

出國報告（出國類別：談判）

出席亞太農業研究機構聯盟(APAARI)舉辦之「未充分利用之魚類與海洋生物基因資源(FMGR)與改善方式區域型研討會」

服務機關：行政院農業委員會水產試驗所

姓名職稱：葉信明 研究員兼組長

派赴國家/地區：斯里蘭卡/可倫坡

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摘要

未充分利用之魚類與海洋生物基因資源與改善方式區域型研討會係由亞太農業研究機構聯盟(APAARI)與斯里蘭卡農業研究政策委員會共同主辦，於 108 年 7 月 10 至 12 日假斯里蘭卡國家海洋資源研究發展署(NARA)舉行。會中各國代表一致認為建立基因資料庫是首要，各國代表對臺灣水產試驗所的水產種原庫、基因轉殖水產動植物田間試驗場及超雄性吳郭魚等保種及育種印象深刻，並認為利用臺灣生物多樣性資訊等網站結合物種分類與基因資訊，並收集國內不同目的建立的基因資源資料庫的方式可能是各國在有限經費及人才的情形下，可借鏡的發展模式。我國可依據新南向政策協助建立異地保種制度及指導種原庫及基因資料庫的建置，以促進臺灣和 APPARI 會員國暨新南向國家在各層面的連結，創造互利共贏的新合作模式。

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一、目的

未充分利用之魚類與海洋生物基因資源與改善方式區域型研討會(Regional Workshop on Underutilized Fish and Marine Genetic and their Amelioration)係由亞太農業研究機構聯盟(Asia-Pacific Association of Agricultural Research Institutions, APAARI)與斯里蘭卡農業研究政策委員會(Sri Lanka Council for Agricultural Research Policy, SLCARP)共同主辦，假斯里蘭卡國家海洋資源研究發展署(National Aquatic Resources Research and Development Agency, NARA)舉行。我國為 APAARI 重要贊助國，該聯盟執行秘書 Dr. Ravi Khetarpal 邀請行政院農業委員會國際處(簡稱 國際處)洪忠修處長出席致詞，並指派一位資深專家出席研討會並發表國家報告。鑒於 APAARI 為我國長期參與之重要農業國際組織，為深化對 APAARI 之參與，並加強漁業技術交流，國際處請行政院農業委員會水產試驗所(簡稱 水試所)指派 1 位資深專家出席研討會發表國家報告並代表行政院農業委員會(簡稱 農委會)致詞。

研討會於 108 年 7 月 10 至 12 日在斯里蘭卡可倫坡的 NARA 舉行，目標如下：

1. 評估區域未充分利用之魚類與海洋生物基因資源(underutilized fish and marine genetic resources, underutilized FMGR)現況，以及亞太地區需要改進與優先投入之研發。
2. 探討未充分利用之魚類與海洋生物基因資源知識缺口，發展未充分利用之魚類與海洋生物基因資源價值與潛力，以改善鄉村與沿海農民生活。
3. 強化未充分利用之魚類與海洋生物基因資源制度架構，並促進其永續發展。

二、過程

1. 出國前準備

旨揭研討會於開會前需繳交國家現況報告(country status report)，以說明各國的未充分利用之魚類與海洋生物基因資源在經濟及糧食安全的重要性、在各國的現況、挑戰及機會、商業及貿易、採取之利用策略、重點規劃領域、基礎建設及經費、未來推動方向等。筆者針對目前我國水產貿易的重要性、魚類多樣性的獨特性、生物多樣性資料庫及水試所水產種原庫現況等重點撰寫國家現況報告(附錄一)。另依據研討會的議程草案，代表農委會擬致詞稿(附錄二)說明臺灣是微小的島嶼，但有高於全球平均的物種數及特有種，使得保存特有種基因資源成為重點工作。近年來臺灣的水產養殖利用保存及應用重要基因資源，期能達到永續水產養殖的目標，故水試所自 2001 年起，陸續建造水產種原庫，以保存重要水產基因資源。6 月底負責執行本研討會之 APAARI 的 Dr. Rishi Kumar Tyagi 來臺出席另外的會議時，

要求與代表農委會出席之筆者見面討論研討會事宜。與 Dr. Tyagi 面談之中，請求筆者擔任研討會第 2 日(7/11)的技術會議(Technical Session) III 的共同主持人之一(附錄三)。7 月 6 日的研討會議程更新版又進一步要求筆者於研討會第 3 日(7/12)上午的技術會議 V 主持小組討論會(Panel Discussion)外，下午的全體會議(Plenary Session)中以共同主辦單位及共同主持人的身份，各別提供短評(brief remark)。

2. 出國行程

(1) 7 月 9 日 (星期二): 出國第 1 日

行程：台灣/台北 – 馬來西亞/吉隆坡 – 斯里蘭卡/可倫坡

內容：

- a. 15:10 台灣/桃園國際機場(TPE) – 20:00 馬來西亞/吉隆坡國際機場(KUL)：馬來西亞航空 MH367 (飛航時間: 4 小時 50 分)
- b. 22:00 馬來西亞/吉隆坡國際機場(KUL) – 22:55 斯里蘭卡/可倫坡國際機場(CMB)：馬來西亞航空 MH179 (飛航時間: 3 小時 25 分)
- c. NARA 官員 2 人至可倫坡機場接各國出席研討會人員並接送至位於 Wattala 之 Pegasus Reef Hotel 住宿。

(2) 7 月 10 日 (星期三): 研討會第 1 日

行程：開幕式、技術會議 I、技術會議 II、招待晚宴

內容：本研討會開幕式由斯里蘭卡農業研究政策委員會(Sri Lanka Council for Agricultural Research Policy, SLCARP)主席 Dr. D T Kingsley Bernard 發布新聞稿(附錄四)並邀集數家媒體採訪。開幕式主席為斯里蘭卡農業、農村經濟、畜牧發展、灌溉暨漁業與水產資源發展部之內閣大臣(Cabinet Minister) Hon. P. Harison。主要貴賓有漁業暨水產資源開發國務大臣(State Minister) Hon. Dilip Wedaarachchi、APAARI 的 Dr. Rishi Kumar Tyagi、NARA 主席 EASK Edirisinghe 及 SLCARP 的本研討會負責人 Dr. Frank Niranjana 等。在開幕式中，首先由 Dr. D T Kingsley Bernard 致歡迎詞後，依序由 Dr. Rishi Kumar Tyagi、筆者及 EASK Edirisinghe 致開幕詞後，Hon. P. Harison 進行就職演說，最後由 Frank Niranjana 致謝辭，並全體拍攝紀念照。

技術會議 I 為主題式會議，主要介紹 underutilized FMGR 的國際及斯里蘭卡國內的利用現況及未來趨勢。技術會議 I 主要由大會邀請聯合國糧食暨農業組織(Food and Agriculture Organization of the United Nations, FAO)的亞太區域辦公室(FAO Regional Office for Asia and the Pacific, FAO-RAP)自然資源管理支援

