Asia Pacific Regions. The foreign buyers from Japan,

Malaysia, United States, Canada, Germany, Spain, and Australia came and increased the number of business transactions in the exhibitions.

Factors of effective agricultural technologies transfer

Prior to 1999, fewer than 50 patents were issued to the COA by Taiwan and foreign countries. Nevertheless, numbers of invention disclosures has been increased remarkably in recent years. By the year of 2005, about 200 patents had been issued to the COA. As the numbers of partners and stakeholders expanded, effective linkage of research and technology transfer becomes more complicated. Great coordination and synergy between research institutes and agro-industry will be required if the technologies transfers produce impacts.

According to the literature, the success of technology transfer usually depends on a long-term relationship between the licensor, the licensee and the technology transfer agency. Successful technology transfer is not achieved through the simple movement of technology to a new environment. It requires the development of a process and infrastructure that will help the technology get into the industry smoothly. The successful agricultural technology transfer includes a clear government policy, incentive of IPR commercialization for researchers, and a platform to match the demand and supply side of technology market. In others, nature of the technology, patent protection, broad application and relationship between licensor and licensee are also the key factors for successful technology transfer. Communication is a key element in the technology transfer process. A good communication is important not only

between licensor and licensee but also related to society communication. If a new product and technology is not known and acceptable by the public, they will never reach their intended markets. Technology transfer requires human intervention for a technological innovation to become part of a large system. The communication channels that support the transfer process include the printed words (journals, newspapers, and brochures), personal correspondence (letters, e-mail, and telephone), formal instructions (research institutes and universities), education and training. Obviously, societies that control and limit open communication would hamper the process of diffusion and ultimately the successful of innovations. Other factors affecting the efficiency of technology transfer include the R &D capabilities of the licensee, cognitive bias, and organization culture.

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