小組(Natural Resources Management Support Group)的資深漁業官員(Senior Fishery Officer) Simon Nicol 對太平洋地區捕撈漁業及水產養殖的管理及永續利用進行視訊簡報。該簡報分別對亞太地區的捕撈漁業及水產養殖的未來成長趨勢提出看法。Simon 認為捕撈漁業的持續成長有限且面臨多項問題，目前野外已很少有未利用資源、IUU 的漁獲需要自供應鏈排除、減少浪費及低價魚等問題。水產養殖在亞太地區仍然會持續成長，但需解決飼料供應及細菌性疾病的抗藥性等問題。永續利用及經營仍為海洋漁業與水產養殖所面臨的挑戰。斯里蘭卡 NARA 的 Mr. Prabath Jayasinghe 簡報介紹在 FAO 的 EAF Nansen program 的經費補助及挪威-斯里蘭卡雙邊合作計畫下，自 2017 年挪威發展合作署(Norwegian Agency for Development Cooperation, NORAD)協助斯里蘭卡建構海洋資源調查及資料分析能力。該署以全長 74.5 公尺之 Dr. Fridtjof Nansen 研究船與斯里蘭卡 NARA 合作將斯里蘭卡周邊海域區分為 6 區，在 20 公尺以深水域利用底拖網及中層拖網調查海洋漁業及生物資源。調查結果指出 40 年前(1978-1980)與挪威的合作調查結果比較，西北區的單位努力漁獲量(catch per unit effort, CPUE)減少最多，由過去的 1200 公斤/平方哩降為不足 200 公斤/平方哩，估計總漁業資源量由 25-35 萬公噸減少為 5.3 萬公噸。另漁業資源自大型、壽命長的魚種變為小型、壽命短的魚種，顯示漁業資源的總經濟產值有降低之趨勢。在調查中，新紀錄 593 種的海洋生物在未來有進一步開發利用的可能性。

技術會議 II 為 underutilized FMGR 的保存及利用策略會議。印度農業和農民福利部(Ministry of Agriculture & Farmers' Welfare)印度農業研究委員會(Indian Council of Agricultural Research, ICAR)漁業處(Division of Fisheries)及畜產處(Division of Animal Science)的副處長(Deputy Director General) Dr. Joykrushna Jena 以「Applications of biotechnologies in ex situ conservation, characterization and utilization」簡報介紹水產養殖是未來全球蛋白質需求提高時，可依靠的來源之一。過去 20 年全球水產養殖維持 7-9%的成長率，在增加生產力、維持養殖物種的基因多樣性及保障生物多樣性的需求下，21 世紀面臨水產基因資源資訊、國家級水產基因資源資料庫計畫及全球性的水產基因資源管理策略等挑戰。印度推動藍色革命(Blue Revolution)提升魚類基因資源的保存策略。印度 ICAR 的國家魚類基因資源署(National Bureau of Fish Genetic Resources, NBFGR)及漁業、畜牧業暨乳業部(Ministry of Fisheries, Animal Husbandry and Dairying)國家漁業發展局(National Fisheries Development Board, NFDB)在 Upscaling program 下，

推動印度國內鯉科魚類繁殖場的種魚交換、建立 18 種魚類的標準程序並確認保存 23 年的冷凍精液之 52%能使卵受精及孵化，提高配子的數量及品質並商業化規模的標準程序建立是未來的推動目標。另取得野外基因來評估養殖基因、基因型的選擇及利用等皆需要全面性的基因資源資訊建立策略。



致詞者為 Dr. D T Kingsley Bernard (SLCARP)、貴賓席右二為 Hon. P. Harison (Cabinet Minister)、貴賓席右三為 Hon. Dilip Wedaarachchi (State Minister)。



亞太農業研究機構聯盟(Asia-Pacific Association of Agricultural Research Institutions, APAARI) 負責執行本研討會的 Dr. Rishi Kumar Tyagi 於開幕式致歡迎詞。



筆者代表農委會於開幕式致歡迎詞



斯里蘭卡農業、農村經濟、畜牧發展、灌溉暨漁業與水產資源發展部之內閣大臣(Cabinet Minister) Hon. P. Harison 進行就職演說。



筆者致贈臺灣名產給貴賓 (右為 Dr. D T Kingsley Bernard)



與會者團體合照於斯里蘭卡國家海洋資源研究發展署(NARA)

(3) 7月11日(星期四): 研討會第2日

行程: 技術會議 III、技術會議 VI、歡送晚宴

內容: 技術會議 III 為各國代表對 underutilized FMGR 的國家現況報告。技術會議 III 上午場次的國家現況報告由南亞及西亞國家進行簡報，由筆者及斯里蘭卡 NARA 的 Dr. H. M. Palitha Kithsiri 擔任共同主持人。依序由不丹農業暨森林部(Ministry of Agriculture and Forest)畜牧處(Department of Livestock)國家河川暨湖泊研究中心(National Research Centre for Riverine and Lake Fisheries) 的 Mr. Gopal Prasad Khanal、印度 ICAR 的國家魚類基因資源署(NBFGR)署長 Dr. Kuldeep K Lal、伊朗農業研究、教育暨推廣組織(Agriculture Research, Education and Extension Organization, AREEO)伊朗漁業科學研究所 (Iranian Fisheries Science Research Institute, IFSRI) 的 Dr. Ali Salarpouri、斯里蘭卡 Sri Jayewardenepura 大學(University of Sri Jayewardenepura)動物系(Department of Zoology)的 Dr. Varuni Gunathilake、尼泊爾農業研究委員會(Nepal Agricultural Research Council, NARC)的 Ms. Neeta Pradhan 及巴基斯坦農業研究委員會(Pakistan Agricultural National Research, PARC)國家農業研究中心(National Agricultural Research Center, NARC)的 Dr. Rehana Kausar 進行簡報並討論。

技術會議 III 下午場次的國家現況報告由東南亞及太平洋洲國家進行簡報，由斯里蘭卡 Dr. Varuni Gunathilake 及泰國亞太水產養殖網絡(Network of Aquaculture Centers in Asia-Pacific, NACA)的連絡經理(Communications Manager) Mr. Simon Wilkinson 擔任共同主持人。依序由寮國國家農業暨森林研究所(National Agriculture and Forestry Research Institute)的 Dr. Latsamy Phounvisouk、馬來西亞漁業處(Department of Fisheries Malaysia)漁業研究所(Fisheries Research Institute)的 Ms. Masazurah A Rahim、菲律賓的菲律賓大學(University of Philippines)海洋科學研究所(Marine Science Institute)的副所長 Dr. Rachel June Ravago-Gotanco、筆者(附錄五)、泰國北泰國灣水產研究暨發展中心(Upper Gulf Marine Fisheries Research and Development Center) 的 Miss Anyanee Yamrungrueng 及斐濟漁業部(Ministry of Fisheries Fiji)的漁業官員 Mr. Tevita Vodivodi 進行簡報並討論。技術會議 III 的討論中，各國代表一致認為建立 FMGR 基因資料庫是利用 underutilized FMGR 的首要。印度在水產及畜產基因資源的保存設施、軟體建設(主要為資料庫系統)及收集策略等居於領導地位，但需要龐大的經費及人才的支撐並非一般國家所能負擔。各國代表對臺灣水產試驗所的水產種原庫、基因轉殖水產動植物田間試驗場及超雄性吳郭魚等保種及育種印象深刻，

並認為利用臺灣生物多樣性資訊(TaiBIF)等網站結合物種分類與基因資訊，並收集國內不同目的建立的基因資源資料庫的方式可能是各國在有限經費及人才的情形下，可借鏡的發展模式。

技術會議 IV 為針對區域性相關 underutilized FMGR 優先議題的 World Café 換桌論壇。論壇共分為 5 桌組討論議題，第 1 組議題為保育、促進與利用 (Conservation, improvement and use)、第 2 組議題為加值化、行銷與輸出(Value addition, marketing and export)、第 3 組議題為以生物技術促進應用(Biotechnology for enhancing utilization)、第 4 組議題為合夥關係與能力建構(Partnership and capacity development)及第 5 組議題為區域性資訊共享系統與焦點(Regional information sharing system and focal point)。每組 10 人，針對各桌組議題討論 15-20 分鐘再換下個桌組議題進行討論至所有人對所有議題均提供意見為止。桌長將所有人的意見彙整後，於研討會第 3 日再進行簡報。



筆者與出席本研討會最西邊之伊朗國家代表 Dr. Ali Salarpouri 合影



筆者於研討會第 2 日上午場次與 Dr. H. M. Palitha Kithsiri(左一)共同擔任主持人

(4) 7月12日(星期五): 研討會第3日

行程：技術會議 V、全體會議

內容：技術會議 V 為針對法律暨政策架構促進 underutilized FMGR 的永續利用的議題進行專門小組討論(panel discussion)。每位受邀人員簡報 8 分鐘，依序由泰國 Mr. Simon Wilkinson、斯里蘭卡 Sabaragamuwa 大學的 Dr. D. Achini. M. De Silva、菲律賓水產養殖暨漁業發展綜合服務公司(Integrated Services for the Development of Aquaculture and Fisheries, Inc.)的 Dr. Anicia Q. Hurtado、筆者(附錄六)、斯里蘭卡 Mahaweli 發展暨環境部(Ministry of Mahaweli Development and Environment) 的生物多樣性主任秘書(Director Biodiversity Secretariat) Mrs. Pathma Abeykoon、伊朗 Dr. Ali Salarpouri、斐濟 Mr. Tevita Vodivodi 及菲律賓 Dr. Rachel June Ravago-Gotanco 進行簡報及進行 25 分鐘的討論。討論中，分別對技術會議 I 的簡報內容歸納出 5 個建議事項，主要為每個國家應掌握自己的海洋生物資源、利用可能性、價值化、鼓勵研究暨發展及分享資訊。對技術會議 II 的簡報內容歸納出 5 個採用策略，主要為對海洋生物資源的鑑定及找出能利用的特徵，再建立由野外族群繁殖的種原，並策略性的建構管理及生產系統。對技術會議 III 的國家現況報告的簡報內容歸納出 2 個關鍵事項，第 1 點為多數國家的 FMGR 仍然依照傳統方式利用，值得進一步開發利用。第 2 點為所有國家已有漁業開發的機制，但 FMGR 的食用以外的用途仍然維持問號。但仍可整理出 5 個具體的想法，依序為探索 EEZ 以外的漁業資源、洄游魚類的資源評估、過漁的管理、尋找生物機能物質及瞭解生物多樣性。

全體會議針對 World Café 換桌論壇討論議題歸納結論並提出建議事項進行簡報。雖然已整理出具體建議事項，在執行上仍面臨缺乏經驗及實際操作程序。特別在異地保種的執行上，各國希望借助臺灣及印度等已有執行經驗國家協助建立標準程序及基因庫。筆者在代表農委會的閉幕致詞提及目前政府推動新南向政策，促進臺灣和東協、南亞、紐澳和大洋洲等國家的經貿、科技、文化等各層面的連結，共享資源、人才與市場，創造互利共贏的新合作模式。目前在此政策下，本研討會希望臺灣協助的建議事項應該會受到支持。

Recommendations

- Each country should identify their available underutilized marine resources
- Should identify the potential use of available underutilized marine resources
- Technology should be acquire through knowledge sharing
- Strategies should be implemented to popularize the Value added product
- Should encourage the research and development activities related to the underutilized marine resources (ex-identification and characterization of bioactive compound)

研討會第 3 日技術會議 V 對技術會議 I 的簡報內容歸納出的建議事

Major focus /Strategies adopted to harness potential of underutilized FMGR

- Knowledge generation, Explorations & document status of FGR, Evaluation of the prioritized species & new species for preferable traits
- Establish breeding population through wild collections, Captive propagation & Package of Practices
- Enabling environment & infrastructure to promote aquaculture at different strata
- Policy frameworks & certification protocols for Best management practices, quality inputs and production, Improve domestic consumption of fish products
- Focus on region specific packages; intensive to backyard

研討會第 3 日技術會議 V 對技術會議 II 的簡報內容歸納出的採用策略

Key points

- In many countries FMGR are still at an underutilised stage. Some, such as Malaysia, have utilised conventional FMGR completely, but there are still new opportunities to investigate.
- All countries have already identified the mechanisms to develop fisheries. But potential for use of FMGR other than food is a question mark.

研討會第 3 日技術會議 V 對技術會議 III 的簡報內容歸納出的 2 個關鍵事項

A few concrete ideas

- Investigate potential of fisheries beyond the EEZ.
- Status of transboundary and migratory fish stocks?
- Controlling overfishing (= improving resource management)
- Searching for bioactive compounds.
- Documenting biodiversity (what have we actually got?)

研討會第 3 日技術會議 V 對技術會議 III 的簡報內容歸納出各國利用 FMGR 的具體想法

Constraints in implementing the suggestion

- Lack of experience and facilities to
 - establish integrated taxonomy tools (Molecular & Morphological)
 - cryopreservation
- Selective breeding

Opportunities

- Countries like Taiwan & India has already established the ex situ conservation protocols. Therefore, technical support can be expected from them to develop the regional/country wise gene bank
- Micropropagation of seaweed has already practiced in Philippine. Technical support can be expected from them

全體會議對研討會第 2 日的 World Café 換桌論壇討論議題歸納結論並提出建議事項

(5) 7月13-14日(星期六-日): 出國休假

(6) 7月15日(星期一): 返國

行程: 斯里蘭卡/可倫坡 - 馬來西亞/吉隆坡 - 台灣/台北

內容:

- a. 00:05 斯里蘭卡/可倫坡國際機場(CMB) - 06:20 馬來西亞/吉隆坡國際機場(KUL): 馬來西亞航空 MH178 (飛航時間: 3 小時 45 分)
- b. 09:15 馬來西亞/吉隆坡國際機場(KUL) - 14:10 台灣/桃園國際機場(TPE): 馬來西亞航空 MH366 (飛航時間: 4 小時 55 分)

三、心得及建議

1. 印度在水產及畜產基因資源的保存設施、軟體建設(主要為資料庫系統)及收集策略等居於領導地位,但需要龐大的經費及人才的支撐並非一般國家所能負擔。
2. 各國代表對臺灣水產試驗所的水產種原庫、基因轉殖水產動植物田間試驗場及超雄性吳郭魚等保種及育種印象深刻,並認為利用臺灣生物多樣性資訊(TaiBIF)等網站結合物種分類與基因資訊,並收集國內不同目的建立的基因資源資料庫的方式可能是各國在有限經費及人才的情形下,可借鏡的發展模式。
3. 各國在 *underutilizd FMGR* 的利用及執行上仍面臨缺乏經驗及實際操作程序。特別在異地保種上,各國希望借助臺灣及印度等已有執行經驗國家協助建立標準程序及基因庫。西亞、南亞、東南亞及大洋洲各國對水產基因資源的保種制度與設施尚待發展,我國可依據新南向政策協助建立異地保種制度及指導種原庫及基因資料庫的建置,以促進臺灣和 APPARI 會員國暨新南向國家在各層面的連結,創造互利共贏的新合作模式。

The Taiwan Status Report on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration

1. Introduction

Today fish provided about 3.2 billion people with almost 20 percent of their average per capita intake of animal protein. Aquaculture and capture fisheries directly employ over 59 million people, and each sector provides about 50 percent of the world's aquatic food supply (FAO, 2018). Although the wild harvest of fish, invertebrates (mainly mollusks and crustaceans) and aquatic plants (mainly seaweeds) has provided human populations with important sources of nutrition from ancient times, aquatic genetic resources have only recently begun to attract the attention internationally. Fishery genetics is defined as the application of genetic principles and methods for increasing aquaculture productivity by genetically modifying fish stocks and for the management of fish populations to obtain maximum sustainable yield without affecting the genetic diversity. Recently, the research of marine genetic resources (MGR) is fairly new but growing rapidly. Biological compounds taken from marine resources include those with potential medical benefits, like anticancer agents, and those with industrial value, like antifreeze proteins. These biologically derived compounds can then be patented by those who isolate and test them, to be used for potential profit.

Taiwan is a small island, but it occupies a pivotal position as its proportion of species numbers and endemic organisms are high when compared to the world's average. This makes preserving the genetic materials of Taiwan's native species all the more important. Taiwan has been engaged since the early beginning in the use of molecular genetic techniques to assist genetic improvement in aquaculture, aiming at the production of superior broodstocks of fish for traits such as faster growth, resistance to diseases, and a better understanding of sex determination. Important work has been undertaken on genetic mapping, Quantitative Trait Loci (QTL) analyses and gene expression in aquaculture species.

Better management and conservation of important aquatic genetic resources towards sustainable aquaculture has been the focus in Taiwan in recent years. The Fisheries Research Institute (FRI), Council of Agriculture (COA) has launched a project to establish the National Aquatic Genetic Resources Center since 2001. It was planned to construct genetic resources facilities at four research centers of FRI. Selected aquatic organisms of genetic importance are conserved in indoor ponds.

2. Importance of FMGR in economy and food security of the country

a. Production and consumption

Taiwanese fish production was about 1,026.5 thousand tonnes (Table 1) in 2017, with aquaculture representing 27.6 percent of the total (FA, cited 2019 Jun 30). The total first sale value of fisheries and aquaculture production in 2017 was estimated at USD 2,906 million, of which USD 1,174 million was from aquaculture production. In per capita terms, food fish consumption reduced from 35.2 kg in 2013 to 24.6 kg (global average is 20.5 kg) in 2017, at an average rate of about 8.5 percent per year. In 2017, fish accounted for about 20.4 percent of animal protein consumed by the Taiwanese population. In comparison, preliminary estimate for the 2017 global per capita average is 20.5 kg. Fish accounted for about 17 percent of animal protein consumed by the global population (SOFIA, 2018).

The capture fisheries production of Taiwan was 743.4 thousand tonnes in 2017, a small decrease in comparison to the previous years. Fisheries in marine and inland waters provided 99.7 and 0.3 percent of the country total, respectively. The aquaculture production of Taiwan was 283.1 thousand tonnes in 2017, an increase of 10.9 percent over the previous year and a decrease of 30.7 percent in comparison to the 2014. Aquaculture in marine and inland waters provided 9.5 and 90.5 percent of the country total, respectively. Aquaculture production in 2017 included 283.1 thousand tonnes of food fish and 0.84 thousand tonnes of aquatic plants. Farmed food fish production included 185.8 thousand tonnes of finfish, 80.1 thousand tonnes of molluscs, 16.4 thousand tonnes of crustaceans and 2.67 thousand tonnes of other aquatic animals such as turtles and frogs.

Table 1. Taiwanese fisheries and aquaculture production and consumption

Category(1,000 tonnes) \ Year	2013	2014	2015	2016	2017
Production					
Capture					
<i>Inland</i>	0.029	0.03	0.103	0.088	2.62
<i>Marine</i>	925.3	1068.4	985.6	748.5	740.8
Total capture	925.3	1068.4	985.7	748.6	743.4
Aquaculture					
<i>Inland</i>	317.2	309.9	288.8	230.0	256.3
<i>Marine</i>	31.7	29.3	24.7	25.3	26.8
Total aquaculture	349.0	339.2	313.6	255.3	283.1
Total fisheries and aquaculture	1274.3	1407.6	1299.3	1003.9	1026.5
Consumption					
Human consumption	821.6	830.2	673.0	559.8	580.0
Non-food uses	1.98	1.99	5.67	4.82	3.84
Per capita consumption (kg/yr)	35.2	35.5	28.7	23.8	24.6

b. Imports and Exports

Total fish and fish products production in 2017 imported included 326.7 thousand tonnes of edible products with a value of 1,330.4 million USD (Table 2), and 155.2 thousand tonnes of non-edible products with a value of 241.4 million USD. The 707.2 thousand tonnes of total fish and fish products exported in 2017, included 700.1 thousand tonnes of edible products with a value of 1,766.4 million USD and 7.1 thousand tonnes of non-edible products with a value of 36.5 million USD.

Table 2. Quantities and values of Taiwanese imports and exports of fish and fish products in Taiwan

Category\ Year (Quantity in 1,000 tonnes, Value in 1,000,000 USD)	2013	2014	2015	2016	2017
Import					
<i>Edible</i>					
Quantity	322.0	318.3	312.2	315.5	326.7
Value	912.5	1,040.0	1,083.4	1169.3	1,300.4
<i>Non-edible</i>					
Quantity	144.3	169.3	152.9	137.3	155.2
Value	269.9	310.2	316.2	275.2	241.4
Total import (Quantity)	466.3	487.6	465.2	452.8	481.9
(Value)	1,182.4	1,350.2	1,399.6	1,444.5	1,541.8
Export					
<i>Edible</i>					
Quantity	665.7	780.8	787.2	671.8	700.1
Value	1,792.2	1,821.0	1,613.9	1,566.3	1766.9
<i>Non-edible</i>					
Quantity	17.9	13.7	8.2	7.2	7.1
Value	51.5	49.1	41.2	37.7	36.5
Total export (Quantity)	683.5	794.5	795.4	678.9	707.2
(Value)	1,843.8	1,870.1	1,655.0	1604.1	1,803.4

3. Status of FMGR

a. Unique underutilized FMGR

The fishes of Taiwan contain 3,115 species in 1209 genera from 298 families, which include 13 species of hagfish (Class Myxini), 192 species of cartilaginous fishes (Class Chondrichthyes), and 2,992 species of ray-finned fishes (Class Actinopterygii) (TaiBIF, cited 2019 Jun 30). In total, eleven of the 13 hagfish species (85 %), seven of the 192

cartilaginous fish species, and 95 of the 2,992 ray-finned fish species (3.2 %) are endemic to Taiwan (Shao, 2019 Jun 30). A look into 220 species of freshwater fish, 36 species (16 %) are endemic to the rivers of Taiwan.

The mollusks of Taiwan contain 4,308 species in 1,297 genera from 321 families, which include 926 species of bivalves (Class Bivalvia), 113 species of cephalopods (Class Cephalopoda), 3,214 species of gastropods (Class Gastropoda), 21 species of chitons (Class Polyplacophora), 33 species of scaphopods (Class Scaphopoda), and one species of solenogaster (Class Solenogastres). Totally 3,244 of 4,173 bivalves, gastropods, chitons and scaphopods (78 %) live in marine, only 295 of 3,214 gastropod species (9.2 %) are terrestrial. A look into 295 species of terrestrial gastropods (land snail), 193 species (65 %) are endemic to Taiwan (The Taiwan Malacofauna Database, cited 2019 Jun 30).

The decapod crustaceans (Order Decapoda) of Taiwan contain 1,635 species in 623 genera from 130 families. The euphausiid crustaceans (Order Euphausiacea) contain 31 species in five genera from one family.

b. Germplasm collection, characterization, evaluation, conservation and documentation

Selected aquatic organisms of genetic importance are conserved in the National Aquatic Genetic Resources Center, FRI since 2001. The 61 species of germplasm are collected at the three research centers of FRI, the Freshwater Aquaculture Research Center (FARC), Eastern Marine Biology Research Center (EMBRC), and Penghu Marine Biology Research Center (PMBRC). The other 101 species are under evaluation for germplasm collection (Table 3).

Table 3. The germplasm collection of the National Aquatic Genetic Resources Center of Taiwan

Phylum	Class	Scientific name
Chordata	Actinopterygii	<i>Amphiprion clarkia</i> ¹
		<i>Amphiprion ephippium</i> ¹
		<i>Amphiprion frenatus</i> ¹
		<i>Amphiprion ocellaris</i> ¹
		<i>Amphiprion ocellaris</i> var. ¹
		<i>Amphiprion percula</i> ¹
		<i>Amphiprion perideraion</i> ¹
		<i>Amphiprion polymnus</i> ¹
		<i>Amphiprion</i> sp. cf. <i>clarkia</i> ¹
		<i>Amphiprion</i> sp. cf. <i>clarkii</i> ¹

		<i>Bidyanus bidyanus</i> ³
		<i>Candidia barbata</i> ³
		<i>Carassius auratus</i> ³
		<i>Chrysiptera brownriggii</i> ¹
		<i>Chrysiptera cyanea</i> ¹
		<i>Chrysiptera glauca</i> ¹
		<i>Ctenopharyngodon idellus</i> ³
		<i>Cyprinus carpio</i> ³
		<i>Cyprinus carpio carpio</i> ³
		<i>Dascyllus trimaculatus</i> ¹
		<i>Epinephelus coioides</i> ¹
		<i>Epinephelus fuscoguttatus</i> ¹
		<i>Herichthys carpint</i> ³
		<i>Hippocampus kuda</i> ²
		<i>Macropodus opercularis</i> ³
		<i>Micropterus salmoides</i> ³
		<i>Neoglyphidodon melas</i> ¹
		<i>Neoglyphidodon oxyodon</i> ¹
		<i>Oreochromis aureus</i> ³
		<i>Oreochromis hornorum</i> ³
		<i>Oreochromis mossambicus</i> ³
		<i>Oreochromis niloticus</i> ³
		<i>Oreochromis niloticus N1</i> ³
		<i>Oreochromis spilurus</i> ^{2,3}
		<i>Oreochromis sp.</i> ³
		<i>Oryzias latipes</i> ³
		<i>Paracanthurus hepatus</i> ¹
		<i>Parachromis managuensis</i> ³
		<i>Piaractus brachypomus</i> ³
		<i>Plectropomus leopardus</i> ²
		<i>Pomacentrus moluccensis</i> ¹

		<i>Premnas biaculeatus</i> ¹
		<i>Premnas biaculeatus</i> ¹
		<i>Pseudorasbora parva</i> ³
		<i>Puntius semifasciolatus</i> ³
		<i>Puntius snyderi</i> ³
		<i>Rhodeus ocellatus ocellatus</i> ³
		<i>Tilapia zillii</i> ³
		<i>Zacco pachycephalus</i> ³
Arthropoda	Merostomata	<i>Tachypleus tridentatus</i> ²
	Maxillopoda	<i>Apocyclops royi</i> ¹
	Malacostraca	<i>Cinetorhynchus hendersoni</i> ²
	Malacostraca	<i>Hymenocera picta</i> ²
	Hexanauplia	<i>Pseudodiaptomus annandalei</i> ¹
	Malacostraca	<i>Rhynchocinetes durbanensis</i> ²
Mollusca	Gastropoda	<i>Babylonia areolata</i> ²
Rotifera	Monogononta	<i>Brachionus plicatilis</i> ¹
Ochrophyta	Coscinodiscophyceae	<i>Chaetoceros muelleri</i> ¹
Chlorophyta	Chlorodendrales	<i>Tetraselmis chui</i> ¹
Chrysophycophyta	Eustigmatophyte	<i>Nannochloropsis oculata</i> ¹
	Prymnesiophyceae	<i>Isochrysis galbana</i> ¹

1: Eastern Marine Biology Research Center (EMBRC); 2: Penghu Marine Biology Research Center (PMBRC); 3: Freshwater Aquaculture Research Center (FARC).

4. Challenges and opportunities

Taiwan has been engaged in the study of genetic variation and stock structure of wild populations of fish species, aiming also at the identification of management units of commercial fish. It plays a leading role in deciphering the phylogenetic patterns and evolutionary history of marine species in the East Pacific, shedding light on possible connections between past climate variations, demographic histories, and present-day genetic variation in marine species (Chu et al., 2012; Hsiao et al., 2016; Chou et al., 2015). We has produced very successful work in the area of natural populations by applying molecular markers in studies of the genetic structure of marine species, with conclusions of direct relevance to practical applications such as fisheries management and

conservation policies. There is a long list of species, such as black seabream (Hsu et al., 2011), flying fish (Chou et al., 2015), yellowfin tuna (Wu et al., 2010; Aguila et al., 2015), dolphinfish (Ting 2014) etc., whose genetic structure has been investigated by means of molecular genetic markers. The synthesis of the multi-species data is actually an important goal to better understand global patterns of biodiversity of marine species.

5. Marketing, commercialization and trade

Taiwan researchers are experienced in the use of molecular techniques for species and authentication of origin in marine organisms and their products. Shark fin is the most valuable part in a whole shark body, the custom of eating shark fin is very popular in East and Southeast Asia, and it has been counted a traditional noble delicacy in China for centuries. We analyzed constitution of species in Taiwan market fins by using the molecular tool- DNA barcode (Liu et al., 2013; Chuang et al., 2016). We have developed a molecular technique for the identification of shark species, in order to aid traceability of commercially sold shark and ray fins which will be helpful for fishery management and species conservation. Additionally, mislabeling of fish products not only impacts consumer finances, but can also be deleterious to public health. Fish products may be mislabeled for reasons including ambiguity of common fish names, challenging morphological identification, or willful intention to deceive. We reveal a high rate of mislabeling samples from Customs offices and Coastal Patrol Offices in Taiwan using DNA barcoding based on a partial segment of the mitochondrial cytochrome c oxidase subunit I gene (COI) (Chang et al., 2016). In order to reduce the mislabeling of imported fish products, the authorities should take some actions into consideration, such as institutionalizing molecular authentication of fish products, standardizing the usage of common fish names, and legislating for penalties. Finally, metabarcoding approaches have been used to study stomach contents, fish communities in a species-rich coastal sea and deep sea communities (Shao et al., 2002; Ko et al., 2013; Chang et al., 2017; Shao and Lin 2014).

6. Strategies adopted to harness potential of underutilized FMGR

The first step is establishing the Barcode of Life Database (BOLD), which is promoted by the Consortium for the Barcode of Life (CBOL), International Barcode of Life (iBOL), and Global Biodentification System (GBS). All the data can be accessed online at the Taiwan Wildlife Genetic Material Cryobank (<http://cryobank.sinica.edu.tw>). Many domestic and foreign research institutions have abided by the specimen management rules and obtained tissue samples, promoting academic exchanges and enhancing research qualities. This project will continue to expand the archiving of wild animals genetic materials. We hopes to build a DNA barcode system and permanently preserve all of Taiwan's wildlife genetic materials before some species disappear or become extinct.

Moreover, it will continue to manage and maintain the cryobank and database website so that it can provide material for future research, education, conservation, restoration, and sustainable utilization, as well as meet the need of different aspects such as genetic diversity study, genetic resource usages, smuggling prevention, and alien invasive species control.

7. Major focus areas for underutilized FMGR

Taiwan has been engaged since the early beginning in the use of molecular genetic techniques to assist genetic improvement in aquaculture, aiming at the production of superior broodstocks of fish for traits such as faster growth, resistance to diseases, and a better understanding of sex determination. Important work has been undertaken on genetic mapping, Quantitative Trait Loci (QTL) analyses and gene expression in aquaculture species.

8. Infrastructure, capacity building and financial investment

Better management and conservation of important aquatic genetic resources towards sustainable aquaculture has been the focus in Taiwan in recent years. The FRI has launched a project to establish the National Aquatic Genetic Resources Center since 2001. It was planned to construct genetic resources facilities at three research centers of FRI, namely, the Freshwater Aquaculture Research Center (FARC), Eastern Marine Biology Research Center (EMBRC), and Penghu Marine Biology Research Center (PMBRC). The facilities at FARC and PMBRC were completed in 2006. Selected aquatic organisms of genetic importance are conserved in indoor ponds.

10. Future thrusts

- (1) Genetic resources could contribute greatly to our efforts to cope with climate change, but in many cases the magnitude and speed of climate change will surpass our ability to identify, select, reproduce and use these resources in the field.
- (2) Sustainable fishery is key to reversing trends that lead to genetic resources loss, damaged ecosystems, and the overall deterioration of our natural resources.

11. Conclusions

The value of marine genetic resources will emerge in the few next years, and the database on marine genetic resources will also clarify their economic and financial values, as information on these aspects are being made available and compiled. A well-constructed, transparent and easy-to-access information basis will greatly facilitate the sustainable management of marine genetic resources in the future. The steady increase in the number of scientific publications and patents on marine genetic resources observed demonstrates that this area is of growing importance to both the scientific community and

to those involved in bioprospecting.

12. References

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附錄二、開幕致詞 (Opening Remark)

Opening Remarks
at the
Regional Workshop on Underutilized Fish and Marine Genetic Resources (FMGR) and
their Amelioration
by
Dr. Hsin-Ming Yeh
Chief, Marine Fisheries Division, Fisheries Research Institute,
Council of Agriculture, Taiwan
July 10, 2019

P Harison, Hon'ble Minister of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries and Aquatic Resources Development, Government of Sri Lanka; Dr. D T Kingsley Bernard, Chairman of the Sri Lanka Council for Agricultural Research Policy (SLCARP); Dr. Rishi Kumar Tyagi, Coordinator of Asia-Pacific Consortium on Agricultural Biotechnology and Bioresources (APCoAB), Asia-Pacific Association of Agricultural Research Institutions (APAARI); EASK Edirisinghe, Chairman of the National Aquatic Resources Research and Development Agency (NARA), Sri Lanka; Frank Niranjana, SLCARP, Sri Lanka; Distinguished Speakers, Guests and Participants; Ladies and Gentlemen:

Good morning. It is my great pleasure to be with you here today at the opening ceremony of the "Regional Workshop on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration". On behalf of the Council of Agriculture, Taiwan, I would like to thank NARA and APAARI for co-hosting this meaningful event.

As you are all aware, Today fish provided about 3.2 billion people with almost 20 percent of their average per capita intake of animal protein. Aquaculture and capture fisheries directly employ over 59 million people, and each sector provides about 50 percent of the world's aquatic food supply. Recently, the research of marine genetic resources (MGR) is fairly new but growing rapidly. Biological compounds taken from marine resources include those with potential medical benefits, like anticancer agents, and those with industrial value, like antifreeze proteins. These biologically derived compounds can then be patented by those who isolate and test them, to be used for potential profit.

Taiwan is a small island, but it occupies a pivotal position as its proportion of species numbers and endemic organisms are high when compared to the world's average. This makes preserving the genetic materials of Taiwan's native species all the more important. Better management and conservation of important aquatic genetic resources towards sustainable aquaculture has been the focus in Taiwan in recent years. The Fisheries Research Institute (FRI), Council of Agriculture (COA) has launched a project to establish the National Aquatic Genetic Resources Center since 2001. Important work has been undertaken on genetic mapping, Quantitative Trait Loci (QTL) analyses and gene expression in aquaculture species. It is my honor that I have a chance to elaborate more on the "The Taiwan Status Report on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration' in the tomorrow.

I am confident that this workshop will provide a great opportunity for all the participants to review the current situation and the challenges that we are facing. And I believe that, with your contributions and input, this workshop will yield fruitful outcomes and valuable suggestions in order for us to tackle the tasks ahead.

Finally, I would like to express my gratitude to NARA and APAARI for their meticulous preparations for this event. My sincere thanks also to the gracious presence of all assembled here. I wish the workshop great success.

Thank you for your attention.

附錄三、研討會議程 (Technical programme)



Regional Workshop on Underutilized Fish and Marine Genetic and their Amelioration

Tentative Technical Programme

Date: July 10-12, 2019

Venue: National Aquatic Resources Research and Development Agency (NARA), Colombo, Sri Lanka

Day 1: Wednesday; July 10, 2019

08:00-09:00	Registration	
09:00-10:30	Opening Session	
09:00-09:10	Welcome Address	DT Kingsley Bernard, Chairman, SLCARP, Sri Lanka
09:10-09:18	Remarks	Rishi Tyagi, APAARI, Thailand
09:18-09:26	Remarks	Hsin-ming Yeh, COA, Taiwan
09:26-09:35	Remarks	EASK Edirisinghe, Chairman, NARA, Sri Lanka
09:35-09:55	Inaugural Address	P Harison, Hon'ble Minister of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries and Aquatic Resources Development, Government of Sri Lanka, Sri Lanka
09:55-10:00	Vote of Thanks	Frank Niranjan, SLCARP, Sri Lanka
10:00-10:30	<i>Group Photograph and Tea/Coffee Break</i>	

Technical Session I: Thematic Presentations on Underutilized Fish and Marine Genetic Resources

Co-Chairs: Subasinghe, World Fish Centre (TBC) and JK Jena, ICAR, India

Rapporteurs: Suseema Ariyaratna, NARA, Sri Lanka

10:30-10:50	Mainstreaming the biodiversity in fisheries and aquaculture with special reference to underutilized resources	Praulai Nootmorn, DOF, Thailand
10:50-11:10	Conservation and sustainable use of	Simon Nicol, FAO-RAP, Thailand

	fisheries and aquaculture in the Pacific	(via Skype)
11:10-11:30	Fridtjof Nansen survey around Sri Lanka – Recent studies	Prabath Jayasinghe, SLCARP, Sri Lanka
11:30-11:50	Possible alternative uses including non-food uses of underutilized FMGR	Chamari Dissanayake, USJ, Sri Lanka
11:50-12:20	<i>Discussion</i>	All Participants
12:20-13:30	<i>Lunch</i>	

Technical Session II: Strategies for Conservation and Utilization of Underutilized Fish and Marine Genetic Resources

Co-Chairs: Monty Ranathunga, Fisheries Sector of the Ministry, Sri Lanka and Praulai Nootmorn, DOF, Thailand

Rapporteurs: Deshinee Herath, NARA, Sri Lanka

13:30-13:50	Applications of biotechnologies in <i>ex situ</i> conservation, characterization and utilization	JK Jena, ICAR, India
13:50-14:10	Access and benefit sharing of fish and marine genetic resources – legal considerations	Pathma Abeykoon, MDE, Sri Lanka
14:10-14:30	Inclusive development including gender equality of small-scale fisheries and aquaculture	D Achini M De Silva, SU, Sri Lanka
14:30-15:00	<i>Discussion</i>	All Participants
15:00-15:30	<i>Tea/Coffee Break</i>	
15:30-15:50	Information System of fish and marine genetic resources	Simon Wilkinson, NACA, Thailand
15:50-16:10	Asia-Pacific Seaweed: farming and its sustainability	Anicia Hurtado, UPV, Philippines
16:10-16:30	Sponges and their potential uses	Ranjith Edirisinghe, RU, Sri Lanka
16:30-17:00	<i>Discussion</i>	All participants
19:00-22:00	<i>Reception Dinner Hosted by APAARI in Pegasus Reef Hotel</i>	

Day 2: Thursday; July 11, 2019

Technical Session III: Country status Reports on Underutilized Fish and Marine Genetic Resources

Co-Chairs: Hsin-ming Yeh, COA, Taiwan and Palitha Kithsiri, NARA, Sri Lanka

Rapporteurs: Sujeewa Ariyawansa, NARA, Sri Lanka and Ashoka Deepananda, University of Ruhuna, Sri Lanka

South and West Asia		
09:00-09:20	Bhutan	Gopal Prasad Khanal, DOA, Bhutan
09:20-09:40	India	Kuldeep K Lal, ICAR, India
09:40-10:00	Iran	Ali Salarpouri, AREEO, Iran
10:00-10:20	Sri Lanka	Varuni Gunathilake, USJ, Sri Lanka
10:20-10:40	Nepal	Neeta Pradhan, NARC, Nepal
10:40-11:10	<i>Tea/Coffee Break</i>	
11:10-11:30	Pakistan	Rehana Kauser, NARC, Pakistan
11:30-12:00	<i>Discussion</i>	All Participants
12:00-13:00	<i>Lunch</i>	

Technical Session III: Country Status Reports on Underutilized Fish and Marine Genetic Resources (Contd.)

Co-Chairs: Varuni Gunathilake, University of Sri Jayawardenapura, Sri Lanka and Simon Wilkinson, NACA, Thailand

Rapporteurs: Sujeewa Ariyawansa, NARA, Sri Lanka and Ashoka Deepananda, University of Ruhuna, Sri Lanka

South-East Asia and Pacific		
13:00-13:20	Lao PDR	Latsamy Phounvisouk, NAFRI, Lao PDR
13:20-13:40	Malaysia	Masazurah A Rahim, DOF, Malaysia
13:40-14:00	Philippines	Rachel June Ravago-Gotanco, UPD, Philippines
14:20-14:40	Taiwan	Hsin-ming Yeh, COA, Taiwan
14:40-15:10	<i>Tea/Coffee Break</i>	
15:10-15:40	Thailand	Anyanee Yamrungrueng, DOF, Thailand
15:40-16:00	Fiji	Tevita Vodivodi, MOF, Fiji
16:00-16:30	<i>Discussion</i>	All Participants

Technical Session IV: World Cafe' Discussion - Regional Priorities for Underutilized FMGR

Co-Chairs: DHN Munasinghe, University of Ruhuna, Sri Lanka and Kuldeep K Lal, ICAR, India

Rapporteurs: Sujeewa Ariyawansa, NARA, Sri Lanka and Ashoka Deepananda, University of Ruhuna, Sri Lanka

16:30-18:10 (About 15-20 min. for a group of about 10 participants on each table)	Moderator: Rishi Tyagi Table 1. Conservation, improvement and use (Host/Facilitator: RMGN Thilakaratne) Table 2. Value addition, marketing and export (Host/Facilitator: MMAS Maheepala, Sri Lanka) Table 3. Biotechnology for enhancing utilization (Host/Facilitator: SS Herath, Sri Lanka) Table 4. Partnership and capacity development (Host/Facilitator: Vasantha Pahalawattarachchi, Sri Lanka) Table 5. Regional information sharing system and focal points (Host/Facilitator: Sachithra Hettiarachchi, Sri Lanka)
18:10-18:30	Compilation of Recommendations: By all Hosts/Facilitators of each table
19:00-22:00	Farewell Dinner Hosted by SLCARP

Day 3: Friday; July 12, 2019

Technical Session V: Panel Discussion on Legal and Policy Framework Support to Promote the Sustainable Use of Underutilized Fish and Marine Genetic Resources

Co-Chairs: JK Jena, ICAR, India and S Thayaparan, King Aqua Services Pvt. Ltd., Sri Lanka

Rapporteurs: Shyamalee Weerasekara, NARA, Sri Lanka

09:30-10:45	Perception of Panellists (8 min each)
	Simon Wilkinson, NACA, Thailand
	D Achini M De Silva, SU, Sri Lanka
	Anicia Hurtado, UPV, Philippines
	Hsin-ming Yeh, COA, Taiwan
	Pathma Abeykoon, MDE, Sri Lanka
	Ali Salarpouri, AREEO, Iran
	Tevita Vodivodi, MOF, Fiji
	Rachel June Ravago-Gotanco, UPD, Philippines
10:45-11:10	<i>Open Discussion</i>
11:10-11:30	<i>Tea/Coffee Break</i>

Plenary Session

Co-Chairs: JK Jena, ICAR, India and Monty Ranathunga, Fisheries Sector of the Ministry, Sri Lanka

Rapporteurs: Prajanees Heenatigala, NARA, Sri Lanka

11:30-12:30	Presentation of recommendations of Technical Sessions/World cafe Discussion	Rapporteurs of each session and World Café discussion
12:30-12:40	Brief remarks by the Co-Organizers 2-3 min. each)	Representatives of SLCARP, COA, NARA, APAARI
12:40-12:50	Remarks by the Co-Chairs (5 min. each)	Co-Chairs
12:50-12:55	Vote of Thanks	Rishi Tyagi, APAARI, Thailand
13:00-14:00	<i>Lunch</i>	

Departure



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Sri Lanka Council for Agricultural Research Policy
Ministry of Agriculture
Food Security Through Sustainable Agriculture



MEDIA BRIEF

Regional Workshop on

Underutilized Fish and Marine Genetic Resources of Asia-Pacific and their Amelioration

Organized by the

Sri Lanka Council for Agricultural Research Policy (SLCARP) in collaboration with Asia – Pacific Association of Agricultural Research Institutions (APAARI) and National Aquatic Resources Research and Development Agency (NARA) from 10th -12th July, 2019

Introduction

In the 2030 United Nations (UN) Agenda for achieving Sustainable Development Goals (SDG 2030), food and agriculture are given prominence. Many Sustainable Development Goals are directly or indirectly related to fisheries and aquaculture, particularly SDG Goal 14, which includes enhancement of the conservation and sustainable use of oceans and their resources. There is no argument that fisheries is the main source of the animal protein in Sri Lanka and in Asia which provides over 60% of the animal protein requirement of the Sri Lankan people. Situation in the other countries in South Asia is also similar. Even though it is revealed by the Food and Agriculture Organization (FAO) that there is a gradual depletion of fish resources in the global scenario as well as country specific situation due to over exploitation and adverse climate

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114/9, விஜேராம மாவத்தை, கொழும்பு 07, இலங்கை. - 114/9, Wijerama Mawatha, Colombo 07, Sri Lanka.

Tel No.:(+94)11-2697103, 2698001, 2697648 / Fax No.: (+94)11-2682951

Website: www.slcarp.lk - E-mail: slcarp.agri@gmail.com/agri@slcarp.lk

impacts. FAO and other global and regional corporations are now promoting their member states to uphold culture based fisheries and other alternatives.

Rationale

In view of the above, the most of the countries in Asian region are now paying the greatest concern on aquaculture and utilizing underutilized fish and marine genetic resources. Though most of the other Asian countries are now infatuated a sound knowledge and skills in the areas of utilizing underutilized fish and marine genetic resources, we in Sri Lanka have not adequately gained such knowledge and information. Considering the importance of grasping the same, National Committee on Aquatic Resources of the Sri Lanka Council of Agriculture Research Policy (SLCARP) has planned to conduct a Regional Workshop on Underutilized Fish and Marine Genetic Resources and to facilitate a forum for discussion on this subject with the other countries in the region. Asia-Pacific Association of Agricultural Research Institutions (APAARI) based in Bangkok, Thailand (in which SLCARP is a member institution) is organizing collaboratively this Regional Workshop on Underutilized Fish and Marine Genetic Resources of Asia- Pacific and their Amelioration with the National Aquatic Resources Research and Development Agency (NARA). There are about 25 international participants who have already been agreed to participate at the workshop in NARA, Sri Lanka on 10th, 11th & 12th July 2019. Participants are from Philippines, Pakistan, Lao, India, Nepal, Taiwan, Malaysia, Bhutan, Thailand, Fiji Islands, Iran and Sri Lanka.

Inaugural address will be delivered by the Chief Guest Hon. P. Harison, Cabinet Minister for Agriculture, Livestock Development, Irrigation and Fisheries & Aquatic Resources Development. Hon. Wasantha Aluwihare, State Minister for Agriculture and Irrigation, and Hon. Dilip Wedaarachchi, State Minister for Fisheries & Aquatic Resources Development will also be participating as Guests of Honour.

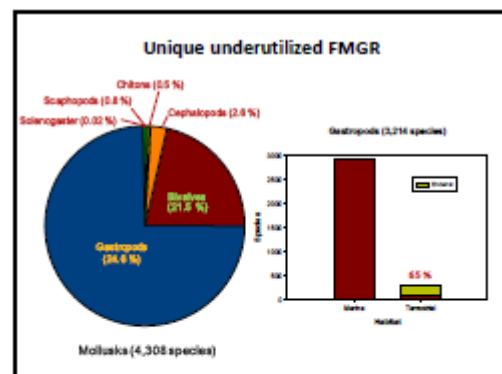
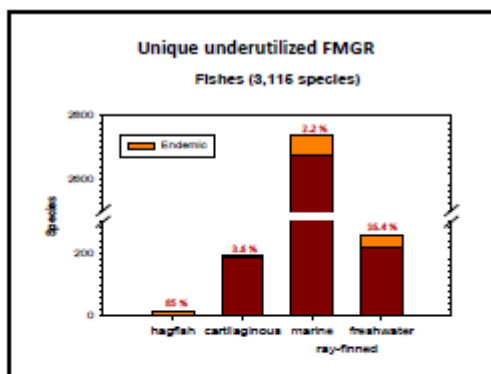
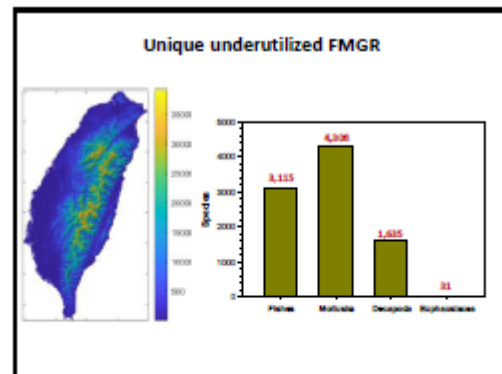
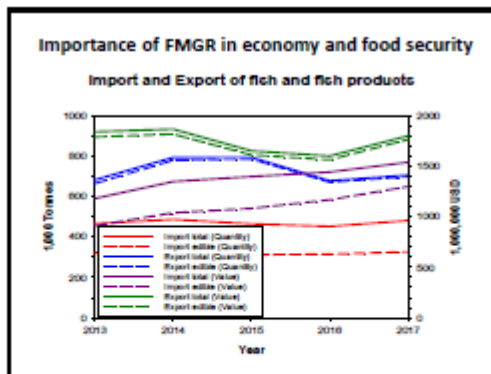
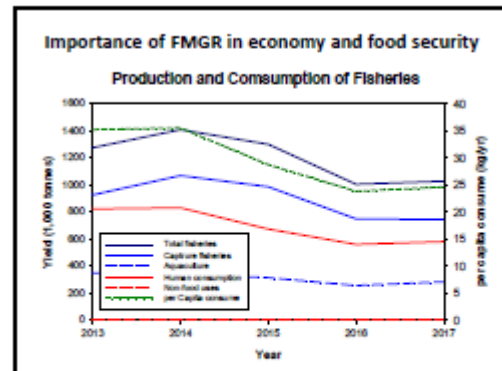


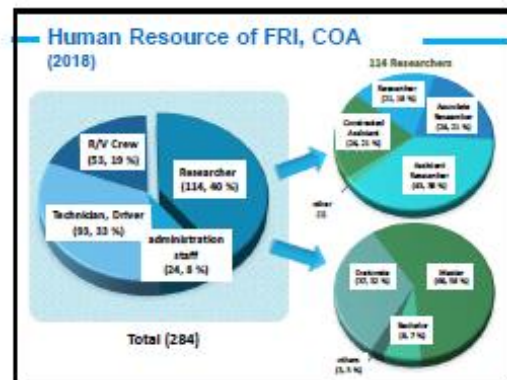
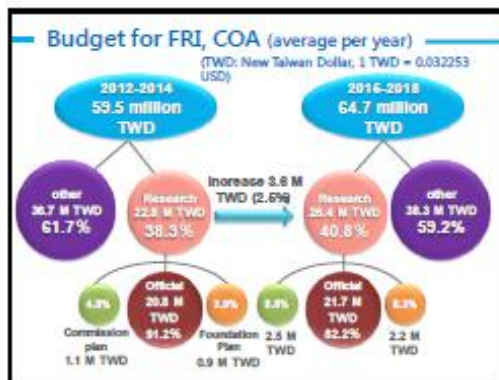
Dr. D T Kingsley Bernard
Chairman, SLCARP

The Taiwan Status Report on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration

Dr. HSIN-MING YEH

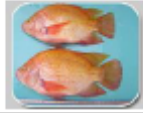
Marine Fisheries Division, Fisheries Research Institute
Council of Agriculture, Executive Yuan
Taiwan





tilapia breeding techniques

- Improvement of tilapia breeding techniques
 - > To breed excellent pure or hybrid strains of tilapia (pure seawater strain from 0.45 to 5 TWD for fry, 330 TWD/kg for meat).
 - > Production of all-male tilapia (more than 97 % fry is male)
 - > To breed pure-red red tilapia.
 - > To analyze the genetic variation of tilapia populations with biotechnological methods (growth rate 10 % up, Meat rate 5-9 % up)
- Establishment of the genetic markers techniques for freshwater fishes
 - > Genetic markers of freshwater fishes are found out by the manipulation of DNA fingerprinting techniques.



Thank you
for your
attention

附錄六、小組討論 (Panel Discussion)

Regional Work on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration

Panel Discussion

Dr. HSIN-MING YEH

Marine Fisheries Division, Fisheries Research Institute
Council of Agriculture, Executive Yuan
Taiwan

- The value of marine genetic resources will emerge in the near future, and the database on marine genetic resources will also clarify their economic and financial values, as information on these aspects are being made available and compiled. A well-constructed, transparent and easy-to-access information basis will greatly facilitate the sustainable management of marine genetic resources in the future.
- Genetic resources could contribute greatly to our efforts to cope with climate change, but in many cases the magnitude and speed of climate change will surpass our ability to identify, select, reproduce and use these resources in the field.
- Sustainable fishery is key to reversing trends that lead to genetic resources loss, damaged ecosystems, and the overall deterioration of our natural resources.

附錄七、閉幕致詞 (Closing Remarks)

Closing Remarks
at the
Regional Workshop on Underutilized Fish and Marine Genetic Resources (FMGR) and
their Amelioration
by
Dr. Hsin-Ming Yeh
Chief, Marine Fisheries Division, Fisheries Research Institute,
Council of Agriculture, Taiwan
July 10, 2019

Dr. Rishi Kumar Tyagi, Chairman EASK Edirisinghe, Dr Frank Niranjana, Invited Speakers, and all Participants:

Good afternoon. It is my great pleasure to be with you three days at the “Regional Workshop on Underutilized Fish and Marine Genetic Resources (FMGR) and their Amelioration”. On behalf of the Council of Agriculture, Taiwan, I would like to thank NARA and APAARI for co-hosting this meaningful event.

As some of you are aware, the New Southbound Policy of the Taiwan Government under President Tsai Ing-Wen was officially launched in 2016. The New Southbound Policy initiative improves Taiwan’s cooperation and exchanges with 18 countries in Southeast Asia, South Asia and Australasia. The New Southbound Policy is for Taiwan to cooperate with 18 countries in Trade, Technology, Agriculture, Medicine, Education and Tourism. Many suggestions about Trade, Technology and Agriculture issues during this workshop should be supported by Taiwan government.

I am confident that this workshop provides a great opportunity for all the participants to facing the challenges and to promote cooperation and good relationships together. And I believe that, with your contributions and input, this workshop have yielded fruitful outcomes and valuable suggestions in order for us.

Finally, COA thanked the SLCARP and member of NARA for hosting this workshop and acknowledged with appreciation the warm welcome and generous hospitality provided to all delegations to the Workshop and for the arrangements made for this workshop. My

sincere thanks are also to all participants.

Thank you.